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<tr>
<td>President</td>
<td>Prof. Bipin V. Mehta</td>
<td><a href="mailto:president@csi-india.org">president@csi-india.org</a></td>
</tr>
<tr>
<td>Vice-President</td>
<td>Dr. Anirban Basu</td>
<td><a href="mailto:vpb@csi-india.org">vpb@csi-india.org</a></td>
</tr>
<tr>
<td>Hon. Treasurer</td>
<td>Mr. R. K. Vyas</td>
<td><a href="mailto:treasurer@csi-india.org">treasurer@csi-india.org</a></td>
</tr>
<tr>
<td>Immd. Past President</td>
<td>Mr. H. R. Mohan</td>
<td><a href="mailto:ipp@csi-india.org">ipp@csi-india.org</a></td>
</tr>
</tbody>
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Nomination Committee (2015-2016)

| Chairman               | Dr. Anil K. Saini                        | lorel@csi-india.org                     |
|                       | Mr. Rajeev Kumar Singh                   | rvp3@csi-india.org                      |
|                       | Prof. (Dr.) U.K. Singh                   | ipp@csi-india.org                       |

Regional Vice-Presidents

Region - I
- Mr. Shiv Kumar
  National Informatics Centre
  Ministry of Comm. & IT, New Delhi
  Email: rvp1@csi-india.org

Region - II
- Mr. Devaprasanna Sinha
  73B, Ekdalia Road,
  Kolkata Email: rvp2@csi-india.org

Region - V
- Mr. Raju L. Kanchibhotla
  Shramik Nagar, Moula, Hyderabab, India
  Email: rvp5@csi-india.org

Region - VII
- Dr. K. Govinda
  VIT University, Vellore
  Email: rvp7@csi-india.org

Division Chairpersons

Division-I: Hardware
- Prof. M. N. Hoda
  Director, BVICAM, Rohtak Road,
  New Delhi, Email: div1@csi-india.org

Division-IV: Communications
- Dr. Durgesh Kumar Mishra
  Prof. (CSE) & Director-MIC
  SAIT, Indore Email: div4@csi-india.org

Division-II: Software
- Dr. R. Nadarajan
  PSG College of Technology,
  Coimbatore, Email: div2@csi-india.org

Division-V: Education and Research
- Dr. Suresh C. Satapathy
  ANITS, Vishakhapatnam
  Email: div5@csi-india.org

Division-III: Applications
- Dr. Ravikiran Manikkar
  Jer Villa, 3rd Road, TPS 3, Santacruz
  East Mumbai, Email: div3@csi-india.org

Important Contact Details

For queries, correspondence regarding Membership, contact helpdesk@csi-india.org

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CSI Headquarter:
Samruddhi Venture Park, Unit No. 3, 4th
Floor, MIDC, Andheri (E), Mumbai-400093
Maharashtra, India
Phone: 91-22-29261700
Fax: 91-22-28302133
Email: hq@csi-india.org

CSI Education Directorate:
CIT Campus, 4th Cross Road, Taramani,
Chennai-600 113, Tamilnadu, India
Phone: 91-44-22541102
Fax: 91-44-22541103 - 91-44-22542874
Email: director.edu@csi-india.org

Publication Committee

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<tr>
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<td>Dr. Vipin Tyagi</td>
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</tr>
<tr>
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<td>Dr. R.N. Satapathy</td>
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CSI Registered Office:
302, Archana Arcade, 10-3-190,
St. Johns Road, Secunderabad-500525,
Telengana, India
Phone: 040-27821998
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Complaints of non-receipt of CSIC may be communicated to Mr. Ashish Pawar, 022-29261724, ashish@csi-india.org, indicating name, membership no, validity of membership (other than life members), complete postal address with pin code and contact no.
Dear Fellow CSI Members,

A computer network is a group of devices connected thorough a communication medium to share the information and computer resources. Connected devices may be a personal computer, printer, mobile phones, tablets or any device having the capability to send/receive the data. Computer networks facilitates merging of computers with communications. Resources can be shared using computer network. The Computer Networks are classified based on their functional areas as Local Area Network (LAN), Metropolitan Area Network (MAN) and Wide Area Network (WAN). It is used in various applications like email, file sharing, chatting, video conferencing, printer and fax machine sharing and instant messaging. In the last few decades, the Internet has become integral part of our life and it is possible because of Computer Networks. Although there are a large number of advantages of Computer network but at the same time security of information is a challenging task related to Computer network.

Keeping in mind the importance of Computer Network, the publication committee of Computer Society of India selected the theme of CSI Communications (The Knowledge Digest for IT Community) February 2016 issue as "Computer Networks".

In this issue, the first cover story "Avionics Full Duplex Switched Ethernet (AFDX) as a Replacement of MIL STD 1553B Data Bus" by P. K. Jha and P. Tandon examines the capability and suitability of AFDX technology to meet the real time data communication requirements and reliability needed for aerospace applications. In next cover story "Internet of Things - A Communication Protocol Perspective", S. Kumar and G. S. Kumar has given the developments in the area with a stress to the communication techniques and protocols for facilitating interaction of these constrained devices with the web. In cover story "Bidirectional Forwarding Detection: A Tutorial Dialog", N. Datta explains the requirements and salient features of BFD in the form of a dialog between a rookie network administrator and his mentor.

In Technical Trends category, “Latest Trends in the Learning” by Rashmi G. N. and A. Raman describes the current trends in learning techniques with focus on the different contexts in which each type of learning could be used effectively.

In Research Front, “Big Data Mining: A Review” by C. Bhatt and T. Shah explains various aspects of data mining.

Article “ICT for Sports: A Whole New Ball Game” by P. Lal gives some of the ICT applications in various sports under three heads i.e. tracking, decision making and prediction. In next article “Protégé – An Open Source Ontology Editor”, S. Suresh, A. Amalanathan and K. Govinda describe the open source ontology editor that can be used to create any type of ontology.

In Security Corner, we have included “Sustainable Approaches for Time-Critical Surveillance Applications” by R. Shettar, M. Shrivastava and Chaitra R. that describes some approaches that can be used safely in time critical applications.

This issue also contains views of Mr. Raj Kalady, Managing Director, PMI India on Collaboration with CSI.

This issue contains Citations of Hony. Fellow and Fellow awardees, Crossword, CSI activity reports from divisions, chapters, student branches and Calendar of events.

The publication committee express it’s deep condolence on the sad demise of late Major General A. Balasubrahmanian, AVSM(Retd.), the father figure, founder secretary and past president of CSI. We request all the members, chapters, student branches to organize Major General A. Balasubrahmanian memorial lecture every year in the mark of respect and memory of the great founder member of CSI.

I take this opportunity to express my sincere thanks to Dr. Vipin Tyagi, Guest Editor, for bringing this issue successfully. I extend my gratitude to the entire ExecCom and Publication Committee for their continuous support in bringing this issue successfully.

On behalf of publication committee, I wish to express my sincere gratitude to all authors and reviewers for their contributions and support to this issue.

Finally, we look forward to receive the feedback, contribution, criticism, suggestions from our esteemed members and readers at csic@csi-india.org.

Prof. A.K. Nayak
Chief Editor

Prof. A.K. Nayak, Director, Indian Institute of Business Management, Patna, aknayak@iibm.in
Greetings!

I am happy to inform that elections for National ExecCom, Delhi Chapter and Kolkata Chapter for the year 2016-2017/2018 are successfully held by e-balloting and results are announced. Nomination Committee Dr. Anil K Saini, Prof. (Dr.) U.K. Singh and Shri Rajeev Kumar Singh completed the task successfully with excellent coordination of HQ team. Congratulations to Nominations Committee and HQ team.

The newly elected members will join ExecCom from 1st April, 2016. I congratulate newly elected members of the ExecCom. I am confident they will contribute to the growth and visibility of CSI in the years to come.

I express a deep condolence on the sad demise of CSI founder Secretary and Life Time Achievement Awardee Major Gen A Balasubrahmanian, AVSM (Retd.) His demise is a great loss to CSI and his family.

A group comprises of CSI Fellows, representatives from industry, academics, research and computer users studied the ‘Consultation Paper on the Differential Pricing for Data Services’ of TRAI. The group confined its research and study strictly on the merits and demerits of compromising on Net Neutrality. The group is of the opinion that the basic internet access should be made available to everyone free of cost; and it should be provided by an instrument of the state. A report prepared by this group on the impact of ‘Free Basic’ on IT Community, in case it was ever implemented, was submitted to TRAI.

I delivered a keynote address on ‘Internet of Things’ in all India Seminar on ‘Internet of Things – Trends that affect lives’, hosted by the Institution of Engineers (India), Gujarat State Centre jointly with Computer Society of India, Ahmedabad Chapter, Center of Excellence, in IoT, Government of India, IETE and NASSCOM. Such joint programmes bring various professional societies together on a platform to deliberate on emerging technologies benefitting the participants.

As per United Nations report, India ranks 131st out of 167th nations on Global ICT access index, even as the number of households with internet and computer have increased in the country over the last five years. The report states that globally 3.2 billion people are now online, representing 43.4% of the world’s population. In India 13% homes are with computer, 15.3% homes are with internet and 18% people are using internet. This will be a challenge for India while planning for smart cities.

Recently Prime Minister Shri Narendra Modi announced 19 point action plan ranging from tax waiver for three years, ending inspector raj and a mega fund to help boost the start-up eco-system. A start-up has to work towards innovation, development, deployment or commercialization of new products, processes or services driven by technology or intellectual property. This initiative of Government will help entrepreneurs to the greatest extent.

I had an opportunity to attend Academic Research Summit hosted by Microsoft Research India, ACM and Infosys at Pune. There were plenary talks, panel discussion and technical tracks on solutions for smart cities, analytics and social media. Microsoft Research India offers Research Fellow programmes to final year students of BS/BE/B.Tech or MS/ME/M.Tech programmes in Computer Science or related areas. This is an excellent opportunity for our student members having inclination towards research in computer science and technology.

I congratulate Brig S V S Chowdhry (Retd), Past President CSI & IETE for receiving Lifetime Achievement Award of IETE during the IETE Convention held at Kolkata in September,2015. He received similar award from CSI during CSI-2014 at Hyderabad.

I am happy to note that National Student Convention, Regional Student Conventions and State Student Conventions are being hosted by various student branches across the country. Details are available in the CSI events calendar. I convey my best wishes for the success of the conventions.

With best wishes,

Bipin V. Mehta
President, CSI

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Prof. Bipin Mehta, Director, School of Computer Studies, Ahmedabad University, Ahmedabad, president@csi-india.org
1. CSI Elections are over and new ExecCom Members are going to join on April 1, 2016. Congratulations to all the candidates who were successful and greetings to all who contested!

2. Unfortunately the percentage of votes polled continue to be poor. However this year has been highest. There are numerous reasons for members not casting their votes and every year Nomination Committee members have been trying their best in increasing the voting.

3. During election time, Members find out that they have not received the voting id as they had not changed their contact details. Members are requested to change their contact details by writing to sonali@csi-india.org with an ID proof.

4. We are trying our best to open new CSI Chapters and Student Branches across India. We have been successful in opening Chapters in Amaravati in Maharashtra and Gunupur in Odisha. A number of Student Branches have been opened recently and few more are being planned.

5. I have been stressing on the need to improve CSI Conferences and bring out useful and attractive proceedings. For this purpose talks are on with Springer to have a MOU so that proceedings of conferences which meet their international standards can get it published by Springer. This will definitely boost the quality of the conferences as well improve the publications.

6. CSI-Education Directorate is conducting a variety of programs with NIELIT, Chennai on Embedded Systems. These are mostly catering to the student community.

7. Now we are in the process of finalizing an agreement with PMI (Project Management Institute) to offer trainings on different aspects of Project Management. The skills in Project Management are in demand all over India and it will be great help if we can offer the certification trainings to our members at reasonable cost.

8. Increase in CSI Membership is of prime importance and all efforts are required to add members in the Golden Jubilee year. We look forward to the help of all in meeting our goal of 10% growth in the financial year 2015-16.

9. There have been proposals to reintroduce the concept of Life Time Institutional Membership for academic institutes. We hope to do the same after due deliberations in the coming days.

10. CSI Foundation Day happens to be on March 6 and all Chapters and Student Branches are requested to celebrate CSI Day on March 6 or in the week of March 7 with Seminars and other knowledge sharing events. The events should be widely publicized to create awareness about CSI activities.

Best wishes,

Dr. Anirban Basu

Vice President, CSI
Views of Mr. Raj Kalady, Managing Director, PMI India on Collaboration with CSI

Collaboration – The Key to Greater Success

Over the last two decades, India has emerged as one of the fastest-growing economies in the world. Projects are vital to a country like ours that is changing, creating and growing fast to rise above the rest of the world. Project management processes are indeed critical to bridge the chasm between high level strategic vision and successful outcomes and are widely practiced and incorporated among projectized sectors like IT-ITES, infrastructure, energy, automobile, and defense.

Here are some interesting facts about the project management profession:

- One fifth (1/5) of the world’s GDP (US $12 trillion) is being spent on projects.
- Out of the 20 million people participating in projects worldwide, just one million have professionally recognized formal project management training.
- It’s the only profession where the income levels continued to rise despite the recession. As per ‘Earning Power, PMI’s Salary Survey 2015 Report - Ninth Edition’, a project manager in India with PMP certification receives 40% higher salary compared to a project manager without a certification.
- Project management practitioners are in demand across various industry segments including IT/ITES, Construction, Infrastructure, Engineering, Finance, Manufacturing Industry, Health Care and Service Industries.
- The future of project management professionals looks promising as, the Anderson Economic Group’s study, ‘Estimating Project Management Practitioner Skills Gap, 2010 - 2020’, estimates that every year up to 2020, India would required almost 4,00,000 new project professionals in project-oriented industries.
- However, it would be startling to know that in India, organizations waste an average of 11% (USD 109 million for every USD 1 billion spent on projects or programs) due to poor project performance as per PMI’s Pulse of the Profession report -2015. Imagine the impact a saving of even 50% of the wastage would have on the bottom line!

Importance of project management profession

As is fairly established, the success of projects depends on effective project management. Which means, not just planning the project from A to Z, but also anticipating problems along the way and still managing to complete the project within the allocated time and budget. In fact, across industries, the key differentiator that has won organizations projects is their ability to deliver quality, meet deadlines, effectively manage resources and meet last minute change requests. And for young professionals entering the industry, it will be significant to note that project management is a profession that offers excitement, challenges and desirable salary packages.

PMI office was established in India in 2008 with the sole goal of advancing project management profession and inculcating a project management culture within the establishments across central/state government, academia, and industry. Project Management Institute is the world’s leading not-for-profit professional membership association for the project, program and portfolio management profession. Founded in 1969, PMI delivers value for more than 2.9 million professional memberships working in nearly every country in the world through global advocacy, collaboration, education and research.

CSI with its large pool of young members from the IT industry realizes that there are opportunities in store for its community in the project management profession. The various research reports such PMI Pulse of the Profession, Salary Survey, reports conducted by renowned consultancy organizations viz. from Anderson Economic Group, PwC, KPMG, etc. have highlighted time and again the growth and relevance of the profession for future managers in IT industry. In fact, for many organizations, projects have become a way of life.

According to a global research by the Economist Intelligence Unit, 95% of executives from all over the world who were surveyed, agree that skills that comprise the project managers’ skill set (e.g. execution, project risk identification and mitigation, communication, planning and team building) are most needed in their organizations. In another report, 75% have ranked project management as the top 3 skills most wanted by employers, the other 2 being leadership and business analysis.

Given the above context, with CSI as an REP (Registered Education Provider) of PMI, will truly act as a catalyst for facilitating the professional and academic growth of CSI members. Right from training the young professionals to equipping them with required knowledge of project management and program management; this would help them to be better-skilled and readily employable which is a common concern for many IT organizations.

PMI certifications are flexible as they are not based on one particular methodology; they are industry agnostic and globally relevant. They are always up-to-date as they are continually updated with the profession. And last but not the least, they are globally recognized and help project managers better market themselves to prospective employers. Thus, CSI members with PMI certifications and membership can become even more industry ready, stay ahead of the curve and stand out in the crowd.

Eventually, given the young demographics in the country today, both organizations by collaborating can deliver the latent potential of making India the top most exporter of project managers in the world in the near future.

Also, amongst other benefits, PMI and CSI can together host events/ conferences, collaborate and promote their respective goals and objectives through brand promotions, providing networking opportunities for their members and speaking opportunities for their thought leaders.

PMI with its global presence and CSI using its strong presence in India can come together to publish relevant research reports and case studies. We are confident that our association will empower professionals in IT industry in incorporating project management practices to further improve the quality of end results and add value to the entire process. More importantly, PMI is committed to supporting CSI’s initiatives entirely.
Avionics Full Duplex Switched Ethernet (AFDX) as a Replacement of MIL STD 1553B Data Bus

Pramod Kumar Jha
Scientist-E, Centre for Advanced Systems (DRDO), Hyderabad

Praveen Tandon
Scientist-F, Centre for Advanced Systems (DRDO), Hyderabad

Abstract: Serial data communication bus MIL STD 1553B is being used extensively for real time avionics applications since last two and half decades. Rather, it has become the de-facto serial communication protocol for aerospace vehicle. MIL STD 1553B data bus follows command-response protocol and guarantees the delivery of packet in real time every time. The military standard provides the required ruggedness and fault tolerance feature for the real time mission critical applications. However, with the rapid development of embedded system and digitization of sensors, controllers etc. the data traffic has increased exponentially. This puts the need for data bus of higher bandwidth that can handle the increased bus load without any communicational delay or lag. This paper examines the capability and suitability of AFDX technology to meet the real time data communication requirements and reliability needed for aerospace applications.

Introduction

Avionics of earlier days were mostly simple, analog standalone system. Often these systems were composed of multiple subsystems connected to each other in point-to-point fashion. Point-to-point wiring was not only complex but also led to the increase in overall weight of the aerospace vehicle, as cable weight is quite significant in an aerospace vehicle. Advancement of digital technology and digitization of avionics led to the transmission of data in digital format. Serial data communication technology helped in the reduction of complexity in aerospace vehicle with point to point as well as point to multi-point communication. MIL-STD-1553B serial data bus protocol is able to meet this requirement efficiently. It offered a very reliable and fault tolerant data transmission protocol with in-built redundancy for real time mission critical applications. However, with the increase in number of sensors, subsystems in an aerospace vehicle the data traffic has increased tremendously and 1MHz limited bandwidth of MIL-STD-1553B has become a bottleneck. AFDX with bandwidth of 10MHz, 100MHz and now even 1GHz is proving to be a suitable replacement for MIL-STD-1553B data bus. The objective of this paper is to evaluate AFDX data bus in terms reliability, flexibility and its suitability for real time mission critical aerospace applications.

MIL-STD-1553B Data Bus

MIL-STD-1553B data bus is a very reliable and rugged protocol that has served the aerospace industries for last three decades. It offers high reliability, high availability and fault tolerance, because of which it has become the number one choice for avionics communication applications. It is basically a Time Multiplexed bus and uses command/response protocol for data transmission. MIL-STD-1553B defines 3 hardware elements namely Bus Controller (BC), Remote Terminal (RT) and Bus Monitor (BM).(Fig.1) It follows a linear bus architecture where all the devices are connected to a single backbone bus and all of them are capable of transmitting and receiving data to one another. The transmission and reception activity of the bus is managed by BC, which plays the role of a Master and ensures that no two devices ever transmit data simultaneously on the bus. The communication is half-duplex and operates in asynchronous mode.

Though it is still catering to large numbers of avionics applications, but requirements for high bandwidth data bus beyond 1 Mbps is much in demand. In a typical 1553B digital bus at the most 31 RTs can be connected, however there are no restrictions on the number of Bus Monitors. An onboard computer configured as BC on the bus initiates the command/response communication with the remote devices. MIL-STD-1553B defines three types of terminal devices that are allowed on the bus namely,

- a. Bus Controller (BC),
- b. Remote Terminal (RT),

The main function of the bus controller (BC) is to provide data flow control for all transmissions on the bus. In addition to initiating all data transfers, the BC must transmit, receive and coordinate the transfer of information on the data bus. Similarly, remote terminal (RT) is a device designed to interface various subsystems with the 1553 data bus. Typically, RTs are sensors, actuator controllers etc. The interface device may be embedded within the subsystem itself, or be an external interface to tie a non-1553 compatible device to the bus. The RT receives and decodes commands from the BC, detects any errors and reacts to those errors. And the bus monitor (BM) listens to all messages on the bus and records selected messages as per user’s configuration. It is a passive device that collects all data as per Interface Control Document (ICD) for real-time data logging or for offline post flight analysis.

MIL-STD-1553B allows two methods of coupling, direct coupling and Transformer coupling. In direct coupling connections are wired directly to the bus cabling. The isolation resistors and transformers are internal to the terminal device and do not require additional coupling hardware. Direct coupling connections are used only with stub lengths of less than 1 foot. Transformer coupling utilizes an isolation transformer, located external to the terminal device, in its own housing with the isolation resistors. With transformer coupling the stub length can be extended up to...
20 feet and provides electrical isolation, better impedance matching and higher noise rejection characteristics than direct coupling. There are 9 types of message transmission between bus controller and remote terminals. The bus controller sends one command word that includes the remote terminal address, sub address and number of data words to be received by the RT which is immediately followed by 1 to 32 data words for BC-RT communication (BC-RT).

Testing MIL-STD-1553B components validate the functional capability of the bus design. To test the bus design a typical setup was established with the help of PCs each representing a sub-system like BC, RT or BM as shown in Fig. 1. Both BC-RT and RT-BC messages were scheduled by the BC and it was captured by BM. The captured data was analysed to see the correctness of sent data. The following testing methods were adhered to as given below.

a. Developmental Testing
b. Design Verification
c. Production Testing
d. Systems Integration Testing
e. Field/Operational Testing.

General information flow on the bus consists of words, which are mainly of three types namely command word, data word and status word.

A command word contains a sync waveform, remote terminal address field, Transmit/Receive (T/R) bit, Sub address/mode field, word count/mode code field, and a parity. One bit parity is used for error detection. Command words are transmitted by the bus controller to remote terminals to instruct them to receive or transmit data or perform some other operations as may be the case. Commands are sent to aid in data bus management, electrical control of an RT and standard data transfers. Command words are only transmitted by the active bus controller.

**Avionics Full Duplex Switched Ethernet (AFDX)**

AFDX is a standard that defines the electrical and protocol specifications (IEEE 802.3 and ARINC664, Part 7) for the exchange of data between Avionics Subsystems. One of the reasons that AFDX is such an attractive technology is that it is based upon Ethernet, a mature technology that has been continually enhanced, ever since its inception in 1972. New generation of aerospace vehicles requires high available bandwidth and minimum wiring to reduce the weight and low development cost. As a result, the Avionics Full Duplex Switched Ethernet (AFDX) was conceived by Airbus and is being widely used.

As shown in the Fig. 2, an AFDX system consists of following components.

**Avionics Subsystem:** These are traditional avionics subsystems on board an aircraft, such as the onboard controller, etc. An avionics computer system provides a computational environment for the avionics subsystems. Each avionics computer system contains an embedded End System that connects the Avionics Subsystems to an AFDX Interconnect.

**AFDX End System (ES):** End System provides an “interface” between the avionics subsystems and AFDX interconnect. Each avionics subsystem and the End System interface to guarantee a secure and reliable data interchange with other Avionics Subsystems. This interface exports an application program interface (API) to the various Avionics Subsystems, enabling them to communicate with each other through a simple message interface.

**AFDX Interconnect:** A full-duplex, switched Ethernet interconnect generally consists of a network of switches that forward Ethernet Frames to their appropriate destinations. This switched Ethernet technology is different from the traditional ARINC 429 unidirectional, point-to-point technology and the MIL-STD-1553 bus technology, as shown in Fig. 1. Two of the End Systems provide communication interfaces for three avionics subsystems and the third End System supplies an interface for a gateway application. It, in turn, provides a communications path between the Avionics Subsystems and the external IP.
AFDX Configuration: AFDX is mainly composed of Virtual Link (VL), ES and switch. It has been developed from traditional Ethernet and has been for real time and reliable performance based on avionics demand. The main function of ES are system configuration, package handling, traffic shaping, VL scheduling, integrity checking and redundancy management. The switch performs filtering, policing, switching, monitoring and so on. The VL performs data transmission from one source ES to one or more destination ES. The ES receives data sent from the application layer and packaging by UDP, IP and MAC layer, the data are processed by traffic shaping module. Similarly, in the receiving ES it checks the received data through integrity checking and redundancy management system and then after processing by MAC, IP and UDP layer, the data are delivered to the corresponding upper part by ES. Like bus monitor of MIL-STD-1553B, AFDX traffic can also be captured on a port using switch’s echoing functionality for monitoring operational health and error information on the network. The table below gives the comparison of the two protocols.

<table>
<thead>
<tr>
<th>S.No</th>
<th>1553B</th>
<th>AFDX</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Transmission</td>
<td>Half Duplex</td>
</tr>
<tr>
<td>2</td>
<td>Speed</td>
<td>1Mbps</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100/10 Mbps</td>
</tr>
<tr>
<td>3</td>
<td>Redundancy</td>
<td>Rundandant</td>
</tr>
<tr>
<td></td>
<td></td>
<td>bus +main bus</td>
</tr>
<tr>
<td>4</td>
<td>Max.Subsystems</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>64K (VLs)</td>
</tr>
<tr>
<td>5</td>
<td>Cable</td>
<td>Shielded</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Twisted Pair</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unshielded Twisted Pair/Fiber optics cable</td>
</tr>
</tbody>
</table>

Conclusions
MIL-STD-1553B is being extensively used in aerospace domain for hard real-time communication requirements. However, with the digitization of sensors, actuators and other subsystems along with the requirement for more data to be telemetered has put a constraint in the limited bandwidth of MIL-STD-1553B bus. Ethernet’s CSMA/CD protocol could not guarantee transmission of data in real time scenario.

AFDX Protocol being full duplex removes the chances of collision of data packets and guarantees the delivery of packets in real time. Higher bandwidth of AFDX also makes it a suitable choice for avionic applications; however its ruggedization needs to be explored for harsh real time applications.

For safety-critical systems, reliable real-time communications links are essential—and that is where AFDX has brought about major improvements. It is not only reduces the bus weight & quantity, but can also meet the requirements of the bandwidth, the real time performance and so on for the new generation of avionics applications.

About the Authors

Mr. Pramod Kumar Jha [CSI - 00052824] is working as Scientist-E at Centre for Advanced Systems (DRDO) Hyderabad. He is having more than 16 years of experience in the field of Hardware in Loop Simulations, Visual Simulations and Real Time Networks. He holds BE, MSc(IT) and a PG Dip. in Operations Management. He is a recipient of DRDO team ward, two lab level award and CSI’s Significant Contributions award. His current areas of interest include lean manufacturing and Quality Management, computer networks and automation. He is also a life member of Crypto Research Society of India and Systems Society of India. He can be reached at pkj@cas.drdo.in.

Mr. Praveen Tandon is Scientist-F at Centre for Advanced Systems (DRDO) Hyderabad and currently Technology Director of Electronics and Checkout group. He holds an M.Tech in manufacturing management from BITS, Pilani. He is having more than 21 years of experience in the field of instrumentations for rocket motor & its production. He is also a recipient of DRDO team and lab awards. He can be reached at praveen.tandon@cas.drdo.in.
Internet of Things - A Communication Protocol Perspective

Suresh Kumar N.
Research Scholar, Dept. of Computer Science,
Cochin University of Science and Technology, Kerala

G. Santhosh Kumar
Asst. Professor, Department of Computer Science,
Cochin University of Science and Technology, Kerala

Introduction

In recent years, Internet is used by billions of customers from simply browsing webpages to complex business transactions. In all these scenarios, the end point device used for communication is mostly a computer terminal, laptop, or a smart phone. Advancements in networked embedded systems and related protocols now allow computing and communication capabilities to be migrated to a house hold equipment, automobiles and electrical accessories. Moreover, by introduction of IPv6 it is possible to connect every physical object in the real world via Internet. In other words, it is possible to embed micro-fabricated chips into any physical object including house hold equipment like fan, fridge, and air conditioners such that a user can monitor, search, control, manage and play around them remotely through the Internet. The concept of “Internet of Things (IoT)” was proposed by Kevin Ashton, co-founder of AutoID by incorporating RFID Tag for Procter & Gamble supply chain. The idea of Internet of Things is considered as one of the most disruptive technology of the century. The terminology “things” referred in IoT represents any physical device that possesses unique identity, connectivity, sensors and control and is often referred as smart objects. These objects can capture any physical parameter for example temperature, pressure and soil moisture with the help of appropriate sensors. The smart objects used in IoT applications are devices with limited computing power and energy and are powered by batteries. The existing protocols used in communication protocols like TCP/IP and HTTP cannot be directly used on smart objects due to the above constraints. New class of protocols and related techniques are required for smart objects to make it to connect, communicate and manage via Internet. This article looks into the developments in this field with a stress to the communication techniques and protocols for facilitating interaction of these constrained devices with the web.

Emerging Technologies to support IoT

The power constrained nature of the IoT objects requires existing protocol stack used in Internet to be redesigned inheriting low computation, minimum average power consumption and optimal usage of bandwidth. The redesigned protocols should also exhibit the same level of reliability that is guaranteed by existing protocols. Additionally for connecting smart objects via Internet requires the objects to be IP enabled. Standardization of hardware components and the protocols are essential for the growth since many of the technologies developed in this line were proprietary. With this idea in mind, Internet Engineering Task Force and IEEE started working together to develop a frame work suited for networked embedded systems. Some of the developments in this area are described below.

IEEE 802.15.4

This standard was defined by IEEE in 2007 to standardize the low power version of the standard IEEE PHY layer[5]. It describes the hardware specifications associated with radio on top of which every smart objects are been built. This standard defines different PHY layers in which the most commonly used radio devices are the one that operates in the unlicensed 2.4 to 2.485 GHz Industrial Scientific and Medical (ISM) band. IEEE also defines a MAC layer (Power Saving Link Layer) on top of PHY layer in which the most commonly used radio devices are the one that operates in the unlicensed 2.4 to 2.485 GHz Industrial Scientific and Medical (ISM) band. IEEE also defines a MAC layer (Power Saving Link Layer) on top of PHY layer to optimize the power requirements of constrained devices. Power optimization is done by switching the transmitting radio to off-mode for most of the time. The disadvantage of this MAC layer is that it not effective for multi-hop networking. IEEE 802.15.4e working group focused on redesigning the MAC layer to suit with multi-hop networking requirements of IoT. The redesigned MAC version of IEEE 802.15.4 is known popularly as IEEE 802.15.4e[6] and it also incorporates Time Synchronized Channel Hopping mechanism.

IETF 6LoWPAN

Internet Engineering Task Force (IETF) IPv6 over WPAN (6LoWPAN) working group started its operation from 2007 with an idea to develop specifications for allowing IPv6 packets to be compatible among IEEE 802.15.4 networks. Wireless Personal Area Networks (WPAN) typically have characteristics like minimal packet size, large number of devices on the network, and low duty cycle of the radio transmitter to conserve energy. IPv6 generally use 40 byte header and a maximum of 65535 bytes as payload. An adaptation layer was developed to incorporate header compression capability[7], packet size reduction and minimization of overhead involved in routing and management[7]. This layer is introduced between IPv6 and MAC layer and performs forwarding and fragmentation of link layer. IPv6 header compression is achieved by removing redundant information that can be captured from other layers in the communication stack.

IETF ROLL

The IEEE 802.15.4 MAC Layer designates duties of routing and forwarding of packets to the upper layers. The lossy or asymmetric links, low powered radio, dynamic topology, and mobility of nodes impose major challenges in developing the specification for packet routing in WPAN. An effective and optimal solution was developed by IETF Routing Over Low Power and Lossy Networks (ROLL) working group. This group proposed IPv6 Routing Protocol for Low Powered and Lossy networks (RPL)[8] which forms a suitable solution for routing protocol for IEEE 802.15.4 complaint devices. RPL are used along with router devices that build up network routes, disseminate routing information among nodes, adapting to topology variations etc. It also supports energy constrained and lossy networks. RPL views a group of interconnected nodes as multi-hop paths to a limited set of root devices. The function of the root devices are data collection and co-ordination duties. A simple schematic view of collection of

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have come up with Constrained RESTful Environments (CORE) working group[2] and a Constraint Application Protocol (CoAP) [1] has been developed. It is considered as a generic protocol leveraging the constraint features available in LLN with the Internet. The important feature of CoAP is that it can be easily translated to HTTP thereby leveraging HTTP applications to communicate with CoAP applications and vice versa over a constrained environment. A subset of scenarios in which both HTTP and CoAP coexist across constrained LLN and typical Internet environment are depicted in Fig. 2.

Here, TE1 through TE2 are equipments connected to the traditional Internet world where as CE1 through CE7 are LLN or constrained devices. Both the traditional and constraint environment are connected via a router which run the routing protocol for LLN (RPL). From the figure it is clear that RPL constructs two Destination Oriented Direct Acyclic Graphs (DODAG), one routed at R1 and another routed at R2. The router device makes use of two protocol stacks, a traditional TCP/IP stack and a protocol stack for LLN.

Communication Protocol Stack For IoT

Based on the web architecture described in Fig. 2 a communication protocol stack for IoT can be developed as shown in Fig. 3. Protocol stacks involved in the message exchanges between two or more devices can be categorized into three groups a) Protocol stack for a device connected in the traditional Internet environment (TE1 and TE2) b) Protocol stacks used in the Routing device (Router) that run RPL c) Protocol stack running on Constrained device in the constraint environment (CE1 through CE7). From this it can be seen that TE1 and TE2 make use of the protocol stack in part (b) of the Fig. 3 where these equipments make use of HTTP client software (Web browser) and the constrained nodes CE1 through CE7 make use of the protocol stack in part (a) of Fig. 3. The routing device uses both protocol stacks that convert an HTTP client request from traditional Internet environment to CoAP client request for constraint environment and vice versa. This routing device is equipped with an Ethernet port and IEEE 802.15.4 PHY interface.

For demonstrating the communication between a LLN device and a device connected with traditional internet environment consider a message request from TE1 to CE4 for the web architecture discussed in Fig. 2. Here the device TE1 is connected with an Ethernet port and CE4 is equipped with IEEE 802.15.4 interface. The request is to get the room temperature where equipment CE4 is deployed. The various layers through which the message passes through are depicted in Fig. 4. From the equipment TE1 an HTTP get request is made through web browser which then passes to the TCP/IP protocol stack attached with the router. From the TCP/IP stack it pass to the CoAP layer associated with the LLN stack which then translate the HTTP request into a CoAP request and pass it to the UDP layer. From the UDP layer the message is passed through the ROLL and this layer constructs two DODAGS as described earlier in Fig. 2 and also determine the IPv6 address of the next hop through which the message have to be routed. From the ROLL layer the message passes through 6LoWPAN layer where it performs header compression, IEEE 802.15.4 MAC and finally transmitted.
through IEE 802.15.4 PHY layer of the routing device. Through the medium the message is transferred to the PHY layer of the next immediate node (PHY layer of next hop CE7) of CE7 and move upward to the protocol stack of CE7 until it reaches the UDP layer. The UDP layer will get the IPv6 address of the next hop (IPv6 address of CE6) to which the message have to be forwarded. This is supplied by the ROLL layer running in CE7 and the message will be move down through the protocol stack from UDP layer to the PHY layer of CE7 and this process continues until the message reaches the CoAP layer of CE4. This Layer contains a CoAP server which supplies the temperature requested through the same path of the protocol stack in the reverse direction until the message reaches the HTTP layer of TE1.

**Fig. 3: Protocol stack for the web architecture described in Fig. 2**

**Fig. 4: Message transfer from TE1 to CE4 via protocol stack**

### Conclusion

Smart devices are becoming inevitable for every aspect of human life. A web of such smart devices collecting and driving many useful applications is emerging. Many technologies developed to support IoT devices were discussed. Though the underlying PHY and MAC are standardized, need for improvements in the upper layers are unavoidable for emerging application requirements. A framework integrating heterogeneous smart devices and the Internet from a communication perspective was portrayed. Protocol stacks used in various contexts need improvement to include many aspects of application requirements. Finally, to illustrate a use case of IoT environment, a message transfer mechanism between traditional Internet architecture and a constrained device environment using the integrated framework is explained.

### References


Vijay: Good morning, Sir.
Prof: Good morning, Vijay. What brings you here?
Vijay: I’m facing a rather thorny problem in my network and was hoping that you could help me resolve it.
Prof: Certainly! Please explain your problem.

The Problem
Vijay: My network is frequently encountering traffic loss which often persists for several seconds at a time. This is driving my customers crazy and left me red-faced several times. I’m having a hard time troubleshooting the problem and need some expert guidance.
Prof: Do you have any old or faulty equipment in your network?
Vijay: Yes, but I am always careful to have redundant paths everywhere in the network. So even if a router or switch fails, there will be a secondary backup path to keep the traffic flowing smoothly.
Prof: Hmm, that’s a good high availability network design indeed. Have you ever measured the time required for a traffic flow to switch from the failed primary path to the backup path?
Vijay: Not really, but since I have configured dynamic routing protocols such as OSPF and BGP in the network, I expect them to quickly calculate alternate paths whenever the primary path encounters a failure, and re-route the traffic accordingly. After all, that is why they are called dynamic routing protocols, isn’t it?
Prof: Very true. Do you understand clearly how those protocols detect and respond to path failures?
Vijay: I believe they exchange some kind of Hello packets between neighbors.
Prof: Yes, let me explain that a bit for you. Let us say there are two routers R1 and R2 connected back to back with a network cable (Figure 1). Assume also that both the routers have implemented OSPF on the link connecting them. Now suppose that R2 fails for some reason – this could be because of a software bug or hardware fault, or simply because the network cable was not connected properly and came loose out of R2’s port. What do you think will happen now? (Fig. 2)

Abstract: Bidirectional Forwarding Detection (BFD) is a light-weight network protocol that is used for the detection of failures in the bidirectional path between two forwarding engines. Traditionally, this function has been done by dynamic routing protocols but they have suffered from slow detection times typically in the order of several seconds. BFD provides a significant advantage by achieving sub-second failure detection times. This article explains the requirements and salient features of BFD in the form of a dialog between Vijay, a rookie network administrator and his long-time mentor, Prof. Mukund.

Vijay: Well, that’s pretty simple. Since the routers are connected directly with the network cable, if one end goes down, the other end of the link goes down as well. This change in the link state is immediately signaled to the OSPF routing protocol on R1. The protocol then does a recalculation and figures out an alternate path to divert the traffic.
Prof: You are right! Since the link went down on R1, it was possible for OSPF to quickly detect this change in the link state and repopulate the routing table with alternate paths. Thus, the traffic flowing through R1 undergoes very minimal disruption. For instance, if the traffic was using TCP and a few packets were lost during the time OSPF was recalculating the paths, the TCP protocol on the source host will simply retransmit the lost packets. Once the backup paths have been established, the destination host would receive the retransmitted TCP packets and the same session continues without any breakage. It is not without reason that TCP is called a reliable protocol!
Vijay: Yes, so far so good. What else could be going wrong in my network then?
Prof: In any practical network, it is unlikely that the routers are connected back to back as we discussed. Instead it is common to have Layer 2 switches connect routers, hosts and various other networking appliances. I’m sure your network comprises several switches.
Vijay: I have myself configured several Cisco Catalyst series switches in my network.
Prof: A switch is used to partition the network into several collision domains. Let us go back to our example and introduce a switch between the routers R1 and R2. Here the network interfaces of R1 and R2 are each connected to a different switch port. Now what do you think will happen when R2’s link goes down? (Fig. 3)
Vijay: Only the switch port connected to R2 will go down and the switch port connected to R1 remains up.

Prof: Right. The problem now is that the OSPF protocol running on R1 does not know that R2 has gone down!

Vijay: I remember reading somewhere that OSPF uses Hello packet timeouts to detect that its neighbor has failed.

Prof: Yes, but the timeouts used by OSPF and other dynamic routing protocols are in the order of several seconds. This is done so that OSPF does not falsely conclude that a neighbor is dead even though it may be alive. If the network is congested, then the Hello packets from the neighbor may take more time to reach the router. Hence, the Hello packets are normally transmitted only once in several seconds to avoid congesting the network with a fast burst of Hellos. Further, the router will wait until it does not receive several Hello packets in succession before it declares the neighbor to be dead. A typical OSPF configuration may be to configure the Hello interval as 10 seconds and the dead interval as 40 seconds, i.e. the router waits until it misses four consecutive Hello packets before concluding the neighbor to have gone down.

Vijay: I begin to see where you are going with this. If I have a faulty router in my network, then it will take OSPF several seconds to detect this failure and route traffic around the faulty router.

Prof: Yes. Meanwhile, all the traffic flowing through R1 in our example will be forwarded towards R2 since OSPF has not yet updated the routing table on R1 with the backup paths. This results in a traffic blackhole and leads to dropped packets at the switch and subsequent network disruption. Further some of the TCP connections passing through the router may time out and get closed if the routing protocol fails to detect the faulty neighbors fast enough. For instance if a user was performing an online financial transaction on a browser, then it may get aborted in the middle of the transaction.

Vijay: Now I know why my customers have been furious with me lately! My network devices mostly have gigabit interfaces and if there is a downtime of 8 seconds, it implies a loss of approximately 1 GB of data at peak load (since 1 byte = 8 bits). For the typical OSPF dead interval of 40 seconds, it is possible to lose several GB of transmitted data! Is there no solution to this problem?

Prof: Fortunately there is, and that is BFD.

Vijay: BFD! What's that?!

**BFD to the Rescue**

Prof: BFD stands for Bidirectional Forwarding Detection. It is a protocol that is specifically designed to address the problem we have just discussed. BFD is used to quickly detect the failure of the path between two forwarding engines with low overhead.


Prof: It is customary to bifurcate networking software into two functional components: the control plane and the data plane. The control plane is responsible for all the configuration and control functions of the software such as calculating routes and populating the routing table whereas the data plane is primarily responsible for moving the packets from one network interface to another network interface based on the information in the routing table. The data plane is also known as the forwarding plane and is implemented by high-performance software or specialized hardware such as a network processor or custom ASIC which is known as the forwarding engine.

In many commercial routers, the control plane and forwarding plane are implemented in different processors, and so it is possible that one processor fails while the other is functional. BFD is mainly concerned with detecting failures in the forwarding plane processors.

Vijay: OK, got it. Why do you say that BFD is low overhead?

Prof: As we shall see, BFD is a very simple and light-weight protocol with small packet sizes. Hence, it may be implemented in the forwarding engine itself rather than overloading the control plane processor, and is independent of any routing protocol. These properties enable BFD to detect neighbor failures very quickly.

Vijay: Please tell me more about the protocol itself.

Prof: BFD is a simple Hello protocol and is similar in operation to any other routing protocol such as OSPF. It transmits Hello packets periodically to a specified neighbor and also expects Hello packets to be received periodically from the neighbor. If a certain configured number of Hello packets is not received in succession, then it concludes that the neighbor's forwarding engine has gone down.

Vijay: Normally, routing protocols discover all their neighbors as part of their protocol operation. Does BFD have any such mechanism to discover its neighbors?

Prof: Good question. A BFD session with a neighbor is not established on its own. Rather an application that requires fast neighbor failure detection has to bootstrap BFD with the particulars of the neighbor such as the network interface, neighbor address and the network protocol to use with the neighbor such as IPv4 or IPv6. Typical applications that utilize BFD are dynamic routing protocols such as OSPF, BGP, EIGRP, RIP and IS-IS. These protocols discover their neighbors using their own mechanisms and call upon BFD to monitor some or all of these neighbors. BFD has no means of discovering neighbors on its own.

If more than one application tries to establish a BFD session to the same neighbor over the same network protocol, then a single BFD session is shared between the applications. Any BFD state change is signaled to all the applications. It is also possible to monitor the next-hop gateways of static routes using BFD. In this case, if the BFD session with the gateway goes down, then the corresponding static route is removed from the routing table.

Vijay: Since, BFD can detect neighbor failures very fast, it needs to transmit its Hello packets very frequently. Doesn't this result in network congestion and is there any way to mitigate it?

Prof: BFD packets are very small and take up negligible bandwidth especially on gigabit networks. Nevertheless, BFD can operate in one of two modes. In Asynchronous mode, both the endpoints exchange BFD control packets and detect failures when they do not receive some number of control packets in succession. In Demand mode, the control packets are used to establish the BFD session. Once the session is established, both sides stop sending control packets. It is assumed that they have a separate way of verifying the connectivity. Only when required, the end systems exchange a short sequence
of control packets to explicitly verify the connectivity. Thus, the Demand mode requires very few packets to be transmitted on the wire.

Let me take this opportunity to explain the BFD Echo function as well. When a system that supports the Echo function receives a BFD Echo packet, it is required to loop it back (i.e. echo) to the sender through its forwarding plane. In contrast, the control packets may traverse the control plane and the forwarding plane. The Echo function may be used with either the Asynchronous mode or Demand mode. If the Echo function is being used, then the Control packets may be transmitted at a much lesser frequency since the Echo packets are doing the job of validating the forwarding plane liveness. Since, the Echo packets are not processed by the neighbor’s control plane, an advantage of using the Echo function is that it reduces the variations or jitter in the packet round-trip times and also enables faster detection times.

Vijay: One question is bothering me for some time now. If BFD is very similar in operation to the regular routing protocol Hello discovery mechanism, why can’t we simply configure the routing protocol itself with a reduced timer value to detect dead neighbors more quickly? Why bother configuring yet another protocol just to detect dead neighbors?

Prof: I was expecting this question! Well, you could tune down the routing protocol timers, but BFD has several aces up its sleeve. Perhaps the most important advantage of BFD is that it can achieve sub-second failure detection times, something that none of the routing protocols are capable of. What I mean by this is that BFD can detect failures in less than a second; in fact, the BFD detection time may go as low as a few milliseconds! This feature can be a game-changer in critical networks.

Another advantage of BFD is that since it is independent of any routing protocol, it may be used as a generic failure detection mechanism that may be leveraged by any of the routing protocols. This is useful if a network has several different routing protocols configured. Finally BFD is very light-weight as compared to routing protocols as explained earlier.

Vijay: OK, I see the benefit of using BFD for failure detection now.

**BFD Packet Formats**

Vijay: Do the BFD neighbors need to be directly connected to each other? Or can they be separated by multiple hops? Also are there any well-defined ports for BFD operation in IP networks?

Prof: BFD works with both single-hop and multi-hop neighbors. The single-hop BFD Control packets are transmitted as UDP datagrams to the well-known destination port of 3784 whereas the multi-hop Control packets use the well-known destination port of 4784. The UDP source port in either case must be in the range of 49152 to 65535. The BFD datagrams may be transmitted over IPv4 or IPv6 networks.

It is important to note that the Echo function works with single-hop neighbors only. Since, the Echo packets are simply looped back to the sender, it would not be possible to support this function in multi-hop routed paths. BFD Echo packets use the well-known UDP destination port of 3785. There is no restriction on the UDP source port number for Echo packets.

Vijay: Earlier you mentioned that BFD packets are very small and hence it does not consume much network bandwidth. Can you briefly explain the BFD packet formats that will help me while analyzing the packets captured from the wire.

Prof: The BFD Control packet format along with a brief description of each field is shown in Fig. 4. As you can see, the base Control packet is only 24 bytes long.

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>Protocol Version; set to 1</td>
</tr>
<tr>
<td>Diag</td>
<td>Diagnostic code specifying the sender’s reason for state change</td>
</tr>
<tr>
<td>Sta</td>
<td>BFD Session State as seen by the sender</td>
</tr>
<tr>
<td>P</td>
<td>Poll; if set, the sender is verifying connectivity or a parameter change</td>
</tr>
<tr>
<td>F</td>
<td>Final; if set, the sender is notifying a BFD Control packet with the P bit set</td>
</tr>
<tr>
<td>C</td>
<td>Control Plane Independent; if set, the sender’s BFD implementation is independent of its control plane</td>
</tr>
<tr>
<td>A</td>
<td>Authentication Present; if set, the Authentication section is present and the session needs to be authenticated</td>
</tr>
<tr>
<td>D</td>
<td>Demand; if set, Demand mode is active on the sender</td>
</tr>
<tr>
<td>M</td>
<td>Multipoint; reserved and should be set to 0</td>
</tr>
<tr>
<td>V</td>
<td>Protocol Version; set to 1</td>
</tr>
<tr>
<td>Diag</td>
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<td>Sta</td>
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</tr>
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<tr>
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</tr>
<tr>
<td>C</td>
<td>Control Plane Independent; if set, the sender’s BFD implementation is independent of its control plane</td>
</tr>
<tr>
<td>A</td>
<td>Authentication Present; if set, the Authentication section is present and the session needs to be authenticated</td>
</tr>
<tr>
<td>D</td>
<td>Demand; if set, Demand mode is active on the sender</td>
</tr>
<tr>
<td>M</td>
<td>Multipoint; reserved and should be set to 0</td>
</tr>
</tbody>
</table>

**Optional Authentication Section**

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auth Type</td>
<td>Authentication Type, if the Authentication Present bit is set; may be simple password, MD5 or SHA1 based</td>
</tr>
<tr>
<td>Auth Len</td>
<td>Length in bytes of the authentication section</td>
</tr>
<tr>
<td>Authentication Data</td>
<td>Variable length based on the Auth Type</td>
</tr>
</tbody>
</table>

Vijay: There is an optional section in the Control packet. Please elucidate.

Prof: BFD Control packets may have an optional Authentication Section. This is very important from a security perspective. An active attacker who can inject packets into the network can falsly make a router believe that a dead neighbor is actually alive leading to a traffic blackhole. This can be done by either crafting spurious BFD Control packets and making it appear as if they originated from the dead neighbor, or by simply replaying earlier legitimate packets from the BFD session. Both of these problems may be addressed by properly authenticating the BFD Control packets.

In the simplest scheme, a password known only to the two routers in a BFD session is embedded in the Authentication Section of the BFD Control packet. The receiving router can then validate the password found in the received packet. More sophisticated schemes are also available and they use strong cryptographic hashes such as MD5 and SHA1 to hash the contents of the packets along with a shared secret key to generate the Authentication Data. These schemes prevent the attacker from discovering the shared key by simply peeking into the packets captured from the wire. The Authentication Data also carries a sequence number field that is incremented regularly and helps in avoiding replay attacks.

**Fig.4** BFD Control packet format. The numbers in parentheses represent the size of each field in bits
Vijay: That makes sense. Till now you have described only the BFD Control packets. What about the Echo packet formats?

Prof: Remember that the BFD Echo packets are simply looped back through the forwarding plane of the receiver and are not processed in the control plane. Thus, the Echo packet format is not significant for the receiver and the sender is free to choose an appropriate format that provides enough information to identify the specific BFD session when the reflected Echo packet returns back to the sender.

Conclusion

Prof: In summary, BFD is a light-weight protocol that is increasingly being used for path failure detection in several different kinds of networks such as IP, Ethernet, VOIP, MPLS and GRE Tunnels. This allows the applications such as routing protocols to be less chatty and achieve higher scalability.

Vijay: Thank you very much for explaining the BFD protocol and its applications. I will go back to my network and configure BFD to minimize traffic loss for my customers.

Prof: You are welcome.

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About the Author

Mr. Narasimha Datta [CSI-1501217] is a Technical Leader in the Security Business Group in Cisco Systems India Private Limited. He has worked extensively on various Cisco routing and switching technologies. He holds a Master of Engineering (M.E.) degree from the Indian Institute of Science, Bangalore and has over 15 years of industry experience in software design and development chiefly in the domain of network security. He can be reached at dattann@yahoo.com.

CSI Adhyayan

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Latest Trends in the Learning

Rashmi G. N.
Senior Learning Designer, IBM, Bangalore

Anupama Raman
Curriculum Architect, IBM, Bangalore

Abstract: Instructional Design (ID) has seamless application across industries that anticipate learning. ID indicates how a course is developed and delivered for effective learning. Courseware development in learners’ perspective is a complicated process, which involves many background activities that result in the desired outcome, some of them are the following:

- Analyze learners’ need in learners’ perspective; transform the concepts as interesting chunks of information that would motivate them to have a fulfilling learning experience.
- Create items like hands on activities, games, and short video snippets that would increase concept retention and application for the learner.

In order to adapt to the constantly changing work atmosphere, several new learning trends have emerged in the market. A brief description of each of them is given in this paper with more focus on the different contexts in which each type of learning could be used effectively.

Introduction

As per NMC Horizon Report 2015, the top technology trends in learning are summarized in the graphic which is given below[1]. The various learning challenges and the techniques which could be used to solve the learning challenges are also summarized in the graphic. The focus of this paper is more towards near-term and mid-term technologies. Apart from the learning types discussed in the graphic, we have also tried to highlight other cutting learning technologies and trends which are evolving in the learning space.

Blended Learning

Blended learning: As the name indicates, blended learning blends different instruction media. It integrates traditional classroom learning with learning from digital content. In this learning technique, online instructions replace part of face to face instructions to fetch the best from both learning strategies. Digital content development can benefit from different technology choices such as e-learning, virtual sessions or pre-recorded sessions, websites, job aids, simulations and many more. This feature of blended learning model allows students to take control over pace, place and path of learning. This technique is leveraged mainly in high school learning and on-boarding new employees in an organization where training caters to various people across different geographies. For example, new employees can be trained about the organization’s policies and processes partly through instructors and the rest through online learning material such as how to videos, online user guides, instruction manuals and so on. This model has its own advantages. To name a few, organizations can reduce training costs, maintain consistency in training delivery across locations, timely access to courses and many more. Apparently, Ernst & Young reduced its training costs by 35% while improving consistency and scalability with eLearning; they condensed about 2,900 hours of classroom training into 700 hours of web-based learning, 200 hours of distance learning and 500 hours of classroom instruction, a cut of 53%[1].

Students have the benefit to learn and prepare individually outside the class that are backed up by computer-based activities and complete assignments using the web-based resources such as social software[2]. For example, students can get their preparatory material using the LMS and prepare at their own pace, the result of which could be flipped classroom or iteration of the learning which has already happened, where learning is more productive. The prime decision point to design curriculum in blended learning approach is that what part should suffice for classroom teaching and what part of the content should serve for digital content. This decision mainly depends on audience, discipline and the learning objectives.

The activities captured in blended learning further provide data to analyze why and how often is there a need to meet face to face and also could be involved in instruction decision. This data also can be used to provide much personalized experience for learners.

Another variant of blended learning which is gaining a lot of traction nowadays is called flipped classroom.

Flipped Classroom

Flipped Classroom is one of the latest educational delivery mechanisms which use a combination of online and offline...
learning mechanisms to offer high quality learning experience to the learners. Combinations of several techniques like expert forums, online communities, and recorded videos are used for imparting learning using flipped classroom approach. Flipped classroom approach is different from the existing Knowledge sharing session and expert forum concept. The salient features of flipped classroom approach are explained below:

Flipped classroom = self-guided learning + expert guidance + practice

**Step 1:** Find what you need to learn and focus on it.

Learning must be self-directed and starts from a wide array of small topics, presented in online expert videos, recorded by subject matter experts in specific domains

**Step 2:** Expert guidance - Consult the subject matter expert in scheduled live sessions for use case development, troubleshooting, and reinforcement of the fundamentals which were learnt in step 1.

**Step 3:** Practice, and continue to gain expertise in specific domain.

A variant of Flipped Classroom which has gained a lot of traction nowadays is the concept of Massive Open Online Courses (MOOCs)

A massive open online course (MOOC) is a model for delivering learning content/certifications online to any person who wants to take a course, with no specific restrictions on attendance, age, geographies and so on. This is an education delivery method which has gained a lot of traction in the market off late. Massive amounts of different types of content are made available in MOOCs platforms which are offered by various service providers.

Some of the leading MOOCs vendors in the market are the following:

1. Coursera (https://www.coursera.org/)
2. EdX (https://www.edx.org/)

**Bring Your Own Device (BYOD)**

Bring Your Own Device (BYOD) concept came into the market in 2009 and it was introduced by Intel organization in order to cut down technology costs and improve the productivity of its employees. Now it has found large scale penetration across all domains which includes education as well. BYOD, also known as BYOT (Bring Your Own Technology) refers to using your own personal device in classrooms for performing all types of learning activities. BYOD offers a whole range of benefits of the students, some of them are:

1) Increase in student participation in classroom activities as they will be using the same device at home and in the classroom which in turn would increase their comfort level with the device which would ultimately lead to increased student participation in learning activities.

2) Reduction in training cost which is due to the fact that the training facilitators need not arrange additional training infrastructure which would lead to a drastic reduction in training cost.

3) It provides increased learning avenues like access to e-books, online forums and other expert videos which will open up wider learning options for the learners. Facilities to bookmark interesting learning content and retain them in their learning device will help the learner to have longer retention of their learning.

**Social learning**

The world is witnessing a major shift from formal learning to informal learning methodology, where people can learn by sharing thoughts and ideas. Social learning is found to be an effective learning solution, where people learn by interacting. In the e-learning context, social media is associated to instructional programs to facilitate people to interact with one another. On job learning can happen through social learning. Collaborative enterprise social tools are associated with learning systems to encourage people for open communication, idea sharing and group discussions, which facilitates them to learn from one another as they work together. Employees of an organization can be connected through these tools to provide key information that speeds up learning. This learning strategy focuses to integrate all formal and informal forms of learning. However, it has its own design approach and challenges. It requires the ability to analyze a business situation and the learning context, and recommend appropriate informal/social learning solutions to address them. It anticipates familiarity to different learning models (such as the ‘70:20:10 Model’ and the ‘3-33 Pervasive Learning Model’) that support informal and social learning in workplaces.

**Mobile learning**

M-learning is the buzzword of the day. We are in the middle of m-learning revolution; e-learning through mobile devices. There is a high demand for learning solutions that works anywhere and everywhere. They are required to be concise and simple so that the learners can catch it up when on their subway, or in commute. The m-learning modules are usually designed to work on smart phones or on a tablet. It is very much necessary to identify and use the right technology to serve the purpose. It is required that they work on multiple platforms and have responsive design. Browsers are also a consideration. This learning solution deals with the need for on-demand access to information on smart phones and hence need a different approach than traditional e-Learning. The modules are much appreciated if they have Concise and precise chunked content. The m-learning is easier if it is associated with the scenario and use case based presentation of material. The m-learners can find it easier to learn if the modules have limited use of interactive elements, and they can grab things fast when the developers intensify the use of graphical elements (such as animations) and leverage the maximum use of multimedia elements. This learning solution can be extensively used to develop on-job support resources, FAQs, Tips and tricks.

**Nano learning**

As more and more virtual and matrix teams in organizations are becoming obvious, employees are demographically. There is a paradigm shift from traditional learning where people are required to know everything to adopt social learning practices. Learners should be given the tools and resources to access quick pieces of specific information that helps them to perform their job, as and when they need it. These learning components are extremely small and focus on a single goal. How to do videos, selfie videos, simulations are some common examples. Thus, Nano learning solution targets one objective of a particular topic that supports just-in-time learning. Nano-learning takes place on smart phones and tablets, or any mobile device. There are two ways that you can associate Nano learning with e-learning. Nano learning can be a by-product of main e-learning material, or many Nano learning modules can be combined to form one e-learning module. This learning solution deals with the need for on-demand access to definite information on mobile devices, need some design considerations in addition to m-learning; modular approach and typically can be 2-15 minutes module. They are to be free from prerequisites...
and could be reusable. Applications of such learning solutions can cater to new-hire orientation through online and social learning. Nano-learning solution can provide for additional, related training materials such as other Nano-learnings, practice aids. Long courses that have number of Nano-learnings that could be indexed searched and interlinked. Performance support tools, more in-depth training modules, or other resources, marketing, or promotional material can be developed using this learning strategy.

**Personalized learning**

This learning solution is considered to be the learner-centric approach. It aims to meet the need of individual learner in developing their skill by imparting tailor made courses to students of different ability levels. This methodology focuses to provide flexible learning options and intends not to cause cognitive overload. This approach is based on rigorous survey of what learners need. The courses developed are based on profile, preferences, tracking, and ratings that can provide customized learning experience to users. The solution can be enhanced to adaptive learning, where the learners’ experience can be adjusted based on their progress, further giving a personalized learning experience. Personalized learning gives richer personal experience when integrated with augmented learning. The design of personalized learning solution demands to quantify the learners’ ability and learning levels. These courses are developed based on the preferences of the users and hence, the design comprises to provide the users to select preferences.

Thus, the courses have a need to present topics based on learners’ preferences. This learning solution can be applied for competency based systems, where the learners may move at their own pace, reading levels, assessment learning systems, where learning can be adjusted to individual learners based on their progress. Play based learning can provide personalized learning experience, where learners can learn tasks while playing.

**Wearable learning**

Wearable learning solution is considered to be the future and promising technology that supports learning and performance. It is slowly evolving. Wearable learning is driven by wearable technology. There is a high scope that this technology can be leveraged by organizations to ensure in-time-learning. This learning solution focuses on how wearable technology can empower learning.

Because of their data gathering ability based on biometrics, wearable devices can provide learning patterns of a learner to Artificial Intelligent (AI) systems, which can give the learner an uninterrupted learning experience. The learning pattern can be used to assess the learner and further can be used to provide personalized learning experience. They also can be used to understand the learners’ status and can recommend intervention to provide information, which can lead to performance improvement. Wearable learning solution can be implemented for practical and assessment learning. Wearable devices like GoPro can be used by learners to share the live recording of their experiments, which trainers can evaluate and correct their behavior. The foremost and the crucial design demand for wearable learning solution is the wearable technology itself as it is very expensive. The wearable courses demands short and focused module presentation because of small interfaces.

**Conclusion & Future Scope**

As most industries are changing rapidly, there is a need for us to learn more. With more and more intelligent electronic devices and gadgets, learning solutions have to adapt to the changes in the market. As per the excerpts from Cisco’s Visual Networking Index, Global Mobile Data Traffic Forecast Update for 2014 to 2019, the number of mobile-connected devices is more than the world’s population and the world is witnessing a drastic increase in smartphone usage, which could exceed three-quarters of mobile data traffic by 2019. This study proves the point that the mobile devices play a vital role in learning scenario. Hence, mobile-based courses will be in high demand. Further continuing with the trend, mobile app analytics can be anticipated playing a crucial role to develop personalized courses.

With Bring Your Own Device (BYOD) on rise, organizations encourage device agnostic content development, which encourages learners to learn from their own devices. Laying games on mobile phones is exciting and hence more and more games are thronging the market space. Learning scenarios can exploit this trend to develop game based learning content. Hence, lot of scope on gamification is expected.

Learners want to learn on desktops, mobile phones, i Pad and on any mobile device. Hence, need of the hour is responsiveness. People are more interested in just-in-time and on-demand learning, thus creating a demand for modular courses rather full-sized courses. The learning arena is witnessing a transition from formal to more informal or social learning methodology. Less lecture, more graphics and flat design are ramping up in the learning context. Education through games is also conquering the learning space making gamification a sought after technique to impart skills and knowledge, thus improving the performance curve. Approaches like flipped classrooms and Massive open online courses are conquering the hearts of learners to a great extent. With all these and much more happening in the learning market is the need of the day to device new mechanisms rapidly by using the emerging technologies to conquer the heart and mind of the learners if we have to remain active in the learning market.

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**About the Authors**

Ms. Rashmi G. N. is currently working as senior instructional designer for safer planet portfolio in i2 client success team. She has also worked for WebSphere commerce products of IBM and her contribution is well appreciated by the management. She has been a resource person in various faculty development programs across different verticals of education. Her areas of interest span through analytics, various instructional design methodologies and learning strategies. She can be reached at rasnaray@in.ibm.com.

Ms. Anupama Raman [CSI – 0007945] is currently working as the curriculum architect and lead for IBM Smarter Cities and i2 client success team. She has worked extensively on almost all smarter cities products of IBM and has spoken about the smarter cities initiative of IBM at several leading conferences and forums. She has authored several Forbes blog articles on various dimensions of smart cities for Indian context. She has authored multiple books titled intelligent cities: enabling technologies and platforms which was published by CRC press, USA in June 2015 and High Performance Big Data Analytics - Paradigms and Approaches by Springer Publications. She can be reached at anuprama@in.ibm.com.
Big Data Mining: A Review

Chintan Bhatt
Asst. Professor, U & P U Patel Department of Computer Engineering, Chandubhai S. Patel Institute of Technology, CHARUSAT, Changa, Gujarat

Tadrash Shah
Technology Analyst, Bank of America, Merrill Lynch, New York

Data Mining. Data Analytics. Data Science. Big Data. These terms are so often referred to us in the day-to-day technology world, and more so if you are a member – be it student, teacher, professional, technician or even a loosely related individual – of computer science domain. They tend to make sense to us in a very unobtrusive way given that how they are spelled out. Of course, we know that there is a lot more stuff going on behind these terms. Not just one, but entire bundle of issues on CSI Communications can be published on these topics and yet something or the other can be felt to be left out. The research and the application of these terms are scaling up leaps and bounds. Today, we shall try to look two of these – the first and the last – from a bird’s eye but mind you! Eagle’s Eye – sharp and focused although from higher altitudes.

We shall begin by looking at the definitions of Data Mining and Big Data, followed by how are these fields different and that followed by how can these are coupled tightly together for a synergistic relations in the data domain.

Well, if you have read our previous articles, readers out there would have known that we are averse to defining the terms; as in a proper framed quoted definitions, and rather we just try to understand the concept of it. Let us leave the definitions to the textbooks.

Data Mining. It is all about studying the enormous amounts of data for some patterns and relations between some variables of the data. At times you also would like to look at the inconsistencies of the data, but anyway uncovering the inconsistencies of the data ultimately means that you have to identify the pattern in some reverse fashion. So it is about finding the patterns. There are several classic examples of the data mining which probably the readers would know of and the best is the market-basket example of the beer and diapers problem. With data mining algorithms you would do several operations on the data like –

Association: You try to find the association between different things on each transaction of the data. For Example the one that we mentioned above of the Market-Basket. The retailer try to see what the items that users usually buy together are and then save tie of consumer by placing those items side by side in their store.

Classification: Large sets of the data is classified on certain tags. This is classical method of machine learning. The training dataset is used and is manually classified and then the algorithm uses these methods to learn how to classify what kind of data and then it classifies the rest of the data.

Clustering: Group the same or similar kind of objects in cluster. It is like organizing the books in the library. The books on the same subject are to be kept together. The algorithms uses certain techniques to identify to what cluster the each book belongs.

Prediction: A future extrapolation that is used the most in the markets to identify what the price would be of any instrument. Like, use the weather forecast data to know how the crop would be, and how would be the corresponding trading market. For example, the weather is favorable for growing oranges and hence orange juice market is going to go up and price of the juice to go down – and hence the company manufacturing orange juice is going to make profits and thus it’s stick price going to go up.

There could be many more techniques added to these but we would stop here.

Without going in to much much more detail of these topics, let us shift gears and go to Big Data.

Big Data, as the name suggests, is something about huge amounts of data too. Very conventionally speaking these are the volumes of data that are beyond the capacities of the single excel shear. In technical terms these are the amounts of data that cannot be processed by the conventional database management systems and needs special systems to deal with. These humongous volumes of data need ever more computing power to be gathered and analyzed. The data here is gathered from several different sources and hence the nature of data is totally raw. At times it is unstructured too. Since, you may want to use the data for the purposes it wasn’t originally meant to serve, you need some processing on the data and need to, probably, store it in a special way too.

At this point, it may seem that data mining and Big data are nearly similar, but believe us, they are far from that. If they would have been so similar, there would not have been a different faculty of computer science for it and would not have grown to the size it has and it is. Let us identify the main differences.

Data Mining is also about the large amount of data but the data is usually in the same kind and obtained from one source. In some cases it may have been obtained from different sources but then it is of the same form more of less. While in Big data case, this is not possible. The data is unstructured and raw, as noted earlier. Thus the conventional form of organizing the data in the database fails with Big data. You can say that Big Data is the “Asset” and the data mining is the “handler” of the asset. Big Data is all about the organization and storage of the data. Devising the architectures for containing these type of data. And Data mining is like “finding the needle in the haystack”. With data mining techniques you sift through these amounts of data to find something.

Also it would be injustice to both of these terms if we limit them to be dealing with the textual data. These are the techniques and technologies that deal at the bit-level of any data. And hence, have the capacities of deal with any form of data - text, images, audio and video all. There are data mining techniques deployed at the Google Images too and the result of it is – you see the “View Similar Images” button on the Google Images search. It is also the force behind the “Image Search” on Google.

The widely known algorithm for Big Data is called the HACE theorem. It stands for Heterogeneous, Autonomous, Complex and Evolving data. And looking
from this perspective too - we see that it is beyond the capabilities for the conventional software tools to manage this kind of data. This theorem is nothing but modeling the characteristics of Big Data. By Heterogeneous it means that it can data from various sources with diverse dimensionality; Autonomous meaning that data may come from several distributed and decentralized controls; Complex as in unstructured and having unnatural relationships among them; Evolving meaning these relationships are not absolute or constant and can change over the period of time or over the sets of similar kind of data. And hence, if we look at the one perspective of the data only, it can be the Blind Men and Elephant problem.

From this perspective too - we see that it is beyond the capabilities for the conventional software tools to manage this kind of data. This theorem is nothing but modeling the characteristics of Big Data. By Heterogeneous it means that it can data from various sources with diverse dimensionality; Autonomous meaning that data may come from several distributed and decentralized controls; Complex as in unstructured and having unnatural relationships among them; Evolving meaning these relationships are not absolute or constant and can change over the period of time or over the sets of similar kind of data. And hence, if we look at the one perspective of the data only, it can be the Blind Men and Elephant problem.

Fig. 1: HACE Theorem - Elephant and Blind Men Problem

Few others express the opinion that the Data Mining is the “old Big Data”. And they look like to be right in some flavor. Big Data is expanding the umbrella to cover the big data mining techniques which are much more evolved than the usual data mining techniques. Also with the advent of the more tools, there are some graphical representations coming up so the businesses and the markets have a new wrapper for the old stuff. If you look at it from that brink, it seems that Big Data isn’t a technical term at all while Data Mining and Data Warehousing looks more technical. Well, these are just the arguments that you can make and what we want is the details of it.

Big Data Mining is the techniques to mine the Big Data. It is a conglomeration of the Data mining techniques with the Big Data strategies. In mid August, SBI deployed a lot of Big Data stuff on their data centers and server farms and the results are interesting. They uncovered an important information - close to one crore account holders have not provided any nomination for their savings accounts. What is worse, over half of them are senior citizens. Reportedly they are using the tools like Big R, SPSS Modeler, Hadoop etc.

Another confusion that happens here is this Big Data = Hadoop. Hadoop is a tool or a framework for Big Data. Hadoop is an open source framework for processing massive volumes of data. Instead of one large supercomputer, Hadoop coordinates local storage and computation across multiple servers that act as a cluster, with each server working with a subset of data. To emphasize more, Hadoop cluster are MPP type of clusters with Distributed file system and distributed computation. Agreed that it is one of the biggest player in the Big Data space, it is not the only one. Another big player that you may want to look at is Pentaho. Though, Hadoop and Pentaho are not at all comparable to multitudes of degrees, we just said that it is worth investing efforts to look at.

NVidia recently faced some trouble as the growing number of Data Scientists are using the GPU for big data analytics for better real-time representations to propel the business decisions. They are forced to restructure their GPU architectures and design the GPUs that are more powerful than ever and can process these kinds of data. Intel, too, has been looking at the Big Data needs and responding to it with its own Business Intelligence, Chip Designs, Recommendation systems, etc since 2012. As it puts very correctly in the reports - “Drowning in Data, Starved for Knowledge”, it is pragmatic enough for several Big Data players to respond to growing data and the changing needs.

An interesting byte – Call of Duty from Activision employs Big Data Mining in their new game Call of Duty – Black Ops 3. They monitor the activity from the Activision teams and social media like Twitter to determine the QoS and game balance. When negative social media input causes QoS spikes the system alerts the networking teams and the users know that the Technical Support call does come through, the users can be reassured that the problem is already being resolved.

KDNuggets ran a software poll and collected some 2759 votes about which Big Data and Data Mining tools go together and which ones do not. Depending on the polls, they ran the Big Data Mining Apriori algorithm to determine these cohesion and gave out the Heat Map as under -

“And it can be simply seen, what all kind of relations can be established with Big Data Mining; useful not only to business but also to developers and computer scientists. This may be a tangent to what we were discussing, but it may be a good reference for those who may have ever desired to dive deeper in the Big Data ocean. This Heat Map can be a compass for them to steer their research in correct direction.”

Apart from all these exciting developments in the open market space that is accessible to us, from the field of Big Data, it has its own set of problems. There are issues that some human
behavior experts are looking at. For example, the one that created quite a swirl was with Target (a departmental store in US). Target deployed Big Data techniques to know what kind of products a customer bought or buys frequently and then sends them deals and coupons of the related items that they may like to buy to boost their business. This automated system accidently uncovered a teen girl’s pregnancy to her father. Target identified some 25 products from their analysis that when purchased together indicate that a woman is likely pregnant. So they send related coupons to her. So a girl might have bought some stuff that fell into this category and sent her an automated mailer of related pregnancy products which her father happened to see, learning that his teen daughter was pregnant.

Hence, the report published in 2014 called Big Data’s Big Meaning for Marketing, Forrester.com highlighted 3 main areas of risk -

1. Personal Data Protection : Existing methods of protecting the identity of individuals may no longer be sufficient in the era of Big Data. Forrester cited the example of Netflix, which was sued for releasing data after researchers at the University of Texas were able to positively identify individuals from supposedly “anonymous” reviews.

2. Financial liabilities. The full extent of any financial liabilities for Big Data practices is unknown and at present unquantifiable. Lawsuits against organizations that have data breaches or are perceived to be misusing data are just beginning. Those who use collect and use data need to be aware of relevant legislation and the potential for increased costs if they get it wrong.

3. Ethical dilemmas. New ethical dilemmas are being created by the analysis of Big Data. Just because something can be predicted, should that information be used, or that prediction acted upon?

Bloomberg Business reported last year that Carolinas HealthCare System, operator of more than 900 care centers, began to purchase data to allow them to identify high-risk patients. Why? So they could intervene in an attempt to prevent potential health problems from developing.

These days people are getting aware and interested to see what is going on with their data, so organizations that are involved need to be getting more vigilant about their security and privacy. Some of the organizations also reportedly started paying out, literally, to the employees for honesty. The secondary usage of the data that can happen outside the walls of any organization is an ethical threat to each such organization. Facebook and Google are often at the center of such data privacy controversies, whether it is about defending their own privacy policies or releasing their data to NSA.

Thus, likewise to any new technology, Big Data Mining also comes with its own black and white. But again likewise to any technology, we look at them as shades of grey.

References

About the Authors

Mr. Chintan Bhatt [CSI-11500219] is currently working as an Assistant Professor in Computer Engineering department, Chandubhai S. Patel Institute of Technology, CHARUSAT, Changa, Gujarat. His areas of interest include Data Mining, Web Mining, Networking, Security Mobile Computing, Big Data and Software Engineering. He can be reached at chintanbhatt. ce@charusat.ac.in.

Mr. Tadrash Shah is working as Technology Analyst at Bank of America Merrill Lynch in New York. He has completed his B.E. in Computer Engineering from Gujarat Technological University in 2012. Prior to starting his M.S. in Computer Science from State University of New York at Stony Brook, he has worked on several projects with IIT-Gandhinagar, IIT-Bombay, IIM-Ahmedabad and United Nations. His research areas include - High Performance Computing, Algorithms and Database.
ICT for Sports: A Whole New Ball Game

Prerna Lal
Lecturer in Information Management, International Management Institute, New Delhi

Introduction

Innovations in Information and Communication technologies (ICT) have changed the way sports and the business of sports are organized, played and viewed nowadays. Introduction of technology-enabled sports equipment, wearables, cameras, etc. are now helping players, trainers, coaches, physiotherapists in getting the real-time data as well as feedback across a wide range of performance factors and other human body involving metrics such as biomechanics, stress levels etc.1. Furthermore, ICT has also enhanced the experience of sports fans and vast television and online viewing audiences- be it booking the tickets for tournaments and leagues online, interacting with their favourite team/s or players through social media, or watching the game live in the ground, on TV or online using laptop, mobile or smart phones.

There is no doubt regarding the importance of data analysis in sports. Number of software are available that can help players and coaches in analysing the games as well as predicting the performance or outcomes using analytics and advance data visualization techniques. Some of the examples are Cricket21 and 22yardz for analysing cricket matches, DRAGflik for analysing hockey matches, IBM Slamtracker’s “Keys to the Match” feature for determining the styles and patterns for the Grand Slam tennis players when they win, Addero Solo and Atheletic Logic for training and team management.

Needless to say that ICT is now an integral part of sports and winning is not just about being the best in chosen sporting disciplines or team sports pursuits but also being smartest and having all the latest gadgets and technologically advanced sports equipment in your kit2. We will now look at some of the ICT applications in various sports under three heads i.e. tracking, decision making and prediction.

Tracking Technologies

One of the significant application of ICT applications in sports is the ability to track movements and capture data regarding every move made on the sporting field or playing arena of practice session or every stoke played or move enacted during game play. Use of sensors, lasers to capture data and transmitting data to smart phones and tablets so that it can be analysed and used for making decisions and performance improvement. Let us now look at some of the examples of tracking technologies in different sports.

Tennis rackets: Sensors embedded or hardwired in tennis rackets have literally changed the name of the game in one of most highly competitive individual games. These sensors are generally embedded in the handle and are able to track all aspects of game play by the players wielding them or playing with them. The data generated and collected can be uploaded to smartphones or other computing platforms such as computers, laptops and detailed aspects of all levels of play can be reviewed. Top 10 tennis player and one of the greatest exponent of the claycourt game Rafael Nadal used Babolat PLAY and data generated from Rafael’s games is utilized by his coach to make adjustments or refinements to Rafael’s games.

Boxing gloves: In recent years, even the sports discipline of boxing has not been impervious to the influence of ICT applications. Embedded sensors in boxing gloves aim to give insights on data captured about various aspects about a boxing session or a boxing bout. Data pertaining to speed of punch, type and count of punches, calories burnt during training sessions or actual games are all recorded or analysed. The insights and analysis by specialized coaches are then passed onto the boxer to refine his methods and techniques and to better prepare him for bouts and competitions. Such data captured can be stored in the cloud. One of the leading technologies which is revolutionizing the real-time data-capture of embedded sensors is StrikeTec Boxing technology.

Intelligent and app-enabled soccer ball: Soccer is the most popular universal game and is played in almost all countries of the world. Apart from the alternating quadrennial World Cup and Euro soccer tournaments, the cash-rich and highly competitive European soccer leagues are also highly followed. Expectedly, soccer balls were bound to be influenced by the

application of ICT technologies and help a multitude of players to better their games and coaches to fine-tune strategies based on analysis. Sensors embedded in soccer balls help understand ball impact, ball drift, impact points on playing surface as well as players’ boots and heads and flight trajectories. Sensor packages are generally suspended in the middle of the ball and can transmit data to tablets and smartphones in real-time.

**Decision Making Systems**

The impact of ICT applications in sports and sporting disciplines has been huge. Apart from revolutionizing viewers’ pleasure, they have significantly improved decision making systems. Referees, umpires and other designated officials and authorities can make quick, informed decisions and avoid conflicts.

**Video Referee:** The introduction of video referees has changed the dynamics of decision making and also raised the drama of sports watching for captive television and online audiences. With the introduction of central command centers in NHL, NBA, NFL and MLB and now NRL, video referees are able to make decisions faster and more accurately. With the availability of relevant angles of play and enhanced and high-tech video review technology, average time taken for decision making is coming down. Slicker and faster-decision making also ensure game continuity for both playing arena/audience and television and online audiences. Live explanation of decisions to fans ensures fair-play and transparency and also cuts out human errors and transforms the experience of fans of all sports.

**Goal-line Technology:** The most high-profile global sports soccer has benefited a lot from decision making. Many hair-line and at times human-error driven decisions have decided key tournament matches and also led to controversial exits for many teams during high-octane knockout games. High-profile blunders – and in the full view of vast television audiences – by soccer referees were quite often. FIFA started using goal-line technology during the last World Cup held in Brazil. Such goal-line technologies in a suite of electronic devices placed near goal-lines are precision-driven and speedily determine whether the whole ball has crossed the goal line or not. This immensely helps referees and cuts out controversial decisions. Other competitive and high-profile sports such as tennis, rugby and American football have also started implementing goal-line technology.

**Hawk-Eye:** Hawk-eye technology is used in tennis, snookers and cricket. It was also used in the high-profile Premier League season in the UK in 2013-2014. Hawk-eye technology used in cricket has raised the spectacle of cricket watching for fans. The nuances of hawk-eye technology for such a complex sport like cricket has made cricket more watchable and with debates in the mix more appealing for commentators and players alike.

**Prediction**

The adoption of analytics in sports has been a paradigm shift – and for the constituents and stakeholders concerned. The level of sophistication and the refined use of analytics has changed the name of the game-literally. Some examples of usage of ICT applications include: coaching evaluation, officiating data, draft analysis, rule changes, game strategies performance records, health and injuries.

Prediction is the key when it comes to making sense of the mass and troves of data generated from use and application of sophisticated ICT technologies and analytics. In the current era, all major sports teams in professional as well as semi-professional leagues have analytics departments. Along with general managers, talented teams of data scientists and mathematicians crunch numbers based on the humungous data and information and metrics generated. This is then channelled to hell managers and talent scouts during recruitment strategies and also used during practice sessions. Fans and audiences too have been bitten by the data bug and look for statistical and other analytics content both from the teams as well as independent analysts on sports shows or Websites and blogs and especially with those related to prediction analysis.

Baseball is one of the most analysed sports and given the mass appeal in a vast market like USA and also the popularity of NBA teams worldwide, predictive analytics about the prospects of the storied teams have riveted viewers and audiences. Apart from the popular and mainstream sports platforms and outlets, many independent Websites and online portals do exhaustive data-based analytics of the teams before all games.

**Conclusion**

The use of ICT applications and technologies in sports was almost inevitable after the mainstream use of such technologies in so many spheres of life and also business and commerce activities. With sports and sports leagues also being run like billion dollar businesses, fans and captive audiences always demand the best viewing experience and mostly expect fair decisions to decide the outcomes of games and tournaments. And cut out the chances of bloopers and blunders and human-related errors which tend to impact outcomes and results of games. The usage of ICT applications by the athlete and sports persons themselves has raised the bar for excellence in performance.

The emergence of demanding vast online audiences – well versed and conversant with consumer ICT technologies for sports has also dictated the implementation of ICT technologies by sports administrators and leagues commissioners. Improved decision-making and in real-time has cut out the many human-led errors of the past decades and has raised the sanctity of sports. Sports analytics is here to stay.

**References**


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**About the Author**

Ms. Prerna Lal [CSI - 00134917] is a Lecturer in Information Management at International Management Institute, New Delhi and a published writer in journals and publications, both Indian and international. She is an engineer with an MBA degree (IIT-Roorkee). She is a SAP-certified consultant (HCM) and has ITIL® V3 Foundation-level certificate in IT Service Management. Her areas of interest are Data Warehousing and Data Mining, Business Analytics, Management Information System, Software Project Management, IT Service Management, Cyber Law, and Cloud Computing. She can be reached at prernalal@yahoo.com.
Protégé - An Open Source Ontology Editor
Swathi Suresh
Software Engineer, Teradata, Hyderabad
Anthoniraj Amalanathan
Asst. Professor, School of Computing Science and Eng., VIT University, Vellore
K. Govinda
Associate Professor, School of Computing Science and Eng., VIT University, Vellore

Introduction
Protégé Ontology Editor is open source software that allows users to create any type of ontology. Any real world object could be modeled to be a class and can even have other subclasses that come under it. Object oriented concepts like property inheritance variable value restrictions can even be applied here. Protégé is considered to be superior to a database when the model consists of rich data enclosing many relationships between them that are often traversed by. It is also found to have an upper hand over database when the requirements and application design are often changes with the details not being clearly specified.

It is considered to be a "leading ontological engineering tool" which acts as a framework for which numerous other projects could suggest plugins. The programming language utilized for developing the source code of the software is Java. The user interface of the software which is quite complex greatly relies on the extensive use of Swing. Protégé which is currently licensed under Mozilla Public License 1.1 was developed at Stanford University in association with the University of Manchester. The prime advantage of protégé when compared to other editors is that it is extensible and scalable.

Protégé - History
The Protégé project was first developed by Mark Musen in 1987 and was known to be the Protégé meta-tool for knowledge-based systems. It was initially designed to be used in the medical domain in the protocol-based therapy planning. Musen proposed that the process of knowledge-acquisition proceeds as well-defined stages and the knowledge gained in every stage could be used in the subsequent stages thereby customizing the procedure of knowledge acquisition. This was demonstrated in Protégé I, the earlier version of protégé.

Later the Protégé –II was developed in 1991 which included the concept of domain independent problem solving methods. It also introduces the idea of automatic forms generation. This version was successful in running on NEXTStep machines. By the end of 1994, Protégé - III was introduced which was a refined version of Protégé-II. This version comprised of more integrated set of tools and could be run under MS Windows. It was accepted in a small world – wide user community.

The current version is Protégé 5.0 introduced in 2015 could be implemented on a large variety of platforms containing a Java VM. It provides support for customized user-interface extensions and at the same time helps to incorporate the Open Knowledge Base Connectivity (OKBC) knowledge model. This version is also responsible for interacting with standard storage formats like XML, RDF and relational databases.

Process of Protégé
The architecture of Protégé makes the systems behavior and appearance to adapt to the needs of the present project being worked upon. It does so by adding and activating the plugins dynamically as and when required. The Protégé user interface provides a number of default tabs that presents different views of the ontology.

The ‘Classes’ tab allows the user to define the various entities in the ontology.

The ‘Classes’ tab resembles the classes in object oriented programming. Class hierarchy can be established between the defined entities by placing

Fig. 1: Process of working on ontology with Protégé

the root class at the top and having the subclasses descending from them. Under the classes tab, to the bottom left there exists the description tab where the specifications may be made that includes defining the equivalent class as well as the subclass.

Under the ‘Object properties’ tab, a list of properties will appear that is used to relate two objects and are hence called predicates. The next tab that comes under the architecture of protégé is ‘Data properties’ which are similar to object properties but their domain will bear typed literals. The ‘Individual’ tab will help to view all the instances within the ontology where the real life examples are specified. The ‘OWL Viz’ and ‘OntoGraf’ are the tabs for drawing the relationship diagram that exists between the entities.

Installation Methods
Protégé is freely downloadable and the Protégé 5.0 version can be downloaded from the home page of protégé “protege.stanford.edu” or by using the direct link.
http://protege.stanford.edu/download/protege/5.0/binaries/

The above site has the installation links for all operating systems that includes Windows (both 32 and 64 bit), MacOSX, Linux (both 32 and 64 bit), Solaris, HPUX, AIX and other Java-enabled platforms. There are separate download links for downloading the software to an operating system having a JVM already installed or to install the JVM along with the Protégé software. Once the download has completed, run the install_protege_5.0.exe file.

Desigining an Ontology
The family ontology will be implemented for demo on Protégé where the relationships between various members of the family will be focused upon. A new project could be opened for creating the family ontology by choosing File -> new. An existing project saved in the RDF format could also be opened using the File->open tab. There is also a provision to open an existing ontology through the URL by choosing File ->Open from URL. The individual in this ontology represents...
the members of a family tree. Under the entity tab of the editor, three entities will be defined: Gender+, Sibling, Person.

The ‘Gender’ entity which is defined under ‘Thing’ has members as male and female. There is also the ‘Sibling’ entity defined under ‘Thing’ which has members as brother and sister. The other entity in the family ontology is ‘Person’ which has number of subclasses namely ‘Father’, ‘Mother’, ‘Son’, ‘Daughter’.

In this Family ontology, the same individual may be a daughter of a parent as well as a mother of a child. In addition the same individual may be a person or thing. Such specifications may be given in the description section in the classes tab of the Protégé tool.

Relationships such as hasParent, hasSibling and hasChild are elucidated under the ‘object properties tab’ where relationships are of the format object1 objectproperty object2. The real life relationships can be described under the individual tabs where the father, mother, son, daughter and other relationships can be asserted.

The ‘Father’ entity of the family ontology may use the hasChild property may have the following definition provided under the equivalent tab:

Person and (hasChild some Person) and (hasGender value male)

The ‘Mother’ entity will bear the following definition:

Person and (hasChild some Person) and (hasGender value female)

Similarly the ‘Daughter’ entity may have the following definition provided under the equivalent tab:

Person and (hasParent some Person) and (hasGender value female)

The ‘Son’ entity will be having the following definition:

Person and (hasParent some Person) and (hasGender value male)

The entities ‘Father’, ‘Mother’, ‘Son’ and ‘Daughter’ will be subclasses of the Person class.

Sample RDF file for Family Ontology

```xml
<?xml version="1.0"?>

         xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
         xmlns:owl="http://www.w3.org/2002/07/owl#"
         xmlns:xsd="http://www.w3.org/2001/XMLSchema#"
         xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#">
  <owl:ObjectProperty rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#hasChild"/>
  <owl:ObjectProperty rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#hasGender"/>
  <owl:ObjectProperty rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#hasParent"/>
  <owl:ObjectProperty rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#hasSibling"/>
  <owl:Class rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#Person"/>
  <owl:Class rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#Daughter"/>
  <owl:Class rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#Mother"/>
  <owl:Class rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#Father"/>
  <owl:Class rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#Son"/>
  <owl:Class rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#Sister"/>
  <owl:Class rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#Brother"/>
  <owl:Class rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#HasChild"/>
  <owl:Class rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#HasParent"/>
  <owl:Class rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#HasGender"/>
  <owl:Class rdf:about="http://www.semanticweb.org/swathi/ontologies/2014/2/family-ontology-53#HasSibling"/>

</rdf:RDF>
```

This RDF file containing the ontology can be used by a number of programming language in their respective frameworks designed for the purpose.
Plugins for Development

**Turtle**
A Turtle document is used to exhibit the textual representation of the RDF graph. It does so by ensuring that the RDF graph is written in a proper text form along with abbreviations for data types and common usage patterns. It is extensively used as it compatible with N-Triples and also the triple pattern (subject, predicate, object) format of SPARQL. Once the ontology is created, it can be saved by selecting File -> Save as and could be saved in both the RDF/XML format and OWL/XML format.

**OWLviz**
Once the entities and the relationships between them are described using the ontology editor, the created ontology may be viewed by choosing the OWLviz tab. The ontology will be displayed in a tree structure with ‘Thing’ being the root node. Manual drawing of the ontology is also possible and this is achieved by selecting the Ontograf tab. Here the entity - class relationship may be shown as a tree structure elongating both downwards as well as breath wise.

**Jena**
Java utilized an open source semantic web framework called Jena. It is an Application Programming interface performs extract as well as writes to the RDF graphs.Fuseki which is a sub-project of Jena is the http interface to RDF data that supports both querying and updating in SPARQL. It is developed as a servlet.

**SPARQL Protocol and RDF Query Language (SPARQL)**
SPARQL tab allows the user to enter the query required to retrieve significant information from the created ontology. SPARQL is a query language for database that is responsible for retrieving and manipulating data stored in the Resource Description Format (RDF). The RDF data is considered as three columns in SPARQL relational database. They are Subject, Predicate and Object where the subject becomes the primary key, the predicate becomes the column and the object becomes the value in the cell.

**Activerdf**
Ruby programs use ACTIVERDF to access the RDF data and helps in the rapid creation of semantic web applications. ACTIVERDF provides a Domain Specific Language (DSL) through which the RDF classes, properties and resources could be accessed without any queries.

**4Suite 4RDF**
The 4Suite 4RDF is the framework designed for the Python language. It is an open-source platform for processing both XML and RDF files that are implemented in the Python language with C extensions.

**Conclusion**
Protégé symbolizes a knowledge acquisition system that indicates a set of concepts lying within a domain focusing on the relationship between them, their different types and properties. It acts as a platform where developers may be able to create and edit ontologies as they desire. Protégé imparts a domain-friendly environment where one can create knowledge models and also enter data. The model builders are permitted to define entities, specify properties and describe relationships between them in any given area of application. One can also present the definition of classes, assign class hierarchy variables and also bestow variable-value restrictions. The developer can also save lot of time for designing and developing ontology by using Protégé Editor.

**References**
A process is a program in execution. In UNIX Operating System, starting from booting only process creation takes place. At booting time, a special process called the "swapper" or "scheduler" is created. The scheduler in turn creates three child processes: 1) Process Dispatcher (init process) 2) vhand 3) bdflush with Process ID 1, 2, 3 respectively.

Fork is a system call which creates a child process. So, we have parent child relationship in UNIX. Parent and Child Processes can be identified by their process id. getpid system call gives process id of currently running process. getppid gives parent process id of currently running process. What happens when child process terminates before parent process? Since, parent process is running child process cannot be removed from process table. Such processes are called as zombie processes.

```c
#include<stdio.h> int main()
{
    int p;
    printf("Before executing fork (creating child process)...\n");
    p=fork(); if(p<0)
        printf("fork failed...
"); else if(p==0)
    // child process
    {
        printf("Child's Process ID = %d
",getpid());
        printf("Child Process terminates...\n\n");
    }
    else // parent process
    {
        printf("Parent's Process ID = %d
",getpid());
        printf("Parent Process before sleep...
\n");
        sleep(20);
        printf("Parent Process terminates...
\n");
        return 0;
    }
}
```

In the above program using fork system call child process has been created. If fork is unable to create child process then it returns `-1'. Execute this program as a background process (use &). If program name is zombie.c then first compile it (gcc zombie.c) and then execute it as a background process (/a.out &). Let’s assume that child process executes first. The output of the program is shown below.

Output:

Before executing fork (creating child process)... This is a child process...
Child's Process ID = 4357 Child's Parent Process ID = 4356
Child Process terminates...
This is a parent process...
Parent's Process ID = 4356 Parent's Parent Process ID = 2852
Parent Process before sleep...
Parent Process terminates...

Here, sleep command will put process in sleep mode for 20 seconds. Sleep is written so that child process always terminates first. By the time execute “ps -el” command on other terminal. As soon we execute this command it will print a process table with process id, state of process and all other process related information. If we find “Z” as a state of process for the process with process id = 4357 (which is child process id in our program), it is a zombie process.

So, Zombie Process is a process that is dead but has not been removed from process table. Such situations are typically handled with a special "reaper" process that locates zombies and retrieves their status.

About the Author

Mr. Swapnil M. Parikh [CSI-N1204403] is working as an Assistant Professor in CSE Department at Babaria Institute of Technology, BITS edu campus, Varnama, Vadodara. His area of research is Cloud Computing and Parallel Processing. He can be reached at swapnil.parikh@gmail.com.

Congratulations !!!

CSI Hony. Fellow, Dr. Achyuta Samanta has been elected as General President of Indian Science Congress Association for 2017-18. Dr. Samanta, who is a well-known educationist for setting up renowned institutions like KIIT University and KISS, is currently serving as a member of ISCA’s executive committee. Currently, around 25,000 students are studying in KIIT University where are around 25 programmes are being offered. Interestingly, at Kalinga Institute of Social Sciences, around 25,000 indigenous students are being given free residential education from KG to PG.
In a sensitive and important domain like national security and counter-terrorism, relationships like Call Detail Records (CDRs) or financial transfers can provide valuable insights in determination of association of surveillance targets. Determining links in a national security apparatus is time critical. A sustainable approach to link analysis which shuns existing, traditional relational database approaches such as MySQL for a more localized relationship based or graph-based approach using Neo4j is discussed here. The efficacy of which is confirmed by performance statistics which is found to be to be exponentially faster. Link analysis involves the study of the number and types of connections between nodes of any kind. Link analysis can be used to subsequently apply for models and predict various outliers or objects of interest from a large dataset.

With a low investment required in evasive technologies, it is becoming easier day by day for criminals, nefarious anti-social elements and both state and non-state actors to hide their activity from the view of regulating security agencies. These include activities spanning across various domains, such as illegal money transfers or money laundering and redirection and frauds in finance, geographical location and cross co-relation with relevant intelligence, surveillance data and linking of activities or targets to each other in social network analysis or intrusion detection in case of cyber-attacks or cyber forensics. With the aforementioned well-known, publicly available and rather easy to use tactics, criminals can hide most traces of their activity. If at all a link is left in plain sight, that link is subjected to intense real-time and forensic scrutiny. Since, links are few for any target of surveillance and when a link is indeed found, all possible links are then investigated for possible patterns or events considered to be harmful or potentially harmful, there is a need for analysis of all possible links emanating from a target of surveillance or a person of interest with minimal effort. In the context of intelligence gathering, this actionable intelligence must be treated with top priority until and unless action is taken regarding the input. This presents the unique, vast and insurmountable problem of providing a network link of all possible members of a global network, which is clearly not a computationally sustainable approach. A more sensible and hence, a sustainable approach is to perform a localized search for link analysis, with the query of the link originating from possible multiple sources and presenting the result as an intelligence input. A state of Uberveillance is proposed to perform interception and tracking given globally unique identifiers, but the transition to Uberveillance and querying huge amounts of data using a purely relational model on globally unique data becomes exponentially intensive.

A fast localized search of links through graphs and relationships instead of traditional relational approaches for querying to provide relevant links to a surveillance target during counter-terrorism operations through Neo4j has been presented here.

Relational Model Working and Pitfalls
In a relational database model, data is organized into table of rows and column. A key unique to each row is present. The placement between a tuple and an attribute in a relation is shown in Fig. 1.

The relational scheme suffers from inherent problems of scaling, where applications generate huge amount of data on a day to day basis. Additionally, when number of domains in link analysis increase, relational databases start becoming difficult to obtain results out of multiple join operations in a relational database. When multiple tables are queried, the relational database system becomes unresponsive. For a MySQL process allotted 1 GB of memory, a query using multiple join operations may end up in 2 hours, sometimes even more.

Another cause of concern is that in relational databases, a Cartesian product is first created through a join operation, following which any constraints are then applied on this Cartesian product to return the result. If there are multiple join tables with multiple relations spanning each join, the overall query becomes process intensive and as a result, a number of “join bombs” cause the application to crash.

Graph Databases Working and Functionality
Graph databases store and model data in the form of graphs, unlike relational databases. Each entity or node is related to each other through multiple relationships. Both entities and the relationships which are related can have properties.

The inherent advantage in any graph database compared to a relational database is the power of traversal in a graph. In a relational database, arrival at the result can only be obtained after first performing a Cartesian product of joins and then filtering relevant results based on constraints specified in the query. A graph database performs a traversal, which is the main reason behind its staggering performance. Irrespective of the number of node and relationships in a graph, the traversal will only visit the nodes that are connected to the starting node, which is a basic traversal requirement. A simple graph data set containing five types of nodes and 4 types of relationships is as...
shown in Fig. 2.

**Neo4j**

Neo4j\(^{[10]}\) is an open source, Java based graph database which implements high performance graph querying through multiple ways. It allows for programming graph-based applications through multiple languages using its Representational State Transfer (REST) API or the built-in Cypher Query Language (CQL), which is similar in syntax, structuring and functions to the popular Structured Query Language (SQL) used extensively in relational databases. More importantly, Neo4j is a fully ACID (Atomic, Consistent, Isolated and Durable) transactional database. The ACID transactional support ensures applications are guaranteed of commits as relational databases offer.

**Experimental Analysis and Results**

The experiment has been conducted in Neo4j version 2.1.7 and the results have been compared with respect to execution time of the query against MySQL version 5.5 with datasets having the same properties. To get an estimate of worst-case performance, the database caches were not warmed. The dataset used for the experiment was a randomly created social network with random persons named as friends. The same dataset was used for experimentation using both MySQL and Neo4j. The hardware environment used for experiment involved Windows 8.1 Operating system with 8 GB RAM and an Intel i5 processor. In CQL, the syntax of a node with creation of its relationship is as shown below:

```sql
CREATE (n: Person {name: 'Rama', id: 1});
CREATE (n)-[:friend]->(b);
```

Create tables named “users” and “friends_user”. Table named “users” contains people along with primary key which is represented in the social network. The table named “friends_user” contains two primary keys per tuple. Each primary key signifies friends which identify a particular person in the “users” table. It depicts that node ‘n’ is a “friend” of node ‘b’. For analysis and testing of the results, a social network is created. For link analysis i.e., to find friend of a friend and so on, depth of the node is considered. The number of distinct friends a node / entity has are returned and the execution times measured. The equivalent SQL query is as mentioned below:

```sql
SELECT COUNT (DISTINCT fu4.user2) FROM users, friends_user as fu1,
friends_user as fu2,
friends_user as fu3,
friends_user as fu4
WHERE users.name='person6801' AND users.id = fu1.user1 AND
fu1.user2 = fu2.user1 AND fu2.user2 = fu3.user1 AND fu3.user2 = fu4.user1;
```

The Neo4j equivalent of the CQL query is simple to understand and could be represented as follows:

```sql
START target=person (6801)
MATCH (target)-[:friend]->(a)-[:friend]->(b)-[:friend]->(c)-[:friend]->(d)
RETURN COUNT (DISTINCT) d;
```

The execution time for this query on link analysis for MySQL and Neo4j has been measured and recorded as shown in the Graph 1 and Graph 2.

Here, “break” in Graph 1 signifies that either the MySQL terminal crashed or was unable to complete the request in the hour that the script was allowed to run. The exponential difference in execution times for link analysis in Neo4j against MySQL is plotted in Graph 1. It is interesting to note that at depths of 2 and 3, the relational and graph schemes are almost on par. This is because the join tables in the relational scheme are not so complex and can be handled rather easily by MySQL’s internal indexing schemes. As soon as the depth of search increases, the Cartesian product overhead comes into play and outweighs the indexing through pure joins.

The execution times for Neo4j for hundred thousand nodes versus the depth of search of friends in the social network graph is shown in Graph 2. Unlike MySQL and its exponential progression, Neo4j allows for multiple depth searches with minimal linear progression in execution time. On the other hand, MySQL starts to break at sixty thousand nodes at a depth search of 4 onwards. The Cartesian product and subsequent dropping of over 95 percent of the Cartesian product rows to satisfy the “WHERE” clause causes an extreme computational overhead.
The break points for MySQL for sixty thousand nodes occur at depths of four and five and are depicted in green in Graph 3.

### Conclusion

In a time critical area of link analysis such as fraud detection, national security, cyber-attacks, forensics and counter-terrorism, timely results can be ensured by using a graph for storage of data for querying as purely relational data stores are ineffective and may also be prone to crashing because of their internal mechanisms of handling joins. A graph based database like Neo4j provides better performance in terms of link retrieval by orders of magnitude when scaled compared to existing systems like MySQL, thus proving to be the perfect fit for counter-terrorism link analysis across various domains such as telephony, geo-location and financial transactions.

Further integration of such domains across a network of known criminals for complete analysis through graph databases could be performed. It must also be noted that performance can be improved further if the caches were warmed multiple times for ensuring fast querying.

### References


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**About the Authors**

Dr. Rajashree Shettar [CSI - 11502598] is currently serving as Professor in Department of Computer Science, R. V. College of Engineering, Bengaluru. She received her M.S. degree in Software Systems from BITS, Pilani in the year 1999. She obtained Ph.D. degree for her research work on “Knowledge Discovery in Semi-structured Data”. Her research interest includes data mining and web mining. She can be reached at rajashreesettar@rvce.edu.in.

Mr. Mohit Shrivastava is currently a student in the Department of Computer Science and Engineering, R.V. College of Engineering, Bengaluru. His research interests include data-mining and artificial intelligence. He can be reached at mohitshri.cs11@rvce.edu.in.

Ms. Chaitra R. is currently a student in the Department of Computer Science and Engineering, R.V. College of Engineering, Bengaluru. Her research interests include algorithmic optimizations, operations research and project management. She can be reached at chaitra.r.hebbar@gmail.com.

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**Guest Editor - Dr. Vipin Tyagi**

Dr. Vipin Tyagi, Guest editor of CSI Communications, is working as faculty in Dept. of CSE at Jaypee University of Engg and Technology, Raghogarh, Guna (MP) India. He is Regional Vice President of Computer Society of India of Region 3. He is also associated with CSI Special Interest Group on Cyber Forensics. He has about 20 years of teaching and research experience. He is a senior life member of Computer Society of India. He was President of Engineering Sciences Section of the Indian Science Congress Association for the term 2010-11, and recorder for the term 2008 - 2010. He is a Life Fellow of the Institution of Electronics and Telecommunication Engineers. He is actively associated with professional societies like CSI, IETE, ISCA, Indian Society of Remote Sensing, IEEE etc. He was nominated by Indian National Science Academy (INSA), New Delhi under international collaboration to visit Czech Republic, for two weeks in May 2012. He has published more than 100 papers in various reputed journals, advanced research series and has attended several national and international conferences in India and abroad. He is Principal Investigator of research projects funded by DRDO, MP Council of Science and Technology and CSI. He is serving CSI Communications as Guest Editor since May 2015 issue.

He is an expert in the area of Cyber Security, Cyber Forensics and Image Processing. He can be reached at drvipin.tyagi@gmail.com
Crossword »

Test your knowledge on Computer Networks

Solution to the crossword with name of first all correct solution provider(s) will appear in the next issue. Send your answer to CSI Communications at email address csic@csi-india.org and cc to drdurgeshmishra@gmail.com with subject: Crossword Solution – CSIC February Issue.

Internet of Everything (IoE)

Amidst the evolvement of the Internet of Things (IoT), networking giant CISCO started working on the Internet of Everything (IoE). According to CISCO, “The Internet of Everything (IoE) is a global industry phenomenon, which brings together people, processes, data, and things to make networked connections more relevant and valuable than ever before.” To achieve value in IoE, CISCO recommends companies:

Move from…..

To……

Bigger is better  Better is better
Clout  Cloud
Access to information  Expertise everywhere
Big data  Big judgment
Business intelligence  Intelligence at the point of decision
Connectivity  Connectedness

Rashid Sheikh
Associate Professor, Sri Aurobindo Institute of Technology Indore

We are overwhelmed by the response and solutions received from our enthusiastic readers

Congratulations!

All Correct answers to January 2016 month’s crossword received from the following reader:

Umamahep Pemmaraju  Senior Manager-Compliance, Value Momentum Software Services Pvt. Ltd. Hyderabad
Honorary Fellow Award

Shri J. S. Deepak

J. S. Deepak is an Indian Administrative Service (IAS) officer of 1982 batch of UP cadre. He is an MBA from IIM, Ahmedabad. He has rich experience of working in Government of India, especially in economic Ministries. He worked as Joint Secretary and Additional Secretary in the Department of Commerce for the last 5 years. As Additional Secretary, Department of Commerce, Government of India, he looked after the work related to formulation and implementation of India’s trade policy. He was also India’s Chief Negotiator at the WTO for the Regional Comprehensive Economic Partnership (RCEP) agreement; the mega FTA being negotiated by 16 countries and the India-EU FTA. He was also responsible for the promotion of export of various services from India.

Deepak has also served as Joint Secretary, Telecom from April, 2008 to July, 2010 when he designed and conducted the 3G/4G spectrum auctions which fetched the Government huge revenue of Rs. 1,06,260 crore (US$ 24.5 billion).

This was a pioneering exercise where spectrum was auctioned in India for the first time and an e-auction of such magnitude was conducted through a fair and transparent process leading to an expansion of voice and data services.

This has become a model for subsequent auctions in different sectors.

Deepak has also served as Chairman & Managing Director of State Trading Corporation (STC) of India and has been a Member of the Board of Directors of Bharat Sanchar Nigam Limited (BSNL), Mahanagar Telephone Nigam Limited (MTNL) and India Trade Promotion Organization (ITPO). Presently he is on the Board of Indian Institute of Foreign Trade (IIFT) and is a member of the Central Governing Council of the Institute of Chartered Accountants of India (ICAI)

He has been invited to lecture on subjects related to management, trade, telecom and communication at the Indian Institute Management (IIM), Ahmedabad & Lucknow, National Academy of Administration (LBSNAA), Mussoorie and Institute of Corporate Affairs (IICA), Delhi.

He has been editor of various newsletters and a number of his ‘middles’ and articles on development issues have been published in newspapers including in the editorial column of the Times of India.

The Computer Society of India (CSI) solemnly recognizes the profound contributions of Shri J. S. Deepak & his services in proliferation of IT related activities in India and for his exemplary accomplishments in making the country digitally ready and has decided to confer upon him as the HONORARY FELLOW of the society.

The Computer Society of India also has great pleasure and humble pride in presenting this citation to Shri J. S. Deepak on the occasion of its Golden Jubilee Annual Convention held at New Delhi on 02 December, 2015.

Fellow Awards

Prof. Akshaya Kumar Nayak

Prof. (Dr.) Akshaya Kumar Nayak, M.Sc., PGDCA and PhD in Computer Science is working as the Director of Indian Institute of Business Management, Patna and having 31 years of experience in teaching, training, research and administration in the field of computer science & Information Technology. Prof Nayak initiated for the first time, the Post Graduate Programme in Computer Science, in the year 1984 and Diploma Programme in Computer Application exclusively for women candidate in the year 1986 in the state of undivided Bihar. He is credited for his significant contribution in establishment of first Software Technology Park Unit at Patna under Ministry of IT in the year 1999 in Bihar and first Microsoft IT academy in India in the year 2002. As a pioneer personality in the area of Computer and IT he was instrumental in initiation of computer science programme for school teacher, Govt. officials and other organizations in the year 1984 with the financial support from Department of Electronics, Govt of India. Under his guidance the Dept. of Electronics, Govt of India established the National Centre for Instructional Material Development “at IIBM” under Information Technology awareness programme in the year 1985.

Prof. Nayak is the senior life member of Computer Society of India and was the founder secretary of CSI Patna Chapter in the year 1986. Later on he served CSI as the Chairman Patna Chapter, Chairman (Data Security), Chairman (Applications), four time member of National Nomination Committee and Chairman of National NC in the year 2011-12. He was also nominated as TC Member of System Modeling and Architecture to the International Federation of Information Processing (IFIP) Viena, Austria. He also organized in different capacity the Regional, Divisional and National seminars, conferences and convention at several locations of the country. He has also worked as the member of various statutory committee of CSI from time to time.

Prof. Nayak is the life member of 22 Professional and Technical Societies and worked as president of ICT section of Indian Science Congress Association, Chairman of Bihar – Jharkhand section of Indian Society for Technical Education. He worked as the Zonal Coordinator of National Institute of Electronics and Information Technology, Govt. of India for several year and expert member in DST Govt. of India CEDITI Govt. of India, Banking Services Recruitment Board and other Board and Corporations particularly concerning to IT related activities. Prof. Nayak is a prolific writer on Computer & IT and published 124 technical articles and research papers in prominent magazine and journals authored 12 books on Computer Science and Information Technology out of which 3 books were recommended by the Govt. of Bihar as the text book for intermediate students of Bihar. He has also edited several proceedings of IT related conferences and published 3 news letters. Prof. Nayak is also...
professor and consultant to many organizations, Member of Board of Studies, Research Committee & Governing Council of many Universities and Institutes and External evaluator and / or visiting faculty to more than 35 universities & Institutes of national & international repute at bachelor, Master, M.Phil & Ph.D level as well as member of Board of Studies of many universities of the country. Prof. Nayak is Fellow of united writers association, international society for research & Development, UK, management studies & Promotion institute & national association of computer educators & trainers. His biography is found in several National and International Directories and he has received many International, National and state level awards for his significant contribution in the field of Information & Communication Technology.

In grateful recognition of his services to the Computer society of India (CSI), and his outstanding accomplishments as an IT professional, the CSI has decided to name him fellow of the society. The society takes pride and pleasure in presenting him with this citation on the occasion of its Golden Jubilee Annual Convention held at New Delhi on 02 December, 2015.

Prof. Dr. (Mrs). K. Meena

Prof. Dr. (Mrs.) K. Meena has more than two and a half decades of rich experience, in academics and administration. She has served as first woman Vice Chancellor of Bharathidasan University, Tiruchirappalli. She is an M.Sc., M.Phil in Physics of Bharathidasan University, Tiruchirappalli (with I rank with gold medal in M.Sc.) and an M.E., and Ph.D., in Computer Science & Engineering degree holder of Anna University, Chennai. She has produced 11 Ph.Ds and 62 M.Phils and 2 are pursuing Ph.D., under her guidance.

She formed the CSI Women’s Student Branch at Shrimati Indira Gandhi College, Tiruchirappalli, as a principal of the college, instrumental to a larger extent in founding the Internet Users’ Club of Trichy (IUCT) and bringing Internet Facility to Trichy in the year 1998. She is the life member of computer society of India (CSI). During her tenure as Vice Chairman (1996-1998) & Chairman (2000-2002) of Trichy chapter, she had made significant voluntary contributions to the growth of Information Technology by way of conducting seminars, workshops, conferences and computer oriented training programmes to various sectors in the society such as doctors, lawyers, police officials, headmasters/headmistresses, Adi Dravida Welfare school teachers, BT assistants of high & high secondary schools, district administrators, CHEERS special school children, tour on internet for housewives, self-help group women etc., and also especially to the student community. Linking computer literacy - eye opener camp was conducted for self-help group animators, representatives and promoters of inclusive education for disabled children (IED) and releasing of CD-ROM on entrepreneurship is the unique achievement. Till date she continues to contribute for the development of the society significantly. She has organized more than 200 seminars / workshops / symposia / training and awareness programmes in computer, Internet, IT and ICT to reach the unreached.

She is an expert in developing multi-purpose software tools - soft voice, soft touch, mathematical dyscalculia, residual vision, autism, skill soft and down syndrome for differently abled special children and distributed them at free of cost to many organizations and individuals in India and abroad. Around 3000 special children and organizations are benefitted. She has donated computer systems and accessories to special schools and distributed computer literacy books to the children.

A novel project IT on wheels-lab to Land was launched to create awareness about the most powerful tool of the knowledge era, the computer, to the poorest of the poor living in remote areas far away from towns and cities to their door steps to the school children and self help group women. Establishment of skill oriented training Centre for women at Sevai rural technology Centre, Sirugamani village and Arumbugal Nagar in Trichy enables opportunity for women in rural areas to under go vocational training, data entry operations, desktop publishing and basic computer training etc., to them.

She has published / presented 146 papers / research articles in national and international journals / conferences and published 8 books in the field of Computer Science, Information Technology & Applications. She has delivered invited talks and chaired various sessions at national and international conferences. She has delivered invited lectures in abroad also.

As a Vice Chancellor of Bharathidasan university, she was instrumental in establishing centres / cells / facilities to enhance digital learning through e - resources like Centre for knowledge repository, Centre for differently abled, empowerment centre for differently abled persons, digital talking library, incubation and technology transfer centre, Research Consortium of computer science and NPTEL channel to empower the differently abled in education, employment and entrepreneurship development, to cater the academic and research needs of students and faculty members and to enhance the quality of education.

She is the recipient of several international, national and state awards like gavoty France award, national award for empowerment of persons with disabilities, Young women Scientist award, TANSA award, best teacher award, best social worker award, Young women achiever award - dinamalar, Trinity mirror life time achievement award, Woman Edupreneur award 2015-ICT Academy of Tamil Nadu and SPEEK@CON knowledge connectivy kalam award - Tamilnadu board of continuing education.

In a nutshell, her life is packed with action. She constantly engages herself in CSI activities. She has incredible impact on students, rural women, CHEERS children, various weaker sections of society, by virtue of her Scholarship and innovation in providing Computer Education and Training. She deserves the conferment of CSI FELLOWSHIP AWARD.

In grateful recognition of her services to the computer society of India (CSI), and her outstanding accomplishments as an IT professional, the CSI has decided to name her fellow of the society. The society takes pride and pleasure in presenting her with this citation on the occasion of its Golden Jubilee Annual Convention held at New Delhi on 02 December, 2015.
Shri Sanjeev Kumar, a senior life member is associated with Computer Society of India for the last over 28 years. He has made his contribution in different capacities as a member of Managing Committee of Ranchi Chapter since 1990 and at national level as Regional Vice president of Region-IV and also as Chairman of Nomination Committee.


While working in Public Sector Organisations, his relentless efforts to popularize use of IT in varied functions and processes like HR, Finance, Materials Management embodies his passion to get aligned with the basic motto of CSI. He has made very remarkable contribution in the area of spreading Computer literacy, providing exposure to computers to Rural students since early 1990 and popularizing the developments in the field of ITC through Quiz Programs at School level.

Selected twice by CSI to participate in the training program of Centre for International Co-operation for Computerisation (CICC), Japan in 1994 and 1999, Shri Kumar brought laurels to the nation by getting the “Award of Excellence” by CICC, Japan in the year 1994.

Recognising his unique blend of competence both in the area of ISO 9001 Quality Management System as well as use of IT in education, he was entrusted by Asian Productivity Organisation (APO), Japan to design, develop and implement Web based Training module for ISO 9001 QMS in the year 2003. The project was a stupendous success with 20 participants from 9 different countries attending the program. This was the pioneering web based training started by APO, Japan.

Shri Kumar is associated with NIELIT (earlier DOEACC Society), an autonomous body under Department of Communication & Information Technology, Govt. of India, since its inception. He is empanelled as an expert for accreditation of Institutions for “O” and “A” level as well as responsible for organizing examinations at Ranchi centre in Jharkhand, which is one of the primary centres. CSI did the hand holding for this scheme when it was started in 1994.

His contribution to promote the cause of CSI is praise-worthy: be it spreading and popularizing computer literacy; enhancing the image of CSI through professionally organized international seminars in the area of Networking, Information System, Automation etc.; attracting professionals to become part of CSI through its’ membership or his exemplary ways to enhance discipline and conduct while serving in ExecCom and Nomination Committee.

In grateful recognition of his services to the Computer Society of India (CSI), and his outstanding accomplishments as an IT professional, the CSI has decided to name him FELLOW of the society. The society takes pride and pleasure in presenting him with this citation on the occasion of its Golden Jubilee Annual Convention held at New Delhi on 02 December, 2015.

Sri Parthasarathy holds a Masters Degree in Mathematics specializing in Statistics from University of Madras in 1959; has undergone a one year course from Indian Statistical Institute specializing in SQC and was a Statistician with the Govt of Madras for 5 years. He received Mainframe computer training from ICL and IBM in 1964 and 1968. He is a pioneer in the field of Information Technology, having taken to computers as a career almost from the beginning of the computer era in India. Joining DCM in 1964 as computer Programmer, held various positions in it and became the head of the computer dept.. He was responsible for computerization of Projects on Production, Inventory Control, OR, Marketing & Sales information, Financial & Cost Accounting and other MIS for the company. He has his credit two papers on important applications presented in CSI Conventions in 1972 and 1976.

His association with CSI was from the birth of CSI, since DCM was one of the 7 organisations which formed All India Computer User Group in 1964 and later named as Computer Society of India. Was one of nominated institutional member of DCM. He is a Founder member of Delhi Chapter formed in 1970 and held various offices of the chapter. Among other activities, as a Major initiative, conducted a computer programme for three months for nearly 100 officers of the Controller General of Accounts, Min. of Fin, GOI. He was the Co-Editor of the CSI HQ News letter, forerunner to CSI Comms, being published from Delhi during 1971-78. Organised a IBM computer equipments users group under the aegis of CSI to sort out the issues arising out of winding up of IBM operations in India and the setting up of the CMC by DOE. Took active roles in the CSI conventions held in Delhi (1973,85,91) as member in the OC, PC, Publ.Cs Arranged for proper conduct of SEARCC-CSI School Programming contests held in Delhi during 1991-94 Preserved a lot of records of the CSI activities, CSI HQ Newsletters, CSI comms, etc from 1969 to 2000 and passed on these to CSI in 2007 to help in the creation of a Digital Archive . Is a Senior Life Member from 1992. Presently attached to Bangalore Chapter. Takes active roles in its activities/programmes/meetings as needed.

His most significant and well known contribution to the Information Technology field was implementation of the landmark DOEACC Scheme of the GOI entrusted to CSI during 1990-1994. He coordinated in an admirable manner with the Directorate of Education, CSI for the smooth conduct of the DOEACC ‘O’ & ‘A’ levels examinations in all parts of the country till 1994, when DOEACC Society was
Shri Gautam Mahapatra is a Distinguished Graduate of Indian School of Mines (ISM), Dhanbad (presently IIT Dhanbad) in the year 1991. In the same year he was Awarded ‘President Gold Medal’, ‘Best Student Award of the Institute’, and ‘University Blue’ for his Excellence in Academics, Sports, CO-Curricular Activities; and demonstrating high degree of Moral and Righteousness. In 1992, he secured first rank in All India CSIR Examination and received CSIR Fellowship. A brilliant scholar and researcher, whose seminal project work brought him Dr. Hari Narin Medal by MGGI at very young age. With distinction, he completed MBA in System & Technology Management from BIM & ITM in the year 2002.

Shri Gautam Mahapatra is having 25+ years of Research and Project Implementation experience in the field of IT and Computer Science in Defence R&D organization. Presently as a Scientist-G (DRDO), he is leading the all IT initiatives of Research Centre Imaarat (RCI), a premier National R&D Laboratory of DRDO. During his illustrious career spanning nearly three decades he has worked as Technology Director IT. He led the design, development and implementation of Enterprise class IT Systems and Applications for IT Enablement of R&D Processes. He is steering the Vision of Digital DRDO for IT Enablement of R&D Organization. He brought completely new dimension to the Defence R&D by implementing Enterprise class IT Applications along with ERP, PLM, e-Governance, e-Procurement, e-Imports, e-Analytics &DSS, which have been running successfully. These Enterprise class Application Platforms developed under his technical leadership. This is the First and Only Comprehensive platform in India which is suitable for large R&D Organisation and were as a benchmark the same is in process of roll out to pan India to all 50+ DRDO labs and to its Eco System like CDA and Production agencies etc. In one hand, this platform enables Engineers, Developers and Scientists for collaborative product development in mission mode, integrate & synchronize support & logistic functions and, on the other hand it also enables Corporation to improve the productivity, efficiency and quality. This has facilitated DRDO for faster realization of Defence Research Projects in the line of ‘Make In India’ Programme. This platform has pass through CAG audit and received many Awards like ‘PSU Summit eGov Award 2014’, ‘PSU Summit ERP Implementation Award 2015’, ‘CSI Nihilent e-Governance Awards 2015’, ‘Technology Leadership Award’ etc.

His devoted, long standing and sustained contribution in the field of IT lead to the establishment of Fault Tolerant Computing Facility, Data Centre, Secured gigabit Corporate Network, IT Command Centre, ITIL Compliant IT Help Desk, Defence in Depth IT Security framework which are presently operational for 24x7 and it is the Nerve Centre of Defence Computing. He introduced Mobility (BYOD) and VDI (Virtual Desktop Infrastructure) for delivering enterprise applications. His vision and innovation led to IT for masses.

Shri Gautam Mahapatra, a dedicated community volunteer who has generously given his time and expertise and led from the front to organize CSI Golden Jubilee Convention & International Conference 2014 as Chairman CSI, Hyderabad Chapter. Took the lead role to organize the Mega IT Events- Golden Jubilee Convention, International Conference, E-Governance Summit and Annual Student Convention 2014. With his efficient and dedicated leadership, he brought many Luminaries, Experts, and Decision makers from various sectors during the Golden Jubilee Celebration and provided a common platform for deliberation, discussion and knowledge sharing.

An outstanding Institution builder, Shri Gautam Mahapatra, singlehandedly formed IT Industry Consortium to facilitate CSI for its all-round growth. He leveraged his network and influence to organise funding for Renovation, Refurbishment and IT Enablement of CSI Hyderabad Chapter to make it a World Class Collaboration, Learning and Incubation Centre. Through consortium partners, he introduced internship for CSI students in IT companies of International repute.

With his innovative pursuits, he initiated advanced IT research projects with IITs, IISc, NITs, and other Premier Institutes and R&D organizations globally. Shri Gautam Mahapatra is also Member of various Research Societies including Cryptology Research Society of India (CRSI), Project Management Institute (PMI, USA), Sensors Research Society, Aeronautical Society of India, Glaciological Society of India, and Geophysical Society of India. He is also Board Member of JNTU Hyderabad and LASSIB Society (Lean Six Sigma International Board). As a Member of various Committees/Boards of DRDO, other R&D and Academic Institutes, he played an effective role in evolving several IT Policies and Systems.

A compassionate humanitarian, Shri Gautam Mahapatra is also actively associated with various spiritual organisations for spiritual upliftmen of the Society.

In grateful recognition of his services to the Computer Society of India (CSI), and his outstanding accomplishments as an IT professional, the CSI has decided to name him FELLOW of the society. The society takes pride and pleasure in presenting him with this citation on the occasion of its Golden Jubilee Annual Convention held at New Delhi on 02 December, 2015.

He joined the faculty of Electrical Engineering at IIT, Delhi in 1973 where he became a Professor in 1986. At IIT Delhi, he was instrumental in establishing the first industrially sponsored initiative, viz. Bharti School of Telecommunication Technology and Management, as its founding coordinator (Head). He had been the Head of the Department and the Dean (UGS) at IIT, Delhi. Prof. Gupta has a wide international exposure. He held faculty appointments at McGill University, Montreal, Canada, Drexel University, Philadelphia, USA. He has been Visiting Professor at University of Maryland, College Park, USA, Massachusetts Institute of Technology, Cambridge, USA, Swiss Federal Institute of Technology (EPFL), Laussanne, Switzerland, Helsinki University of Technology, Helsinki, Finland and many European universities. He published close to 170 technical papers in reputed international and national journals and conferences. He successfully completed several sponsored R&D Projects and was consultant to several Government and private sector organizations such as Power Grid Corporation, TCIL, DRDO.

Prof. Gupta has been a Senior Member of the CSI for the last two decades. He has represented the CSI in TC 6 (Communication Systems) and TC 13 (Entertainment Computing) of the International Federation for Information Processing (IFIP). He was Chairman, Data Communication Division during 1999-2001. He has organized CSI Seminars at Delhi and has chaired several technical sessions in CSI Seminars and Conferences, including CSI Convention.


In grateful recognition of his services to the Computer Society of India (CSI), and his outstanding accomplishments as an IT professional, the CSI has decided to name him FELLOW of the society. The society takes pride and pleasure in presenting nd him with this citation on the occasion of its Golden Jubilee Annual Convention held at New Delhi on 02 December, 2015.

Prof. Dharanipragada Janakiram obtained his M.Tech and Ph.D degrees from IIT, Delhi. He is currently a senior professor in the Department of Computer Science and Engineering, Indian Institute of Technology (IIT) Madras, India, where he heads and coordinates the research activities of the Distributed and Object Systems Lab. His current research work is on building large scale distributed systems focusing on cloud computing and big data, database systems and software engineering. He is currently the SIG Chair of Distributed Computing of Computer Society of India and also the founder of the Forum for Promotion of Object Technology in India. He was the program chair for the CSI annual convention held in Mumbai in 2004 and for the CSI conference on Management of Data (COMAD) held in 1997. He was also the General Chair of the CSI conference “Indian Software Engineering Conference (ISEC)” held in 2014.

He is instrumental in setting up the Yahoo Grid Lab in the Department of Computer Science and Engineering, IIT, Madras for carrying out cloud computing and big data research. He has architected the Minimalistic Object Oriented Linux (MOOL) kernel, a research effort that took nearly 10 years. MOOL kernel is known to be the only kernel to support C++ device drivers for Linux kernel. MOOL kernel is now integrated with Bharat Operating System Solutions (BOSS) of CDAC and it is distributed as BOSS MOOL. The distribution is widely available including on Fujitsu devices. Several universities including JNTU, Kakinada, JNTU Anantapur, NIT Trichy, Bharat University and Vels Tech University have signed agreements for use of BOSS MOOL operating system. He has organized along with CSI Education directorate several workshops on BOSS MOOL in various colleges. He is also involved in offering NPTEL Database Design course for certification as MOOCs course, which is enrolled by a few thousand students.

Prof. Janakiram was awarded the Boyscast Fellowship in 1997. He was awarded the IBM Faculty Award in 2007 and Yahoo Faculty Grant in 2009. He has guided 15 Ph.D. students. He served as member on the Board of Studies of JNTU, Hyderabad, JNTU, Kakinada, Andhra University, JNTU Anantapur, and Cochin University and on the Board of Research of Anna University. He has authored over a hundred research papers and edited six books. His books on “Grid Computing” and “Building Large Scale Software Systems” have been brought out by Tata McGraw Hill Publishers.

He is the principal investigator for a number of projects which include the “MobiTel: Mobile Telemedicine for rural India” (Indo-German Project), Peer-to-peer Concept Search (Indo-Italian Collaborative project), Service Oriented Architecture for Linux Kernel (DIT, Government of India) and Cloud Bursting Architecture for Document workflow (Xerox, USA). He is also the founding chair of the ACM Chennai chapter. He is on the board of directors for a few start-up companies in developing products in the area of cloud computing and IOT technologies. He is the Associate Editor of the IEEE Transactions on Cloud Computing and the CSI Journal of Computing.

In grateful recognition of his services to the Computer Society of India (CSI), and his outstanding accomplishments as an IT professional, the CSI has decided to name him FELLOW of the society. The society takes pride and pleasure in presenting him with this citation on the occasion of its Golden Jubilee Annual Convention held at New Delhi on 02 December, 2015.
CSI Madhya Pradesh State Student Convention

CSI Madhya Pradesh State Student Convention was organized by Department of Computer Science & Applications and CSI Student Branch, ITM University, Gwalior during 22nd - 23rd January 2016. The convention witnessed presence of more than 200 participants that included experts and speakers of repute.

During the welcome address Dr. Sanjay Jain, MP state Student Coordinator - CSI, highlighted importance of Convention and its benefits. Prof. Vandana Kushwah, Hon'ble Vice Chancellor, ITM University Gwalior addressed the audience. Prof. Vinip Tyagi, Vice President, Region III, CSI, delivered his expert talk. Dr. R. D. Gupta, Advisor to Chancellor discussed how digital India concept is growing day by day with some real life examples. Shri Jayant Bhide, Chairman, CSI addressed the audience with his impressive speech. Dr. R. S. Jadon, Chief Guest delivered his keynote address on Digital India.

There were 10 different competitions in this Convention namely Logo / Slogan Design, PPT Design & Presentation, Quiz – O Mania, Blind Coding, Code Fight, Debugging, Comic Strip Designing, Project Presentation, Web Designing and Poster making.

Shri Sanjay Pandey, Director - NIC, Gwalior delivered an expert Workshop on Digital India. He explored various dimensions of Digital India theme and Project. He discussed about Digital Signature and its Challenges, Digital Locker and many more interesting topics. Certificates and Cash Prizes were distributed for Competition winners and participants. Dr. Kapil Govil, Organizing Chair delivered the vote of thanks. He honored Shri Sanjay Pandey with a memento of event.

CSI Andhra Pradesh State Student Convention

The Department of CSE, Gayatri Vidya Parishad School of Engineering, Rushikonda Campus has organized a two day CSI State Level Student Convention-2K16. The event was inaugurated by the Chief Guest of the function, Prof. P. S. Avadhani, Vice Principal, AUC College of Engineering and Chairman, CSI Visakhapatnam Chapter in the Central Auditorium at 10.00AM. Dr. Suresh Chandra Satapathy, Prof & HOD, ANITS and Chairperson, Division-V (Education and Research) CSI, graced the occasion as Guest of Honor. The guests addressed the students on Development of Entrepreneur skills, Programming skills, Communication skills and motivated the students to benefit from the expertise of the professional bodies like CSI to prepare for a career in the real world. Principal, Prof. S. K. V. Suryanarayana Raju, Director, Prof. A. Ramakrishna, and Prof. D. Saritha, CSI SBC-Coordinator, of the Institution addressed the students during the inaugural function. 250 Students from different colleges have registered for the 8 events namely, Paper presentation, Workshops (Network Protocols and Red Hat Linux Basics), Code Debugging competition, App Development Competition, and three non-technical gaming events.

Opening of CSI Student Branch at MMCOE, Pune

CSI Student Branch was inaugurated in Marathwada Mitra Mandai’s College Of Engineering, Pune on Wednesday 6 January 2016 by Mr. Anand Paropkari, Vice Chairman – CSI, Pune and Prof. B. M. Patil, State student coordinator of CSI, Maharashtra. During the welcome address, Prof. Harmeeet Khanuja, HOD, Computer Department, MMCOE briefly highlighted departmental activities and its progress. Prof. Dr. S.M. Deshpande, Hon’ble Principal, MMCOE addressed the audience. He encouraged the students to actively participate in workshops and Trainings organized under CSI. Prof. R.V. Dagade, Student Branch counselor of CSI, officially announced 275 registered students as CSI student volunteers. He further nominated Ms. Gautami Jagtap as President, Mr. Pushkar Bhalerao as Vice President, Ms. Supriya Gupte as Secretary, Ms. Payal Andekar as Joint Secretary and Mr. Mahesh Deshmukh as Treasurer for CSI Student Chapter. Prof. B. M. Patil informed that various competitions organized by CSI are best place for students to showcase their technical talents. On the similar lines, Chief Guest Mr. Anand Paropkari discussed technological advances adopted by young generation. He emphasized on setting goal of life in early age. The event witnessed presence of 120 students along with all faculty members.

CSI Patna Chapter

A Seminar on Digital India: Opportunities & Challenges was organized by CSI Patna chapter at Gaya College Gaya, Bihar on 19th January 2016. The key note address was delivered by Prof. A.K. Nayak, Director, IIBM Patna and Chairman, Publication Committee CSI. In his key note address Prof. Nayak highlighted about the scope, objective, vision and utility of Digital India Mission. He discussed about the different components of the mission like Broad band highway, Telecommunication services for all, easy internet access, e-governance, e-karnti, information for all, electronics production, IT for jobs and early harvest programme etc.

On this occasion Prof. Subhas Yadav, former president of ICT section of Indian Science Congress Association spoke about the massive job opportunities to be created due to the Digital India Mission. He has also advised the students to update themselves with the emerging computing technologies in the year to come. The seminar was presided over by Prof. R.K.P. Yadav, Prof. & Head, Dept. of Mathematics & Computer Science of Gaya College, Gaya, Bihar.
Dehradun Chapter

CSI Dehradun, organized a one day workshop in Vivekanand College of Management and Technology Gaulapar Haldwani on 09/01/2016, in Association with Spoken Tutorial I.I.T, Mumbai. The main theme of the workshop was “Technology Enabled Science Education”.

After the Lamp Lighting ceremony, the inauguration speech by Dr. Ashutosh Bhatt revealed various important aspects of the technology based Education.

This programme was well conducted by Dr. B. B Pandey, Principal, Vivekanand college. Director of USERC Prof. Durgesh Pant addressed the students through Skype and stressed that a Knowledge corridor in the state will be developed. He also informed about the innumerable efforts of honorable Dr. Smt. Indira Hridyesh ji in this direction. Sri Abhay Sharma from Birla Institute of Applied science Bhimtal informed students about the relevant features of the technical education in India and also stressed its need in the field of overall employment.

Finally, chairman of the Institute Sh. Ashok Singh Basehra, Sh. Yogesh Tewari, Sh. Rajeev Garg, Mr. Mukesh Suyal, Dr. B.B. Pandey, Principal of V.C.M.T., Dr. Ashutosh Bhatt, Mr. Abhay Sharma and Mr. Kamlesh Padaliya awarded prizes and certificates to the students. In the valedictory speech of the workshop the chairman of the V.C.M.T. Institute wished for the bright future of the students and declared that the institute will soon take up the hands-on training programme of spoken tutorial IIT Mumbai.

Delhi Chapter

CSI Delhi Chapter organised an Evening Technical Talk (Under Digital India Programme) on the theme “Computerization of Traffic Management” in Delhi on Friday the 8th January, 2016 at 6.00 PM. The talk was delivered by Dr. Muktesh Chander, Special Commissioner of Police, Traffic Police Delhi.

Shri Yudhishter Sharma, Chairman, Delhi Chapter welcomed the Hon. Speaker and the audience. He showed his gratitude to the Speaker for his presence on the day and accepting to deliver his talk.

Honorable Speaker very well explained traffic management system in Delhi through computer networking and CCTV. At the end Shri Pradeep Aneja, Vice Chairman cum Chairman elect presented Vote of Thanks.

Mumbai Chapter

CSI Mumbai chapter organised its Annual Technology Conference in association with Department of Physics, University of Mumbai, on “IT Challenges for Smart India” at Green Technology Auditorium, University of Mumbai, Kalina Campus on Jan 21, 22nd 2016.

The key highlight of the conference was felicitation of Dr. F. C. Kohli – Founder of CSI and founder CEO of TCS. Dr. Kohli was awarded shawl, coconut and citation note as per tradition, by Prof. Dr. Sureshchandra J. Gupta: Chairman of CSI Mumbai Chapter. Dr. F. C. Kohli addressed the audience as well as took questions from audience. His main point of discussion was computing should be promoted to become useful for broader audience including non English speaking people.

The conference inauguration started with Address by Guest of Honour Dr. Sanjay Deshmukh Vice Chancellor of University of Mumbai where he stressed on initiative taken by University in area of skill development which will fulfil the vision of Smart India. He also shared other initiatives taken by university in area of eLearning, smart classrooms etc. This was followed by address of Shri. J. Satyanarayana Former IT Secretary of Govt of India and Advisor to Govt of Andhra Pradesh. Dr. Smt. Anuradha Mishra, HOD of Physics, University of Mumbai. Second day was started by address by Dr. Pallab Saha, Chief Enterprise Architect, Govt at Wipro followed by keynote by Ms. Ranjana Narawane MD Accenture and Mr. Nitin Savant Lead of Advance technology and Architecture. Both the topics of discussion were Smart Cities.
The general technology sessions were on topics Financial Inclusion, IT 4 IT, Security and Smart Cities. The invited talks were on following topics : 1) Rural Banking and Priority Sector by Mr. Manoj Rawat, RBL Bank 2) IT4IT by Ms. Lakshmi Malhotra, Accenture and Mr. Sukumar Daniel, Action Research Foundation both were representing Open Group besides there organisations. 3) Cyber Security by Adv Rohas Nagpal, Mr. K K Mookhey and Adv Prashant Mali 4) Car Hacking Demo by Rohan Patil of Vista Infosec 5) Business Opportunity for the security industry : Ms. See Lay Eng MP International, Singapore 6) Smart Cities discussion by Mr. Lux Rao, CTO of HPE and by Ms. Sanjivani Rungta of Cisco. There were sponsored sessions by Accenture, NxtGen Datacenter, Fortinet, Contact Singapore, The Open Group and Vodafone. Apart from speaker slots the sponsors had booths where they could interact with delegates and present their offerings.

Trivandrum Chapter

In connection with the Golden Jubilee Celebrations, CSI Trivandrum Chapter has instituted CSI Golden Jubilee e-Governance Awards Kerala during the year 2015. The Award Distribution Ceremony was held on 25th November 2015 at 5:00 pm at Vivanta By Taj, Thiruvananthapuram. Shri Ramesh Chennithala, Hon’ble Minister for Home and Vigilance, Government of Kerala inaugurated the Golden Jubilee Celebrations and the e-Governance Award.

Distribution ceremony. Shri P. H. Kurian IAS, Principal Secretary, IT Department, Government of Kerala delivered the keynote address and special address by Mr. G. C. Gopala Pillai, Managing Director, KINFRA. Mr. Satish Babu, Chairman Award Jury, declared the award results. Mr. Krishnamurty, Chairman, Valiant Technologies, UAE and Mr. Mohammed Y Safiulla IAS, Director, Kerala State IT Mission delivered the felicitation speech. Earlier Mr. Sreekanth P. Krishnan, Chairman, CSI Trivandrum Chapter delivered the welcome speech and Mr. Vishnu Kumar S, Secretary CSI Trivandrum Chapter proposed the Vote of Thanks. During the ceremony CSI Trivandrum Chapter Golden Jubilee Souvenir was released. Chapter honored the veterans of CSI Trivandrum Chapter during the function.

Following awards were distributed during the ceremony.

1. **CSI-Valiant e-Governance Award**: Thulasi - One Time Registration for Candidates by Kerala Public Service Commission, Govt. of Kerala

2. **CSI-Valiant Runner-up Award**: e-T reasury by Department of Treasuries, Govt. of Kerala

3. **CSI-Valiant e-Governance Sustenance Award**: e-T ransport by Motor Vehicles Department, Govt. of Kerala

4. **CSI-Valiant e-Governance Special Jury Award**: PRICE - PRoject Information and Cost Estimation by Public Works Department, Govt. of Kerala

5. **CSI-Valiant e-Governance Special Jury Award**: e-ABACUS - Enhanced Accounting, Billing and Collection Utility System by Kerala Water Authority

6. **CSI-ICFOSS Open Source Award**: IDEAS - Information and Data Exchange Advanced System by National Informatics Centre, Kerala State Unit, Govt. of India
3. **CSI-Valiant e-Governance Promotion Award**: Kerala State IT Mission

4. **CSI-Valiant e-Governance Promoter Award**: Dr. Nirmala Padmanabhan, Head, Department of Economics, St. Teresa’s College, Eranakulam.

5. **CSI Student Excellence Awards**
   - Ms. Devika S., TKM College of Engineering, Kollam
   - Ms. Soorya V. Nair, Govt. Engineering College, Barton Hill, Thiruvananthapuram
   - Ms. Ruhin Mary Saji, Sree Buddha College of Engineering, Nooranad, Alappuzha
   - Mr. Gowtham M., SCT College of Engineering Thiruvananthapuram

In connection with the Golden Jubilee Celebrations, CSI Trivandrum Chapter organized an International Colloquium on ‘Information Security in e-Governance’ on 25th November 2015 at Vivanta By Taj, Thiruvananthapuram. Mr. Krishnamurty, Chairman, Valiant Technologies, UAE inaugurated the Colloquium. Mr. Ramani B. Executive Director, C-DAC and Dr. K. Rama Subramaniam, Global Chair, International Institute for certified Forensic Professionals (IICFIP) and Group CEO, Valiant Technologies LLC (UAE), Board Member ISDFRF,USA chaired the colloquium sessions. Dr. C. L. Ramakrishnan, IPS (Retd.) Director General of Police,Tamilnadu, Formerly Director of Vigilance & Anti- Corruption, Govt. of Tamil Nadu, Prof. Prabath Lakmal Rupasinghe, MBA(Sri.J),BSc(IT), CISA, CISSP,MCSE MIEEE, MIEEE, Professor, Srilanka Institute of Information Technology, Colombo, Srilanka, Mr. Bhadran V. K., Associate Director, Cyber Forensic, C-DAC and Mr. Sabarish K., Senior Scientist (EZ), Head Information Systems Division, Kerala State Council for Science Technology and Environment were the speakers.

CSI Trivandrum Chapter organised a Technical talk on the topic ‘State of Internet Security & Trends’ by Mr. Sreenath Sasikumar, Board Member, Open Web Application Security Project (OWASP), Thiruvananthapuram

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**Vellore Chapter**

CSI Vellore Chapter organized a one day workshop on “Green Software Development” on 26-12-2015 at VIT University. Mr. Ramalingam. R., CEO, Green India Equipment Limited, Chennai covered Introduction software development models, software design models with emphasis on green computing design models, coding models around 30 faculty members attended the workshop, organized by Prof. G. Jagadeesh and Prof. K. Govinda.

CSI Vellore Chapter organized a two day’s workshop on “Open Source Data Mining Tool R” on 08-09 Jan. 2016 at VIT University.

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**Div - V (Education and Research)**

CSI Div - V organized 3rd International conference INformation Systems Design and Intelligent Applications (INDIA 2016) in collaboration with Dept. of CSE and ANITS CSI Students Branch on 8-9 Jan 2016 at ANITS, Vizag. INDIA 2016 has brought all the intellectuals, researchers, scholars and academicians internationally, who are working on information systems design and intelligent applications in the areas of computer science, information technology, communication engineering and management together at one place and acted as a stage for sharing and exchanging their views on the upcoming trends in the above mentioned areas.
About 750+ papers were received and in which 215 quality papers after thorough review process were selected for publications in the Proceedings by Springer-AISC series in 3 volumes. There were 8 special sessions and 13 parallel tracks where the authors will present their research work, INDIA 2016 has acted as a stage for an author to prove him/herself in his/her interested research area.

The special attraction lies with many internationally renowned and well known researchers and academicians like, Professor Ashok Deshpande from Berlely, Professor Lakhmi C. Jain, Australia and, Dr. Aynur Unal from Stanford University, Dr. Rajib Mall from IIT Khargpur, Dr. B. K. panigrahi, IIT Delhi, Dr. B. Majhi, NIT Rourkela, Fr G Sanyal, NIT Durgapur. The Inauguration function on 8th of Jan, 2016 was attended by the chief guest Dr. GBS Prasad, Director (Personnel), RINL, Visakhapatnam Steel Plant and guests of honor Dr. Aynur Unal, Visiting Professor, IIT Guwahati and Professor Stanford University, USA, Prof. P. S. Avadhanli, Chairman CSI Vizag chapter, Vice-Principal, Andhra University, Sri. Raju L. Kanchibotala, Regional Vice-President, Region-V,CSI, Sri. Aninda Bose, Publishing Editor, Springer India Pvt. Ltd.

Prof. Pritee Parweker, Dept of CSE, ANITS was the Program Chair and Dr. S. C. Satapathy, Head, CSE, ANITS was the organizing Chair of the conf. The management of ANITS, Sri. V. Thapovardhan, Secretary extended excellent support in the organization of this conf.

Prof. Ashok Deshpande, Guest Faculty, University of California Berkeley; Visiting Professor: Indian Institute of Technology, Mumbai India, introduced the concept of fuzzy logic and spoke about various applications of it. Dr. Aynur Unal, Visiting Professor: Indian Institute of Technology, Guwahati, India spoke about Digital open innovations. She insisted on creating our own sustainable recyclable products. Dr. Parag Kulkarni, Founder, Chief Scientist and CEO of the EKLaT Research and Innowlation Research Labs Pvt. Ltd, spoke about knowledge innovation and practical machine learning applications to build world class products. Dr. Lakshmi C. Jain, Visiting Professor in Bournemouth University, United Kingdom and Adjunct Professor in the University of Canberra, Australia, spoke about practical applications of intelligent techniques in aviation and security.

Dr. Gautham Sanyal, Professor in the Department of Computer Science & Engineering and Dean, NIT Durgapur, spoke about Internet of things.

A talk was given by Sri Aninda Bose on “How to write research paper”.

There was a Panel discussion on the topic Paradigm Shift - A New Era: Technology, Entertainment and Values.

Two workshops on “Evolutionary Computational methods” and “Computer security” by Prof. J. K. Mandal were also conducted.

All the papers of this international conference were presented in 13 parallel tracks simultaneously.

In the evening, there was a cultural program with Payal Ram Chandini who is one the famous performer of “Kuchipudi Dance” and who has also performed in many international stages that includes BRICS summit and SAARC conference, has given a performance on “Kuchipudi Dance” and received a huge applaud by the delegates of this conference.
### FROM STUDENT BRANCHES

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<td>JAYPEE UNIVERSITY OF ENGINEERING &amp; TECHNOLOGY, GUNA</td>
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<td>INSTITUTE OF MANAGEMENT RESEARCH &amp; DEVELOPMENT, SHIRPUR</td>
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<td>8-1-2016 – Dr. Maruthuperumal &amp; Mr. Nataraja Suresh during a Technical event on Knowledge Hunt</td>
<td>8-1-2016 – Mr. Vinod Sonawane, Mr. Manish Patil &amp; students during SAP-ERP IT Tour</td>
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<td>19-1-2016 –during the event on Career Guidance</td>
<td>13-1-2016 - Mr. Arun Kishan handling the one day workshop on Web Craft</td>
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CSI Elections 2016-2017/2018

As authorised by the CSI Constitution and Byelaws section 5.7, we present herewith the results of the elections conducted for the year 2016-2017/2018. The opening and closing dates of the elections were December 18, 2015 and January 19, 2016 respectively. The results of the elections are given below:

The following are declared elected:

For the Term 2016-2017 (April 1, 2016 - March 31, 2017)

[1] Vice Chairman (Chairman Elect) Delhi Chapter (2016-17)
Mr. Manoj Sethi

[2] Nomination Committee (2016-17)
Dr. Santosh Kumar Yadav
Mr. Sushant Rath
Mr. Ved Prakash Goel

Prof. A K Nayak

[4] Regional Vice President (Region II - 2016-18)
Mr. Devaprasanna Sinha

[5] Regional Vice President (Region IV - 2016-18)
Mr. Hari Shankar Mishra

[6] Regional Vice President (Region VI - 2016-18)
Dr. Shirish S Sane

Prof. P Kalyanaraman

[8] Divisional Chair Person - Div. IV-Communications (2016-2018)
Dr. Durgesh Kumar Mishra

For the Term 2016-2018 (April 1, 2016 - March 31, 2018)

[1] Vice Chairman (Chairman Elect) Delhi Chapter (2016-17)
Mr. Manoj Sethi

Mr. Aniruddha Nag
Prof. Subho Chaudhuri

Dr. Ajanta Das
Dr. Sanjoy Kumar Saha
Dr. Navendu Chakli
Prof. Goutam Kumar Sen
Ms. Madhumati Sen Gupta
Mr. Sumanta Bhattacharya
Ms. Sharmila Ghosh
Mr. Abhijit Sarkar
Prof. Subro Santiranjan Thakur

Nominations Committee 2015-2016

Dr. Anil Kumar Saini
Chairman NC

Mr. Rajeev Singh
Member NC

Prof. (Dr.) U K Singh
Member NC

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Kind Attention: Prospective Contributors of CSI Communications

Please note that Cover Themes for forthcoming issues are planned as follows:

- March 2016 - Digital Forensics
- April 2016 - Natural Language Processing
- May 2016 - Smart Cities

Articles may be submitted in the categories such as: Cover Story, Research Front, Technical Trends and Articles. Please send your contributions before 20th February 2016 for March issue. The articles may be long (2500-3000 words maximum) or short (1000-1500 words) and authored in as original text. Plagiarism is strictly prohibited.

Please note that CSI Communications is a magazine for members at large and not a research journal for publishing full-fledged research papers. Therefore, we expect articles written at the level of general audience of varied member categories. Equations and mathematical expressions within articles are not recommended and, if absolutely necessary, should be minimum. Include a brief biography of four to six lines, indicating CSI Membership no., for each author with high resolution author photograph.

Please send your article in MS-Word and/or PDF format to Dr. Vipin Tyagi, Guest Editor, via email id dr.vipin.tyagi@gmail.com with a copy to csic@csi-india.org.

(issued on the behalf of Editorial Board CSI Communications)

Prof. A. K. Nayak
Chief Editor

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Obituary

Major General A Balasubrahmanian, AVSM (Retd.)
(1st Mar 1927 – 20th Jan 2016)

Born on 1st March 1927, Maj. Gen. Balasubrahmanian (fondly called Bala), after his engineering course, additionally qualified in Radio Engineering MARCONI’s U.K, Advanced Electronics and Guided Missiles. In 1950, he joined the Army, Corps of Signals and held various Technical appointments at the Army HQ and other units that dealt with Technical Equipment. He also served as an instructor at the Military College of Telecommunication Engineering. During this service, he was involved in the Design and Development of Simulators at Defence Research and Development Organization (DRDO). Between 1962 and 1963, he set up first Computer Centre in the Ministry of Defence with Digital and Analogue Computers. He served as Director (EDPS) and Tech Secretary of Advisory Group for Computers in Ministry of Defence during 1975-1984. He was an Officer on Special Duty (Computers) in Department of Electronics, GOI during 1971-1979. Though he had officially retired from service as Major General in 1984, he had served as an Officer on Special Duty (Computer Systems) in MoD (1984–1985) and Professor (Computers) at Indira Gandhi National Open University (1988-1992) where he was fondly remembered by many as an inspiring teacher and mentor.

Maj. Gen. Bala was one of the founders of Computer Society of India and served as the Founder Secretary (1965–1967), President (1968–1972). He was a distinguished fellow of CSI and IETE. He represented India through CSI in the International Federation for Information Processing (IFIP) and served as its Vice President during the period 1990-1994.

Some of his many contributions include: Setting up first computer centre at the Ministry of Defence; Developed Training Simulators for Indigenous Missile Systems; Technical Secretary, Advisory Group on Computers Ministry of Defence on policies and programmes; Launched the first Computer Distance Education Programme ‘Computers in Office Management for IGNOU; OSD COMPUTERS in DoE for planning and establishment of National Policies, Regional Computer Centres; Setting up Computer Maintenance Corporation Ltd consequent to the winding up of the IBM operations in India, to help the large number of users of the IBM equipment for the maintenance of the same and served as a Founder Director on CMC Board of Management; Formation of National Informatics Centre; Evolving National Computer Policies for Import, Software Exports, Indigenous Industry for Calculators, Micro and Minicomputers, International Cooperation, Technology Development; Leader of Computer Delegations to USSR, EEC, Western Europe; UNDP Projects in India related to Computers; and Establishment of DOEACC and now NIELIT for Human Resource Development and related activities in the area of Information, Electronics & Communications Technology (IECT).

Maj. Gen. Bala has received several awards and honours to his credit. These include: AVSM awarded by President of India; Silver Core of IFIP; Life Time Achievement Award by Dataquest; Life Time Achievement Award by CSI.

Beyond technology and science, he was keenly interested in Carnatic Music, Fine Art and Sports. In his later years, he was working on IT as a tool to help the physically challenged overcome their limitations and constraints.

A man of vision & foresight, an ever smiling face, amiable countenance, pleasing personality and readiness to help anyone coming for his advice, Maj Gen Balasubrahmanian had endeared himself to one and all. He left a strong and positive impression on a great many people whose lives he has touched.

His demise has left a huge void that will remain difficult to fill in the foreseeable future. May God rest his soul in peace.

CSI family conveys heartfelt condolences to his wife Smt. Kalpakasundari, family members and prays HIS ALMIGHTY to provide them enough strength to bear this irrecoverable loss.
Messages received from our CSI senior members (Compiled by Mr. H.R. Mohan, Imm. Past President, CSI)

- Gen. Bala towered the profession and the professionals. The news saddens. It is a national loss and a great loss to CSI. For some of us it a personal loss. - Prof. Vithal, CSI Fellow, LTAA

- I am deeply shocked to know about sad demise of CSI founder Secretary and Life Time Achievement Awardee Major General Bala. His demise is a great loss to CSI and his family. Major General Bala was honoured with Life Time Achievement Award of CSI during CSI 2011 at Ahmedabad. - Mr. Bipin Mehta, President, CSI & Fellow

- I am shocked and grieved to learn that General Balasubramanian is no more with us. He was a pioneer in computing in India and his contributions to CSI are immense. With him we lose a part of the history of the early days of CSI. - Prof. V. Rajaraman, CSI Fellow & LTAA

- It is a huge shock and a great personal loss that Maj. Gen. A. Balasubramanian is no more. I met him for the first time in May 1964 at Faridabad to form the All India Computer Users’ Group which later became the CSI. He was then a Major and I was most impressed with his clarity of thought, sincerity of purpose and keenness to contribute to the profession. We have also both been working very closely with each other on several planes for most of these years. As Secretary CSI, he was the perfect complement to Prof. R. Narasimhan; later as President CSI, he maintained and built up on lofty traditions of the Society and set standards which are very difficult for others to reach. As in-charge of IT in the DoE, his goal was to play a constructive role in the development of Technology and he earned the admiration of all sections: professional, industrial, academic and the user community. Interaction with foreign governments, industries and academic institutions too was an areas that he handles with competence and sincerity. Despite his numerous accomplishments and attainments, he remained a humble, open minded and unassuming person. His family symbolised the finest that there is in domestic harmony and cultural values in the best traditions of this country. There are very few like Major General Balasubramanian. We are all the poorer for this loss. May CSI stand for and promote the standards and values that he stood for. - Prof. P.V.S. Rao, CSI Fellow & PP

- He was my first contact with CSI (still under formation) he and Prof R Narasimhan motivated us. Bala was friendly and motivated us to do more with CSI. I will miss him. - Prof. H.N. Mahabala, CSI Fellow, LTAA & PP

- I had known him closely for over four decades. As GS01 (Sigs 9) at the Army Headquarters during 1974-76, I used to meet Gen Balasubramanian very frequently at that time as all our cases of hardware procurement were routed to the Govt. through him in his capacity as the Chairman of the EDP Cell of the MoD. In later years I continued my association with him through the CSI. In his passing away the country has lost a highly respected leader of the IT community. - Brig S V S Chowdhry (Retd), CSI Fellow, PP, LTAA

- He was a Gentleman to the Core. - Mr. T.V. Balan, CSI Fellow & PP

- Major General Bala, one of the founders of CSI 50 years back, the founder secretary of CSI and Bhisma of CSI is no more with us. He has been a mentor to many in CSI in particular to me for over three decades. Always smiling, positive, humane, supportive, encouraging and motivating. We miss this true visionary and strategist who had strived for the growth of CSI for several years. - Mr. H.R. Mohan, CSI Fellow & PP

- It is a great loss to the entire nation. The entire CSI community will prey his sole rest in peace. - Dr. C.R. Chakravarthy, CSI Fellow & LTAA

- I had the privilege of knowing & working with Gen Balasubramanian from 1971 onwards. A Great person, first VP of IFIP & second president of CSI. He was also OSD in the D.O.E. - Dr. Rattan K Datta, CSI Fellow, LTAA & PP

- In the Computer society, his mature and dignified style of leadership played a major role in getting people to work together. CSI has lost an officer and a gentleman. It is a loss to all of us, who have known and worked with him. - Dr. S. Ramani, CSI Fellow, LTAA & PP

- Extremely sad and sorry. I had known Major General A Balasubramanian for more than 34 years. I had worked with him in various capacities in CSI ExecComs and associated with him in organizing different activities. He contributed very significantly in establishing CSI and for its betterment throughout his life. - Dr. M.L. Goyal, CSI Fellow & PP

- A towering personality with cheerful outlook had always inspired all of us with his winning smile. Loving personal touch with affectionate pat is something this General only could do. It is a hearty feeling that some of us fortunate to get associated with people like General Balasubramaniam in CSI. It was a great honor for me for reading his citation for his Life Time Achievement Award, as the CSI awards Committee Chair. - Prof. P. Thrimurthy, CSI Fellow & PP

- When I returned to India from USA in 1976, Major General Bala was one of the few person who encouraged me to stay back in India, when almost everyone here said please go back to the paradise land-USA, no future for you in India. Will miss him. A wonderful positive smiling person. - Mr. Harish Mehta, CSI Fellow

- Gen Bala, A great friend and guide. He was accessible to all of us in the CSI fraternity. I have had the occasion to consult him in society affairs and also on IFIP affairs, where he represented us for a number of years as a lone Indian warrior, and earned great respect of his IFIP colleagues to become a Vice President of the International Body. - Lalit Sawhney, CSI Fellow & PP

- I recollect our early interactions with him in early 70’s when we brought out first journal of CSI. His contributions will be a guiding force for CSI members in future. - Mr. Chandra Vir Singh, CSI Fellow

- His gentle ways and persuasive nature helped the CSI in conducting its activities in a harmonious way. He was a great friend of IIM Ahmedabad. He involved many colleagues from IIMA in different activities of the CSI in the early years. He supported IIMA in mounting some important training programs. - Prof. Subhash Bhatnagar, CSI Fellow

- We lost a Computer Jewel. When I came back from Canada in 1973 and we wanted to get the process control computer for Bokaro Steel, in May 1973, I met him for the first time in Delhi in DoE and since then, we have been friends and well wishers of each other. - Mr. Adesh Jain, CSI Fellow

- Maj Gen Balasubramanian was a role model, a great source of inspiration and mentor for me in my journey of 50 years with CSI. I have learnt a lot of lessons from him as he gave me proper guidance whenever I sought his advice. His ever smiling countenance is indelible from my memory. I will miss him a lot. - Mr. S. Parthasarathy, CSI Fellow

- It is a sad and shocking news, an irreparable loss to IT fraternity, in general and CSI family, in particular. - Prof. M.N. Hoda, Chair, Div I, CSI

- It is shocking news. - Mr. Sanjay Mohapatra, Secretary, CSI
Saddened to hear the demise of Maj Gen Bala. - Dr. Anirban Basu, Vice President, CSI

It is a tragic and irreparable loss to entire IT fraternity across India and not alone to CSI family. Mr. H.R. Vishwakarma, CSI Fellow

He laid a very solid foundation for CSI. - Dr. S. Agrawal, CSI Fellow

It is a very sad news and irreparable to CSI. - Mr. S. Srinivasan, CSI Fellow

Very Sad to lose a mentor. - Raju L Kanchibhotla, RVP-5, CSI

I remember him as a person who carried people with him and created a team spirit. I also remember him as a proponent of open source software. - Prof. Rajeev Sangal, CSI Fellow

I always thought that Gen Bala was ageless. He was such a landmark wherever the Dept. of Electronics was. I remember the paper he gave at the very first CSI conference I attended at Thumba. It was how to compute the probability of hitting a target, given that you knew the accuracy of its location, and the circle of Likelihood that your round would strike somewhere. He was always encouraging and helpful whenever one met him. Soft-spoken, friendly. That is how I will remember him. - Prof. J.G. Krishnayya, CSI Fellow

We know each other for a very very long period. CSI will always be grateful to him and remember him for the contribution he made in the early years of CSI. - Col. Shivraj, CSI Fellow

I remember him on many occasions. I heard him (then he was Col, and later Brigadier) giving eloquent speeches on various occasions on the different phases of computing environment in India. We have lost a die-hard in our computer fraternity. - P. Sinha, CSI Fellow, RVP-2

Major General Bala Subramaniam was highly committed for promoting CSI. He was towering figure on all counts, very helpful and straight forward. - Mr. M.D. Agrawal, CSI Fellow & PP

I am deeply shocked and grieved. He is one of the founders and strong pillars of CSI. He has been a source of inspiration to us. He was kind hearted, always ready to help and interact and a human being par excellence. - Dr. Swarnalatha R. Rao, CSI Fellow

His contribution to CSI has been truly exemplary. - Mr. Jayant Krishna, Fellow, CSI

He shall remain in the hearts of many in CSI. - Mr. P. R. Rangaswami, CSI Fellow

Grieved. Used to meet him in Music and Dance performances as well as CSIM meetings. Dignified, articulate personality, difficult to replace – Mr. R. Balasundaram, Sr. Member, CSI Chennai

It is very sad that we lost a great visionary. Ms. Latha Ramesh, Patron, CSI Chennai

Major General Bala, our founder secretary of CSI and one of the founder members of CSI way back of 50 years ago, is no more with us to guide us. – Mr. S. Ramasamy, Patron, CSI Chennai

The passing away of Maj. Gen. A. Balasubramanian, AVSM (Retd.) is losing one of my family members. God’s grace the end has been quite peaceful for a man who held several vital positions in India with dignity and pride always worth emulating. - Dr. T.V. Gopal, Ex Chair, Div 2, CSI

I had interacted with him on several issues and he supported me on several moves which all proved productive and progressive. – Dr. S. Sudharssanam, Ex Director, CSI ED

We have lost a great stalwart. - Mr. Ashok Soota, CSI Fellow

I had a few occasions to interact with him and was always charmed by his affable manners and also impressed by his deep commitment to CSI. - Dr. Subas Pani, CSI Fellow

His sincerity, dedication and foresight will be remembered by all CSI members for many years. He has left indelible marks in the affairs of CSI and it will be very difficult for us to emulate the high standard set by him in CSI. - Subimal Kundu, CSI Fellow

I met Major General Balasubramanian for the first time in 1950. I was a student of Physics in Delhi University and my cousin (late) Group Captain R.S. Sivaswamy was posted in Gurgaon Airbase as a signals officer. Balu, as we called him, was visiting my cousin as they were class mates at the Gurury Engineering College where they obtained a degree in Electronics and Telecommunications Engineering. Balu had just joined Army Signals as a Second Lieutenant. I was also visiting my cousin and was introduced to Balu. I was impressed by the tall, lean, ramrod straight officer in uniform with an affable smile. My decision to pursue a course in Electronics and Communications engineering after graduation was to some extent influenced by meeting these two young officers. I never thought that our paths would cross again much later in life. The next time I met Balu (by then a Major) was in 1964 in Hyderabad where he was in-charge of the IBM 1620 installation at the Defence Research and Development Organization. I had joined IIT/Kanpur and was associated with the computer centre where we had installed an IBM 1620. Our next meeting was in December 1964 at the first International Conference on Computing held in India. It was organized by Prof. Harry Huskey (who was later elected an Honorary Fellow of CSI) and held at IIT/Kanpur. At the end of this conference it was decided to start the Computer Society of India and Major Balasubramanian volunteered to register the society at Hyderabad where he was working. He became the founder secretary of CSI. (Incidentally at the Annual Convention of the Computer Society of India held at Ahmedabad in 2012 where he received CSI's Life Time Contributions award, he read out some of the original notes he had written on the registration of CSI). When the Department of Electronics was formed in 1970 Prof. M.G.K. Menon, the first secretary of the department, requested the Army to depute him to the Department as Director of the Computer Division. He joined the department in 1971. India was going through a very difficult economic period with severe paucity of foreign exchange. There was also little appreciation of the importance of computers in development among politicians and bureaucrats. As a consequence all requests for import of computers were scrutinized carefully. Colonel and later Brigadier Balasubramanian had the enviable task of scrutinizing the applications and often paring down the configurations of computers. He was unfappable, very courteous, never got angry with any one, and did a commendable job which everyone appreciated. While in DOE he was very active in CSI and his administrative abilities led to rapid development of our society. He went back to the Ministry of Defence overseeing the applications of computers in Defence Services and retired in 1984 as Major General. Balu came from a musical family. He was a connoisseur of arts, particularly Bharatanatyam and Karnatik music. His sisters were well known performing Karnatik musicians. He married Kalapasusundari an accomplished Karnatik singer. She was a great strength to him supporting him in all his endeavours. His daughter Pushkala Gopal is an accomplished Bharatanatyam dancer and teacher settled in U.K. I knew his son Shiva who studied Physics at IIT/Kanpur and later went to U.S.A. to get a doctorate. Currently he is with IBM in U.S.A. His last son Krishna works for a startup in advertising in U.S.A. In his passing away India has lost a great son and Computer Society of India an inspiring leader and a sage adviser. – V. Rajaraman, Indian Institute of Science, Bengaluru
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Contact: Dr. R.K. Ramanathan, rkramanathan@gmail.com, tenthitd2016@gmail.com  
| 20-21 Feb 2016   | International Conference on Communication and Network ComNet 2015 at Ahmedabad Management Association,  
ATIRA Campus, Ahmedabad 380015  
www.comnet2015.org  
Contact: Email id comnet2015@csiahd.org |
| 20-21 Feb 2016   | National Conference on Digital India organised by Sunbeam College for Women, Varanasi, UP with CSI Varanasi  
Chapter.  
Contact: nsunbeam.conference@gmail.com, 0983916068 |
| 26 Feb 2016      | National Conference on Computational Technologies - 2016 (NCT'2016) jointly organized by Dept. of Computer  
Sc. and Application, University of North Bengal & CSI, Siliguri Chapter, Region-II, at the Dept. of Computer Sc. and  
Application, University of North Bengal, Darjeeling.  
www.rbucasevents.inl  
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Region III, Venue: Sagar Group of Institutions, Bhopal,  
www.sirtbhopal.ac.in/iciremps  
Contact: Rajesh K Shukla, Mob: 09893192616, Email: rkumardmh@gmail.com |
| 5 March 2016     | 11th National conference on "Next Generation Technologies for e-Business, e-Education and e-Society  
(NGTBES-2016)" organised by Institute of Technology & Science, Mohan Nagar, Ghaziabad, (UP) and Div-I of CSI  
Contact: Dr. Sunil Kr. Pandey, sunilpandey@its.edu.in, 9910370632 |
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Udaipur Chapter, in association with CSI Udaipur Chapter)  
www.csi-udaipur.org/iccts-2016  
Contact: Mr. Amit Joshi amitjoshiudr@gmail.com |
| 5 March 2016     | CSI Gujrat State Student Convention, Scool of Computer Studies, Ahmedabad University,  
www.aesics.ac.in/ssc  
Contact: Tel: (079) 26402932, 26402987, Email: rsc3@aesics.ac.in |
| 5 March 2016     | First National Conference on Challenges and Opportunities in Computer Engineering, (NCCOCE 16) Conference  
organized by Department Computer Engineering, Christ University, Bangalore In association with Computer Society of  
India Division IV Communications.  
Website: http://cse.christuniversity.in/nccoce  
Contact: Dr. Samiksha Shukla samiksha.shukla@gmail.com, Ph - +919880462311 |
| 10-11 March 2016 | First International Conference on Data Engineering and Communication Technology-ICDECT at LAVASA, Pune  
www.icdect.com  
Contact: Prof. Suresh Limkar, 9823328686, icdect2016@gmail.com,  
7680995513, convener.iccii2016@jntuh.ac.in |
| 12-13 March 2016 | CSI Golden Jubilee National Student Convention Organized by CSI GLA University Student Branch, GLA  
University, Mathura, UP, in association with CSI Mathura Chapter, Region-I & Div-I,  
www.gla.ac.in/CSINSC  
Contact: Mr. Keshav Goyal, keshav.goyal_cea12@glau.ac.in, Mob. - 9837002003 |
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