



Computer Networks

-An Engineering Design Approach

Lecture-2:

From the Internet to Small Networks : A Top-down Perspective

January 11, 2010

Rahul Banerjee, *PhD (CSE)*

Networking & Distributed Systems Research Group

Computer Science & Information Systems

Birla Institute of Technology & Science, Pilani, INDIA

Email: rahul@bits-pilani.ac.in / Rahul.Banerjee.CSE@gmail.com

Home Page: <http://www.bits-pilani.ac.in/~rahul/>



Interaction Points

- **Examples of Types of Applications benefitting from Networking**
 - hard real-time, soft real-time, non-real-time / best-effort / delay-tolerant applications / services <with examples>
 - **case-study movie**
 - Constituent networking components of a smart room setup
- **The Internet & its Evolution**
- About Internet Architecture
- **Who decides about the Internet?**
- The Internet versus the World-Wide Web
- **Protocols, Layers, Interfaces, Virtual Communication and Services**
- Select References to the literature
- **Questions and Answers / Summary**



Examples of Types of Applications benefitting from Networking

- **Types of applications & services:**
 - hard real-time applications & services,
 - **soft real-time applications & services,**
 - non-real-time / best-effort / delay-tolerant applications / services
 - **Examples of each kind of applications and services**
 - About the significance of application-driven and economics-constrained nature of network system design approaches
 - **Case-study of the Networking aspects of the *Microsoft Easy Living Research Experiment***
-



What is the Internet today?

- Wide Area Network of variety of networks
- Global
- Public
- Not transparent, as yet
- Hybrid topology but largely hierarchical
- No single controller
- Internet Society (ISoc) oversees, assists --- does not control
- QoS, Security continue to have issues – partly at least
- Web, mail, commerce, education, entertainment, sharing continue to dominate its application space



Architecture of the Internet

- Originally, it was a point-to-point WAN.
- Original architecture that led to ARPANET has evolved over the years that have passed by.
- It is loosely hierarchical.
- Currently, Internet architecture is largely governed by the IAB of the ISoc.
- Has many sub-organs which facilitate evolution and coordinated maintenance of the Internet.
- IESG steers the ISoc in a general way the engineering issues are resolved.
- IETF workgroups do the ground work and by a democratic process helps community in building up engineering solutions through IETF drafts and standards (RFCs) etc.



Of the Internet, Intranet and Extranet

- **The Global Public Internetwork: The Internet**
- **The Wholly Owned / Private Internetwork: Intranet**
- **The Hybrid Internetwork-- private networks / internetworks connected through the Internet: Extranet**

In the early stages of development, technologies used for the internetworks of all type were essentially the same, except probably at the lowest level. This situation is rapidly changing.



Elements involved in a Network / Internetwork

- **Nodes**
 - Regular computing nodes
 - Network extension / interconnection devices
- **Network Interfaces**
 - NICs / On-board Chips
 - Wireless interfaces
 - Wireline interfaces
- **Links**
 - Wireline links
 - Wireless links
- **Strategies, Algorithms & Protocols:**
Hardware, Software, Firmware level implementations

Nodes: where processing and communication capabilities co-exist

Hosts: end / intermediate nodes where all levels / layers including those belonging to applications exist



Communication Media / Interconnection

Links / Logical Links

- **Media-based interconnection perspective**
 - Guided / Unguided
 - Noisy / Noiseless
 - Broadcast / Non-broadcast

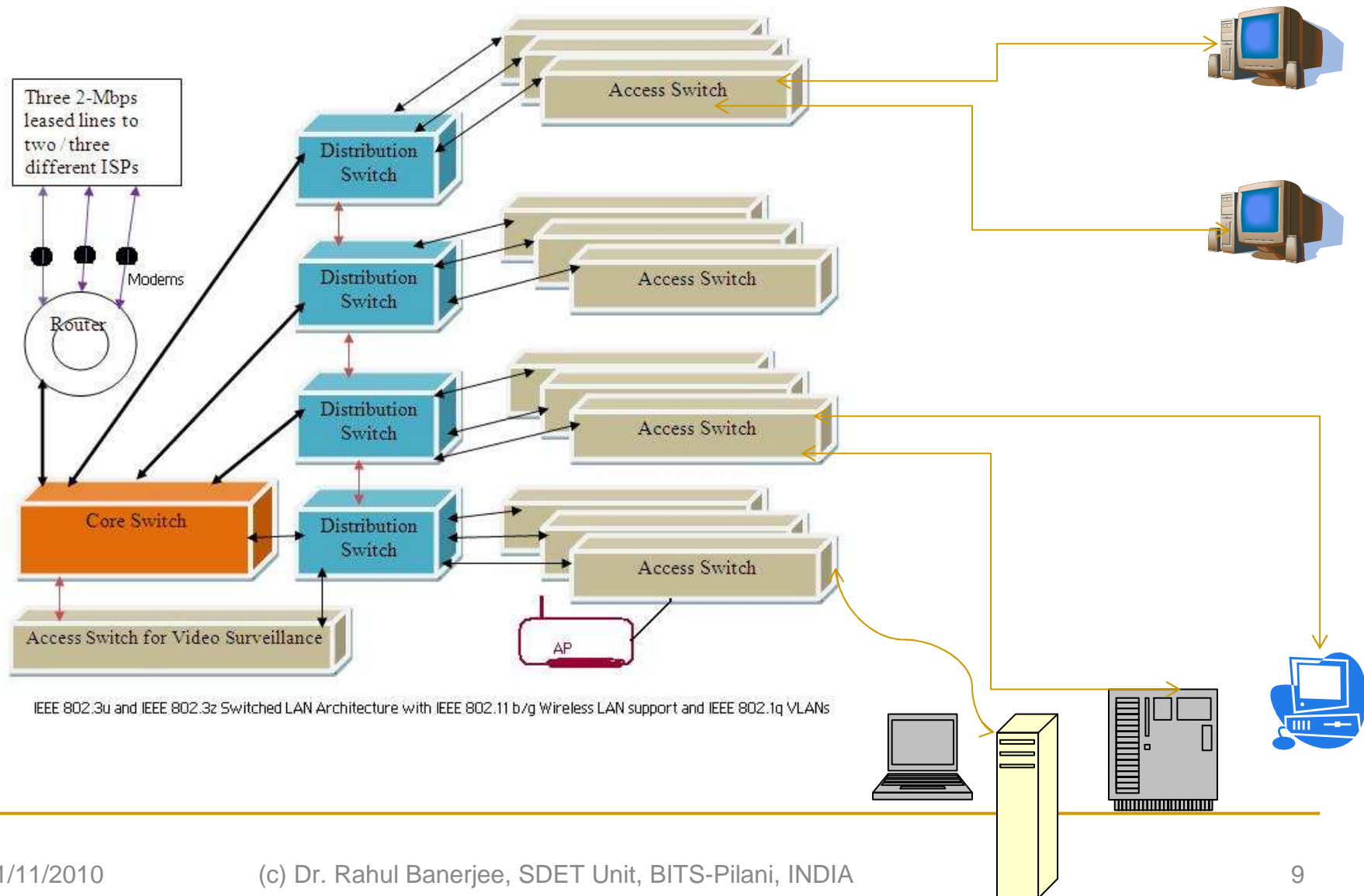
 - **Link-based interconnection perspective**
 - Secure / Insecure
 - Logical / Physical
 - Point-to-Point / Multi-point

 - **Physical Links**: those entities that provide physical path (direct paths between neighbouring nodes (point-to-point / point-to-multi-point) for data delivery over guided or unguided media

 - **Logical Links**: an abstraction showing the logical path of data delivery at layers higher than the physical layer
-

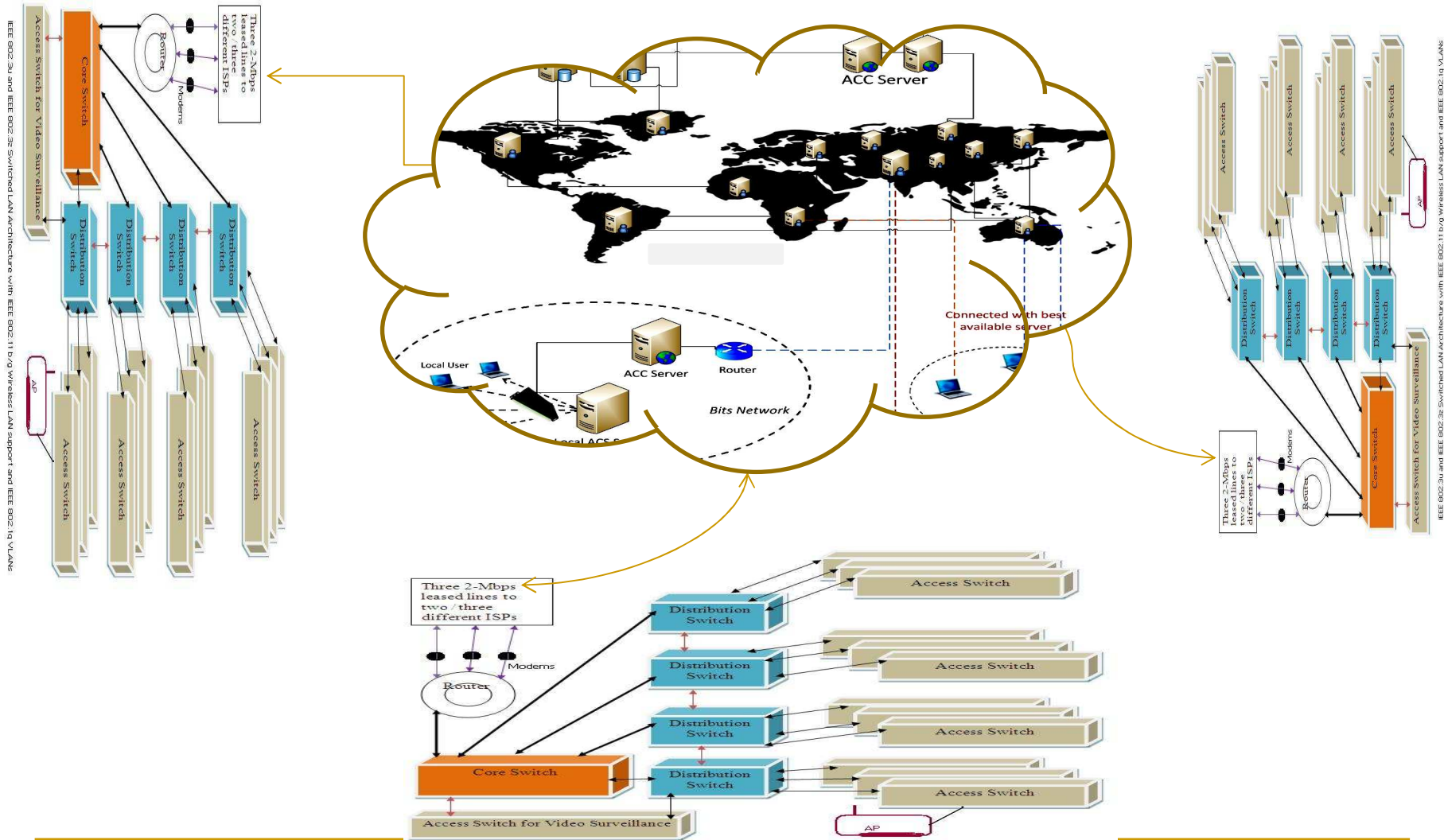


An Example of a Computer Network





What is an Internetwork?



IEEE 802.3u and IEEE 802.3e Switched LAN Architecture with IEEE 802.11 b/g Wireless LAN support and IEEE 802.1q VLANs



Some Terms Related to Networks

- Channel <application-level logical / virtual communication path>
- Services: Functionalities provided by a layer / protocol / entity
- Interfaces: Peer-to-Peer / Layer-to-Layer / entity-to-entity
- Service Access Points: defined addresses / ports through which data / parameters are passed
- Tunneling <Encapsulation & Decapsulation>



Summary of the Concepts & Terms learnt so far



Summary

- **Intranet:** Completely private network of networks
 - Wireline
 - **Wireless**
 - Fixed
 - **Mobile**
 - Hybrid
- **The Internet:** Global public network of networks
 - Wireline
 - **Wireless**
 - Fixed
 - **Mobile**
 - Hybrid
- **Extranet:** Intranets interconnected via the Internet



Any question please?

Thank you for your kind attention!

For further details, you may contact at:

E-mail: rahul@bits-pilani.ac.in / rahul.banerjee.cse@gmail.com

or visit:

Home: <http://www.bits-pilani.ac.in/~rahul/>

References

- *Larry L. Peterson & Bruce S. Davie: Computer Networks: A Systems Approach, Fourth Edition, Morgan Kaufmann / Elsevier, New Delhi, 2007. <System design approach>*
- IEEE 802 standards issued so far PLUS amendments like:
 - 802.3ap-2007: IEEE Standard for LAN/MAN — Specific Requirements
Part 3: CSMA/CD Access Method and Physical Layer Specifications
—Amendment 4: Ethernet Operation over Electrical Backplanes
 - 802.11-2007 IEEE Standard for LAN/MAN — Specific Requirements
Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications
 - 802.15.4a-2007 IEEE Standard for Telecommunications and Information Exchange Between Systems; PART 15.4: Wireless MAC and PHY Specifications for Low-Rate Wireless PANs (LR-WPANs) — Amendment 1: Add Alternate PHY
 - 802.1ag-2007 IEEE Standard for LAN/MAN — Virtual Bridged LANs
— Amendment 5: Connectivity Fault Management

References

- *A. S. Tanenbaum: Computer Networks, Fourth Edition, Pearson Education, New Delhi, 2003. <Conceptual Approach>*
- *Mohammed G. Gouda: Elements of Network Protocol Design, Wiley Student Edition, John Wiley & Sons (Pte.) Ltd., Singapore, 2004.*
- *Thomas G. Robertazzi: Computer Networks and Systems: Queuing Theory and Performance Evaluation, Third Edition, Springer-Verlag, New York, 2000. <Analytical approach>*
- *S. Keshav: Computer Networking: An Engineering Approach, Pearson Education, New Delhi, 1997.*
- *A. Leon Garcia and I. Widjaja: Communication Networks: Fundamental Concepts and Key Architectures, Second Edition, Tata McGraw-Hill, New Delhi, 2004.*
- *Y. Zheng and S. Akhtar: Networks for Computer Scientists and Engineers, Oxford University Press, New York, 2002. <Structural approach>*