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First Steps toward Providing a System for Converged Digital Broadcast and Cellular Telecommunications Services

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Abstract

This article provides the motivation to develop a converged digital broadcast and mobile telecommunications system. It then gives an overview of the main subsystems required to efficiently provide converged broadcast and cellular services.

Introduction

Convergence of IP-Based Services for Mobile Users and Networks in DVB-T (CISMUNDUS) is a European Commission (EC) funded research project that has developed and demonstrated converged digital video broadcast terrestrial (DVB-T) and cellular (general packet radio system, GPRS). CISMUNDUS is an important outcome of a document stating a key social objective presented in December 1999 by Romano Prodi, President of the EC, and later discussed by European leaders in Lisbon (23–24 March 2000), "eEurope: An Information Society for All." The main aim of Mr. Prodi's e-project was summarized in the EC's progress report in March 2000: "The initiative aims at accelerating the uptake of digital technologies across Europe and ensuring that all Europeans have the necessary skill to use them." The EC document recognizes Europe's dynamic role in mobile communications and digital TV, but regrets that access to the Internet spreads relatively slowly. Since then CISMUNDUS has helped close this gap by developing service concepts and systems that enable converged TV and Internet access for people on the move. This system was successfully demonstrated at IBC 2003 and nominated as one of the five best demonstrations in an exhibition that hosted over 1000 stands with companies demonstrating their latest technologies. CISMUNDUS was a collaborative research project of organizations and institutions across Europe: telecom operators (France Telecom R&D, France), broadcasters (Institut für Rundfunktechnik, Germany; Radiotelevisione Italiana, Italy; TeleDiffusion de France, France), equipment manufacturers (Motorola Labs, France; Philips Research Laboratories, United Kingdom), and research institutions (Brunel University, United Kingdom).

Motivation

A converged broadcast and cellular system provides local and remote interaction to portable digital TVs and a high-bandwidth multicast IP downlink to dual-mode mobile phones. The resultant downlink bit rate and number of users are several orders of magnitude greater than mobile phones connected to cellular networks with only cell broadcast capabilities. These are very important benefits for telecom operators, giving them the opportunity to improve efficiency in delivering content to wireless mobile users, and for broadcasters as it increases their potential viewing public to those located within closed populated areas such as stations, airports, or sports stadiums as well as in cars, trains, buses, and metros (e.g., commuters and travelers). Additional benefits consist of complementary service and coverage provision. A complementary service delivers high-quality service on multicast IP over DVB-T if many users subscribe and alternative-quality service on unicast IP over a GPRS network if few users subscribe. Complementary coverage delivers alternative-quality service on the IP over GPRS network if a viewer is watching the IP over DVB version of a service and wanders outside the DVB coverage area. There are also very important benefits for equipment manufacturers because markets for a whole new generation of mobile phones and TVs will be created, providing additional sales revenues. Devices such as mobile phones with TV capabilities and pocket TVs with interaction capabilities will be needed to provide a wide range of new services for people on the move. There may also be additional sales of head-end systems (e.g., servers, IP and broadcast gateways, multiplexers, modulators, power amplifiers, and antennas). The benefits for users are additional choice, greater quality range, and value for money through a competitive market. These benefits are perceived by broadcasters, cellular operators, and terminal and equipment manufacturers as potential market winning differences that can be achieved with the lowest possible investment.

The service scenarios to benefit most from converged broadcast and cellular systems are those in great demand such as those associated with a large public event. Therefore, there will be new opportunities for content creators and service operators to specialize in providing a wide range of services to people on the move in crowded areas (see box, page 4).

In order to demonstrate services that could be provided by such a system, a demonstrator was designed and developed to show how converged broadcast and cellular services can be used to create, announce, manage, and discover converged broadcast and cellular services. The service scenario selected to demonstrate was a live table football sports scenario.

System Overview

A converged network service platform was developed to manage service-level agreements (SLAs) with network opera-

(Continued on page 4)

IEEE Aerospace Electronics Systems, Communications, Laser & Electro-Optics Society Chapter, India: Major Technical Activities: 2003

By R. Gupta, India

Awards and Recognition

1. IEEE Communications Society, USA, awarded 2003 Chapter Achievement Awards to the IEEE Delhi Communication Chapter.

2. IEEE Aerospace Electronics System Society, USA, recognized IEEE AES COM LEO Society Chapter India as the 2002 Outstanding IEEE-AESS Chapter.

3. The Chapter Chair was nominated for Vice Chair of the APB Chapters' Coordination Committee of IEEE Communications Society.

4. The Chapters had their Annual General Meeting. The new executive committee initiated their activity by felicitating Dr. D. P. S. Seth and S. H. L. Bajaj for achieving the highest positions in their respective professions. Dr. Seth and Mr. Bajaj gave a brief overview of developments in the fields of communications and power, respectively.

Lectures

5. The Chapter initiated, along with Department of Information Technology, "A Series on Current Topics of Interests in IT Sector by Eminent Experts" under the Distinguished Lecturer Program. The lectures were arranged once every month. During 2003, the following lectures were arranged:

- Software and Silicon — Opportunities for India: S. Sadagopan, IIT, Bangalore and Mr. Kiran Karnik, President, NASSCOM
- Innovation and Technology in Education: Shri Rajendra S. Pawar, CMD, NIIT
- E-Government: Opportunities and Challenges in India: Prof. S. C. Bhatnagar, IIM, Ahmedabad
- IT Roadmap for India: Prof. D. B. Phatak, IIT, Mumbai
- Soft Computing, Machine Intelligence and Data Mining: Prof. Shankar K. Pal, ISI, Kolkata
- India — A Global R&D Destination: Shri Hanumant Talwar, Vice President, GE Capital
- Status of Bioinformatics in India: Prof. Ashok Kolaskar, VC Pune University
- Neuroinformatics: Linking Molecules to Behavior: Prof. Vijayalakshmi Ravindranath, Director, National Brain Research Center
- International Space Station Communication System: Prof. Zafar Taqvi, Professor, Communications and Tracking, International Space Station, Boeing, USA and Professor at University of Houston Clear Lake
- Information Storage: Where Are We Headed For: Prof. D. K. Pandya, IIT Delhi

The average attendance at these lectures was 125 with 25 members from IEEE. Details of the presentations can be seen at http://www.mit.gov.in

6. The Chapter supported celebrations of World Telecommunications Day with the theme "Helping All of the World's People to Communicate" along with the Institute of Telecommunication Engineers of India on May 16, 2003 at New Delhi.

7. The Chapter arranged in cooperation with the Institute of Electronic Data Processing a lecture, "INDIA: E-READINESS ASSESSMENT," by Mr. S. Ramakrishanan, DIT New Delhi, July 5, 2003.

8. The Chapter arranged in cooperation with the Institute of Electronic Data Processing a lecture, "Info Tech to Knowledge Management Road Ahead," by Mr. C S Arora, October 18, 2003, New Delhi.

9. The Chapter organized a lecture, "Quantum Well and Quantum Dot Intermixing for Optoelectronic Device Integration," by Professor Chennupati Jagadish, Australian National University, December 23, 2003, University of Delhi South Campus, New Delhi

10. The Chapter arranged a lecture under the Distinguished Lecturer Program, Current Topics of Interests in IT, by eminent expert Prof. Zafar Taqvi, Professor, Communications and Tracking, International Space Station, Boeing, USA and Professor at University of Houston Clear Lake, "International Space Station Communication System," December 29, 2003, Department of Information Technology, New Delhi.

11. The Chapter supported a lecture for National Technology Day, "Next Generation Internet," by Mr. S. Ramakrishanan, DIT New Delhi at IIC, May 12, 2003.

Conferences/Workshops

12. The Chapter arranged ELITEX '03 (Electronics & IT Exposition), an annual event of the Department of Information Technology. Shri Arun Shourie, honorable Minister of Communications and Information Technology and Disinvestments, inaugurated the event. Dr. R. Chidambaram, Principal Scientific Adviser to the Government, delivered the keynote address. Both speakers mentioned the importance of R&D and initiatives required to position India as a global destination for R&D. The role of close association between academia, R&D institutions, and industry emerged clearly and was emphasized. The Minister announced the establishment of new institutions in the area of microelectronics and nanotechnologies and ensured his full support to R&D activities in the frontier areas of technology. During the inauguration, the following products/technologies were released:

- Release of e-Readiness report for INDIA
- Digital Mobile Library
- "Digital Set Box" developed by C-DAC, Noida
- "C-Crypto" software tool developed by C-DAC, Noida
- "Urdu Nashir" word processor developed by C-DAC, Pune
- "Single-Chip Phone IC" developed by SCL
- Release of a CD containing all the volumes of *Vishva Bharti*, a publication from DIT giving the latest developments in the field of multilingual technology
- Anglo-Hindi Web-based translation

The seminar sessions were Moving Up the Value Chain: India — A Global Destination for R&D; Technology Incubation; Global IP Protection and Partnership; Emerging Growth areas; Innovation to Enhance Digital Unity; R&D Led Success Stories; and Human Resource Development Initiatives. Seminar sessions also covered enhancing e-readiness as well as technologies developed in DIT in electronics and IT. All sessions attracted a large number of participants. Besides creating awareness about DIT technologies, ELITEX '03 promoted R&D industry links essential for the industry to absorb indigenous technology and stimulating innovations. Further details on ELITEX are available at http://www.elitexindia.com

13. The Chapter provided technical support to ISMOT-2003, held in Ostrava, Czech Republic, 11–15 August 2003.

14. The Chapter sponsored a five-day lecture course on Synthetic Aperture Radar and Its Applications by Professor Siva Prasad Gogineni (Deane E. Ackers Distinguished Professor of Electrical Engineering and Computer Science at the University of Kansas, USA), during 27–31 January 2003 at Vasavi College of Engineering, Hyderabad. Thirty-one participants, including 12 students (seven of whom are IEEE Student Members), attended this workshop. The course outline consisted of radar fundamentals, real aperture radar, synthetic aperture radar, SAR design and review of some results from

(Continued on next page)

earlier SARs, SAR applications, and current and future research in this area. Each day consisted of two lecture hours, 30 minutes of formal discussion, and practical demonstrations during afternoon sessions. The feedback received was positive.

15. The Chapter technically supported a two-week course on multimedia technology and applications at Aligarh Muslim University in January 2004.

16. The Chapter supported the 5th International Workshop IWDC '03 at Calcutta, 27–30 December 2003, jointly organized by IIM-Cal and Jadavpur University.

17. The Chapter provided technical support to the Information Systems, Security and Audit Association 2003 Conference Advisory Committee, New Delhi 24–26 July 2003

18. The Chapter supported and organized the 34th Midterm Symposium on the Wireless and Wireline Future Scenario, 3-4 April 2003, Mumbai.

19. The Chapter provided technical support to the International Conference on Advanced Optoelectronics and Lasers, Alushta, Crimea, Ukraine, 16–20 September 2003, and the 5th International Workshop on Laser and Fiber-Optical Networks Modeling, as an advisory member of the committee.

20. The Chapter provided technical support in arranging the talk of Prof. Yakkov Bar-Shalom, an expert in target tracking and data fusion who is a Distinguished IEEE Lecturer and Fellow, under the DLT programme at Bangalore, during International Radar Symposium 2003, 2–5 December 2003.

21. The Chapter sponsored the National Symposium on Microwaves and Lightwaves, 11–14 October 2003, South Campus, University of Delhi.

22. The Chapter provided technical support to SIMPOTIC'2003, held in Slovakia 26–28 October 2003.

23. The Chapter technically sponsored the Indian National Academy of Engineering Conference on Nanotechnology, which was held at Central Scientific Instruments Organisation (CSIO), Chandigarh, India, 22–23 December 2003.

24. The Chapter supported a workshop for teachers of engineering and science colleges and polytechniques on Fiber Optics and Networking in Bangalore, October 2003.

25. The Chapter provided technical support to a workshop on dense wavelength-division multiplexing and optical networking conducted 28–30 November 2003 in Bangalore.

26. The Chapter sponsored INCEMIC 2003, held at SAMEER Madras in December 2003.

27. The Chapter technically supported the 38th national convention of CSI in Delhi, 9–11, October 2003, with the theme "ICT for the Prosperity of Mankind."

28. The Chapter technically supported IEEE TENCON 2003 Convergent Technologies for the Asia Pacific, 14–17 October 2003 in Bangalore, sponsored by IEEE Region 10.

Student Activities Support

29. The Chapter took initiatives in student projects at state engineering colleges. The Chapter also committed initial financial support for those projects

30. The Chapter sponsored the student seminar, "Wireless Technologies," at IIT Delhi, February 2003.

31. The Chapter sponsored the 25th annual festival Rendezvous 2003, organized by the Students of IIT Delhi.

32. The Chapter supported a national-level Student Papers Presentation Competition at Sarvajanik College of Engineering and Technology, Surat, Gujarat.

33. The Chapter supported the IEEE-Jim's ENCONMIUM 2003 All India Technical Festival, organized by the Jamia Millia Islamia Students Chapter.

34. The Chapter arranged a student travel grant for paper presentation during INTERMAG 2003 for IIT Delhi students.

35. The Chapter technically supported the second consecutive State Level Engineering Undergraduate Techno Festival, organized by Sarvajanik College of Engineering and Technology, Surat.

36. The Chapter supported the activities of the IEEE Student Branch at Amity School of Engineering and Technology, New Delhi.

Promotional Activities

37. The Chapter took initiatives to establish IEEE Women Engineering Chapters. Three chapters at Delhi, Pune, and Bhopal have already started.

38. The Chapter took initiatives to renew some memberships after 5–10-year gaps.

39. The Chapter proposed Profs. K. Tyagrajan, Barothi Sinha, Chander Kumar Sarkar, and Govind for the Distinguished Lectures Program of LEOS and ComSoc.

40. The Chapter sent inputs to *Global Communications Newsletter*, *IEEE Communications Magazine*.

41. The Chapter widely circulated offers made by IEEE-LEOS Society for free student membership and half-year ComSoc free student membership. Thirty-four applications were sent to the LEOS office.

42. The Chapter sponsored 15 IEEE Senior Member applications.

43. The Chapter coordinated the DLT programs arranged by ComSoc in India.

44. The Chapter widely circulated notifications and conference announcements from various IEEE societies.

45. The Chapter provided the proceedings of conferences organized by IEEE in India to some developing countries free of cost.

46. The Chapter motivated members from India to participate in IEEE annual elections, and IEEE ComSoc and LEOS society elections.

47. The Chapter provided functional support to IEEE ComSoc for maintaining Sister Society cooperation with the Institute of Electronics and Telecommunications Engineers, India.

48. The Chapter provided technical support in reviewing *IEEE Vehicular Technology Society News* articles

49. The Chapter Chair participated in the Annual LEOS Chapter Retreat held 26 October, 2003, Tucson, Arizona. LEOS provided all financial support

50. The Chapter provided necessary input for publication of the *IEEE India Council Bulletin* and *Delhi Section Magazine* (BECONS).

51. The Chapter provided technical support for IT education and training in Vietnam through the Indian organization NIIT.

52. The Chapter donated free issues of IEEE magazines to some engineering colleges, particularly women's colleges.

Commitments

53. The Chapter has committed to sponsor the forthcoming Asia-Pacific Microwave Conference 2004, scheduled for 15–18 December 2004, organized by the University of Delhi South Campus.

54. The Chapter will provide technical support to the International Conference on E-Business and Telecommunication Networks, in Setúbal, Portugal, 25–28 August 2004.

55. The Chapter will provide technical support to a lecture, "Physics and Design of Low Noise Avalanche Photodiodes," by Dr. John P. R. David, University of Sheffield, United Kingdom, to be held in Delhi.

56. The Chapter will provide technical support to the Inter-American Organization of Higher Education, which includes about 400 universities, and to EISTA's organizing committee of the International Conference on Education and Information Systems: Technologies and Applications to be held in Orlando, Florida, USA, 21–25 July 2004.

tors and perform SLA management. A session layer management system was designed with no view of the underlying radio conditions of its constituent networks, subdivided into signaling and transport planes (Fig. 1). These planes are used to control service management and end-to-end content delivery, and do not impinge on intrinsic quality of service (QoS) mechanisms of underlying networks. An end-user device can decide to subscribe to a specific service on a specific network.

On the transport plane, the end-user device is interfaced to the cellular network and broadcast delivery subsystem (the broadcast network). These networks guarantee the QoS at which the end-user device receives or transmits data. In the signaling plane, the CISMUNDUS delivery subsystem (CDS) represents the "heart" of the system. Its role is to coordinate configuration of the related domains through signaling links, with the motivation of optimizing usage of SLAs.

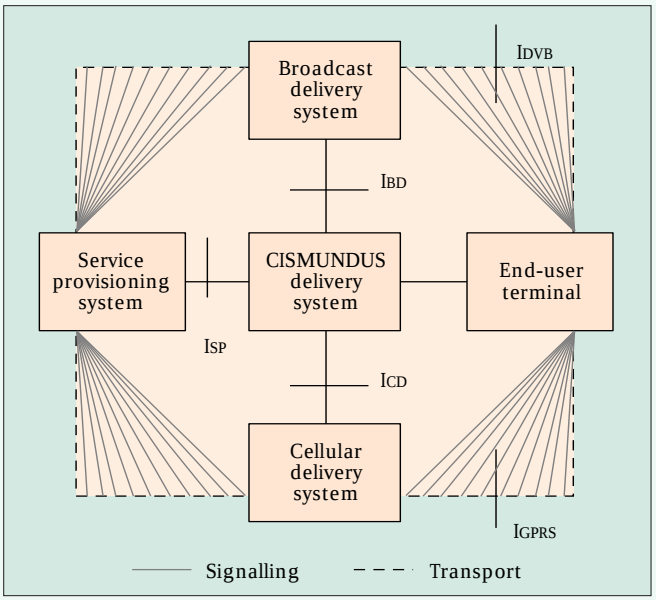

Figure 1. *System architecture.*

The service provisioning subsystem consists of tools needed to capture/create and encode content, store content on servers, describe the converged services, and inform the CDS of these new converged services. It also consists of various service provisioning servers to provide different types of pulled and pushed multimedia services.

The mobile end-user terminal consists of radio interfaces to broadcast and cellular networks, and network management (NM) middleware needed to manage the network interfaces and discover all the services available. It also consists of an electronic service guide that lists all services available to the terminal from the NM (DVB services, IP over DVB, and IP over GPRS), allowing the user to select and subscribe to them.

Conclusions

This article describes the motivations for developing a converged broadcast and cellular system, and outlines the main subsystems required to create, announce, manage and discover converged services. Further information on this system can be found at http://www.brunel.ac.uk/cismundus/integrationanddemonstrations.htm.

Acknowledgments

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List of Potential Services

General information
- Browsing the WEB and EPG (data carousel)
- Interactive shopping
- Online "printed" media
- Online translation
- Location-based broadcasting services
- Intelligent search/filtering facilities

Entertainment
- Watching TV, listening to the radio
- Enjoy programme related services (e.g., text of songs, cover of CDs)
- Audio/video on demand
- Games on demand
- Virtual sightseeing
- E-education

Specific information (e.g., road transport telematics)
- Travel and traffic information, including webcam broadcasting
- Advanced vehicular environment: "automatic" car, email, agenda, including software updating
- Public transportation: passenger infotainment
- Online addressing/managing of vehicle fleets
- Miscellaneous: toll, emergency, searching, remote diagnosis

Business and e-commerce information
- Mobile office
- Narrowcast business TV
- Virtual workgroups
- Virtual banking
- Order information (for travel, books, CDs, tickets, etc.)