TELECOMMUNICATION NETWORK PERFORMANCE

The big picture

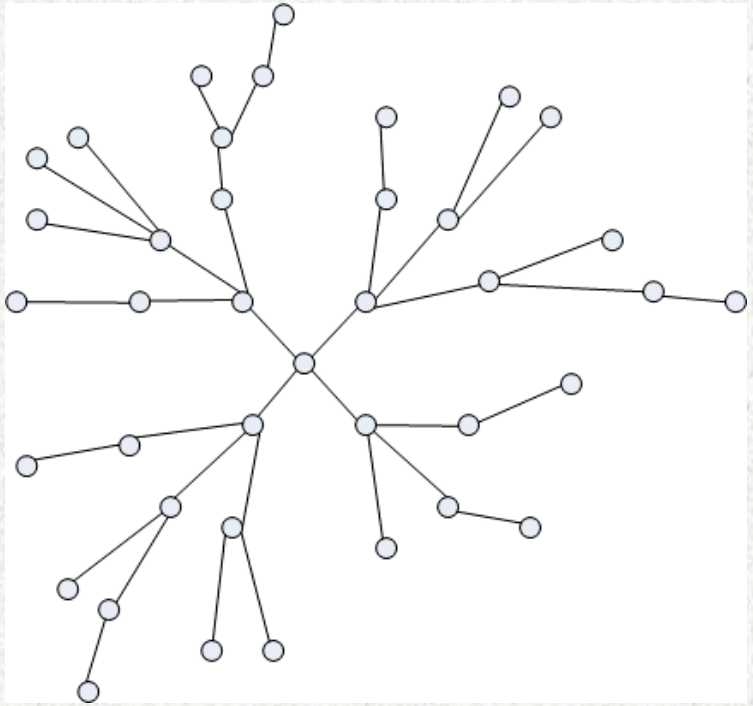
Lecture's Scopes:

1. The big picture of current telecomm. networks
2. Qos metrics (1): phycisal layer and data link layer metrics
3. Qos metrics (2): network layer and transport layer metrics
4. System reliability (1): MTTF, MTTF, MTBT, FIT, availabilty, survivabilty
5. System reliabilty (2): surviability for optical and wireless network cases
6. Network queuing (1): concepts, Kendall notation
7. Network queuing (2): Markov chains model
8. Network controlling (1): optimations
9. Network controlling (2): optimations
10. Network modeling and simulation (1)
11. Network modeling and simulation (2)
12. Network case 1
13. Network case 2
14. Network case 3

Main References:

- William C. Hardy, “QoS Measurement and Evaluation of Telecommunications Quality of Service,” John Wiley & Sons, 2001.
- Dietmar Tutsch, Performance Analysis od network Architectures, Springer-Verlag Berlin Heidelberg, 2006
- Wah Chun Chan, Performance Analysis of Telecommunications and Local Area Networks, Kluwer Academic Publishers, 2002.
- Piet Van Mieghem, Performance Analysis of Communications Networks and Systems, Cambridge University Press, 2006.
- Demetres D. Kouvatsos (Editor), Network Performance Engineering, Springer-Verlag Berlin Heidelberg, 2011
- Jeremiah F. Hayes, Thimma V. J. Ganesh babu, Modelling and Analysis of Telecommunications Networks, John Wiley & Sons Inc, 2004

Telecomm Networks



en.wikipedia.org

- A **telecommunications network** is a collection of terminal nodes, links and any intermediate which are connected so as to enable telecommunication between the terminals.
- The transmission links connect the nodes together. The nodes use circuit switching, message switching or packet switching to pass the signal through the correct links and nodes to reach the correct destination terminal.
- Each terminal in the network usually has a unique address so messages or connections can be routed to the correct recipients.

Telecommunication Nodes Examples

Fixed Telephones Network

- a public or private telephone exchange,
- a remote concentrator,
- a computer providing some intelligent network service.

Cellular communication

- Base station controller
- Home Location Register
- Gateways GPRS Support (GGSN)
- Serving GPRS Support Node (SGSN,

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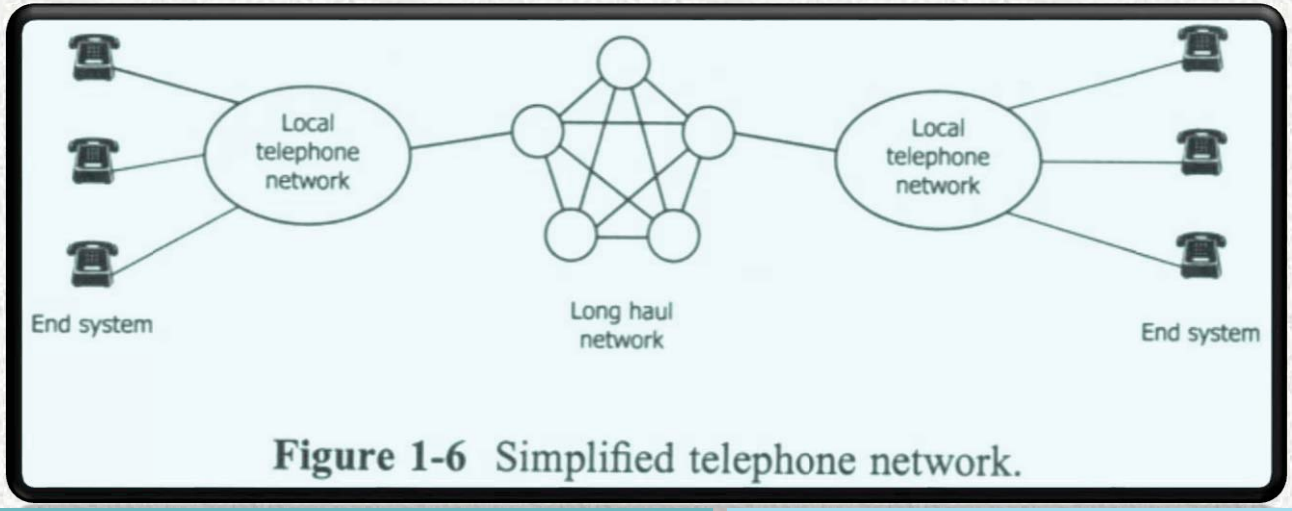


Figure 1-6 Simplified telephone network.

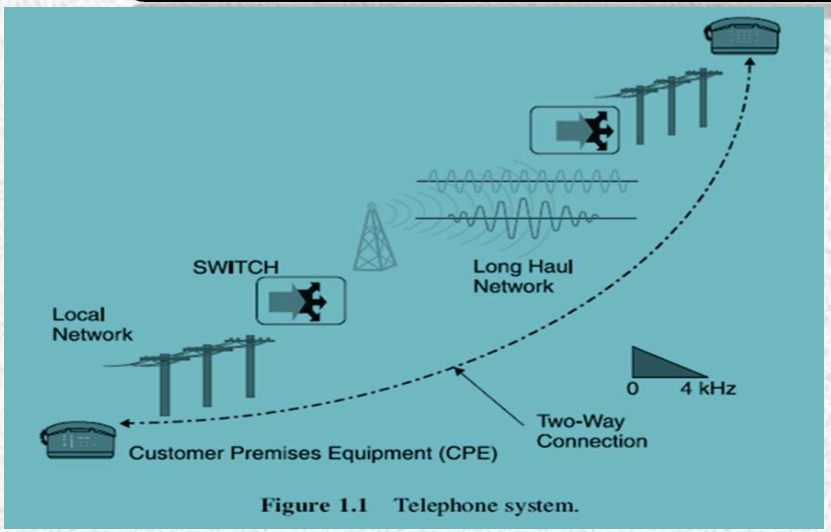


Figure 1.1 Telephone system.

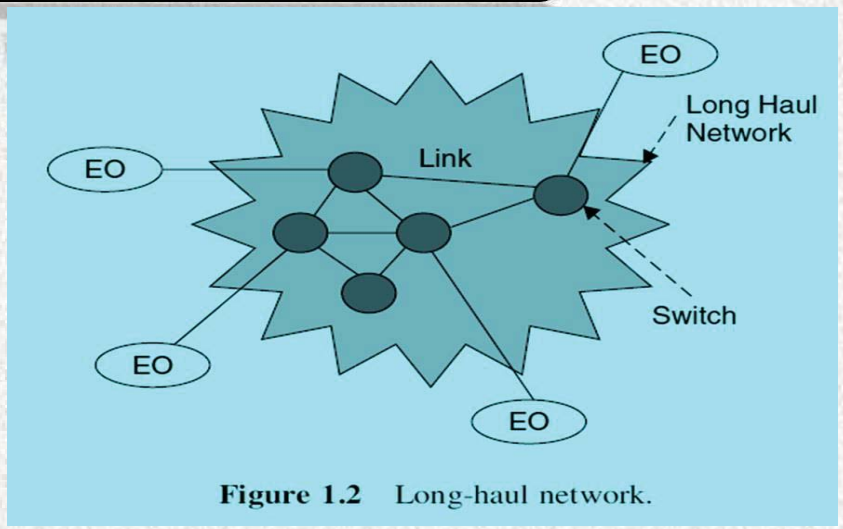


Figure 1.2 Long-haul network.

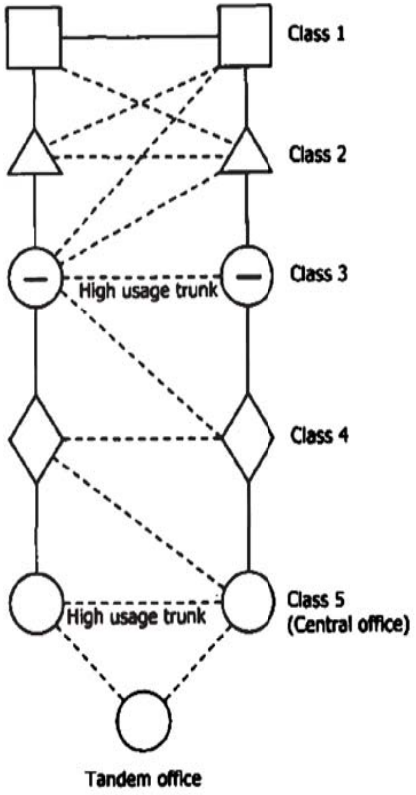


Figure 1-7 The North American (AT&T) hierarchical network (dashed lines show high-usage trunks). Note that the two highest ranks are connected in mesh.

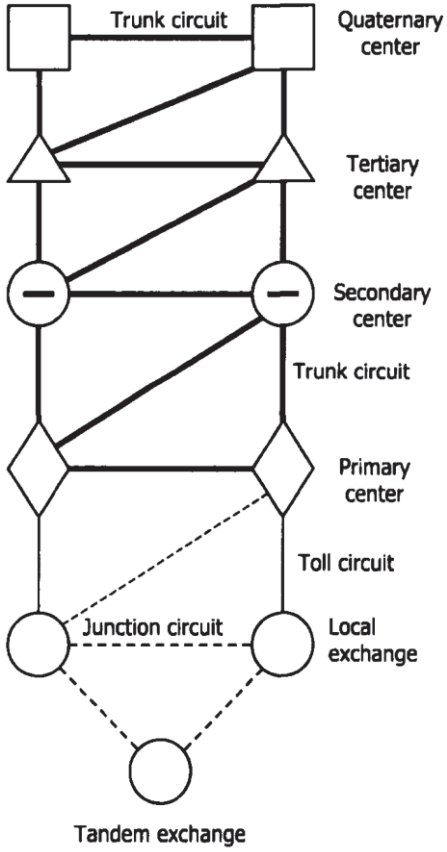


Figure 1-8 The ITU-T (or CCITT) hierarchical structure.

Wah Chun Chan, Performance Analysis of Telecommunications and Local Area Networks, Kluwer Academic Publishers, 2002.

The switching types

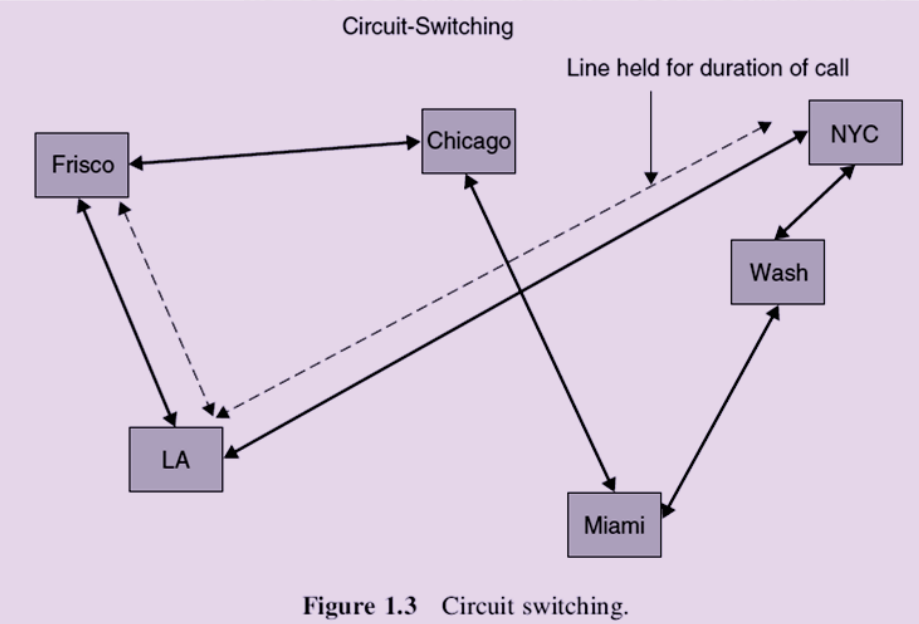


Figure 1.3 Circuit switching.

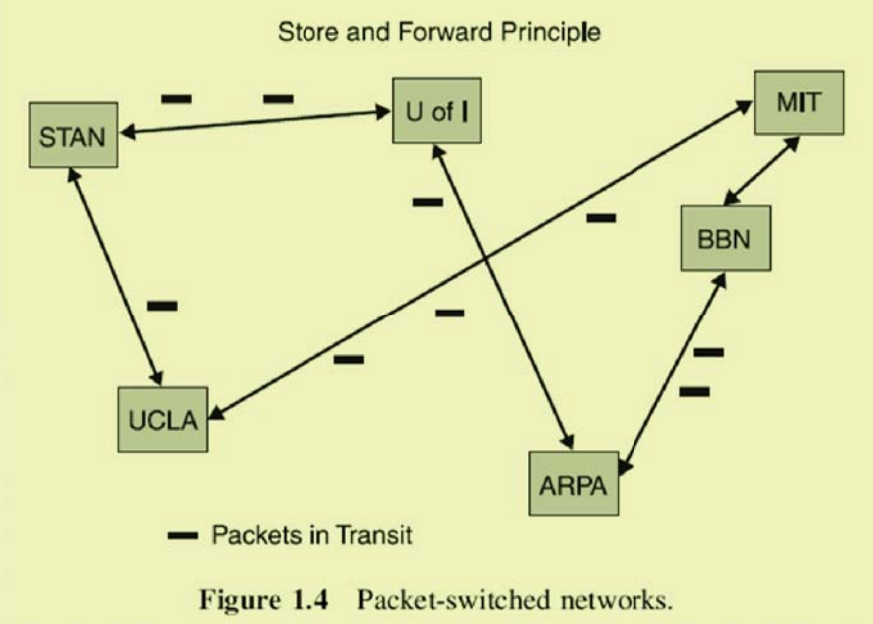


Figure 1.4 Packet-switched networks.

Jeremiah F. Hayes, Thimma V. J. Ganesh Babu, Modelling and Analysis of Telecommunications Networks, John Wiley & Sons Inc, 2004

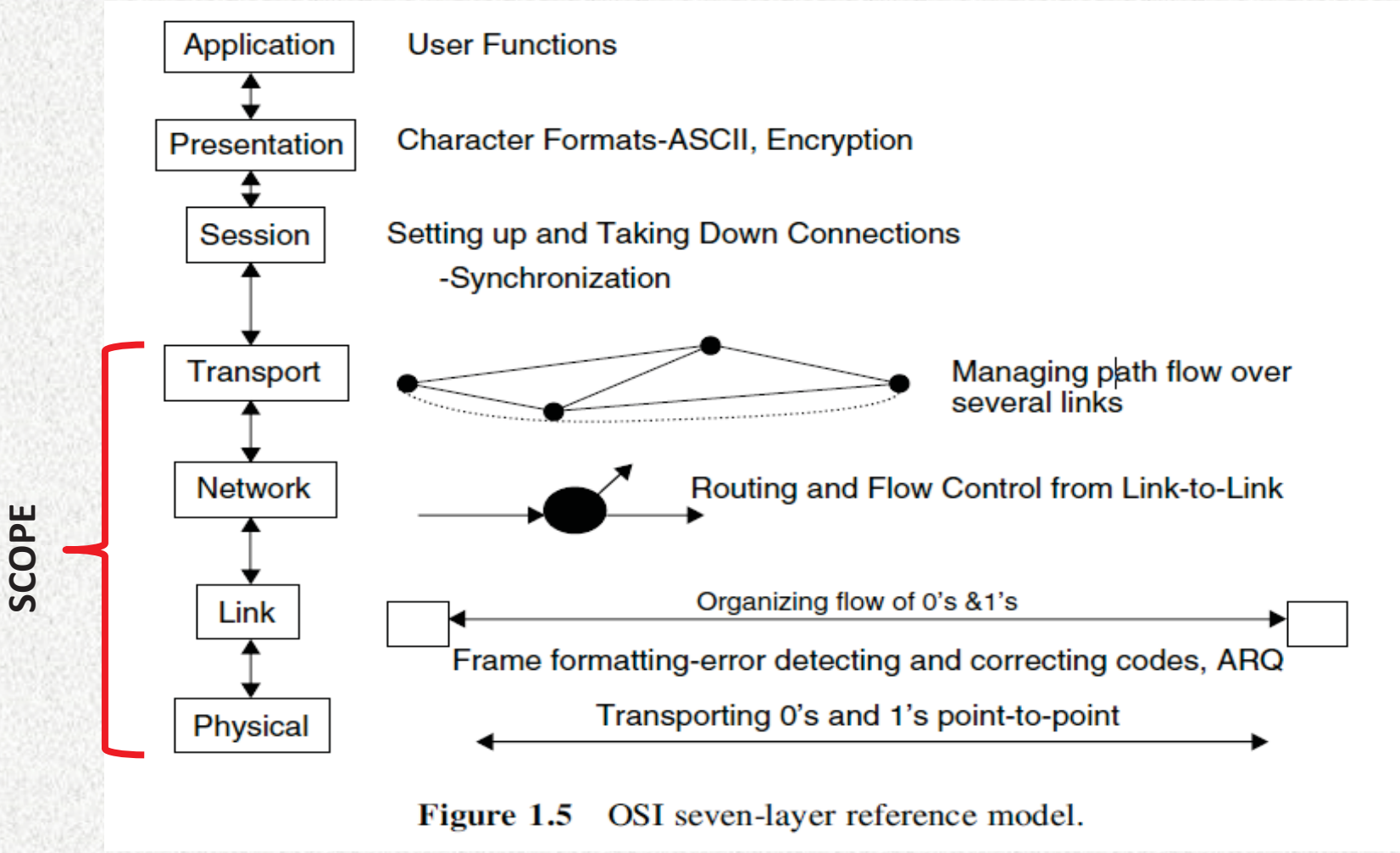
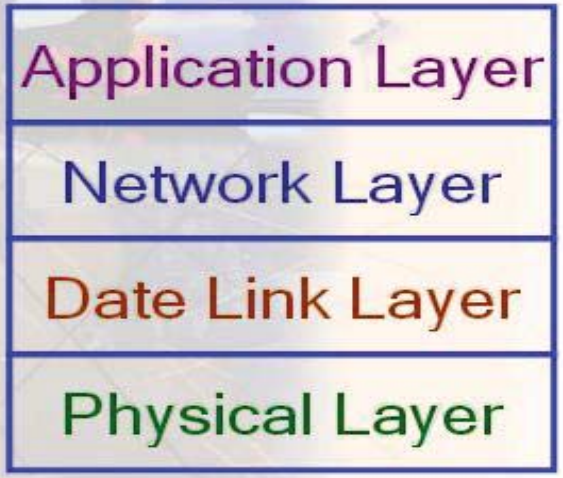


Figure 1.5 OSI seven-layer reference model.

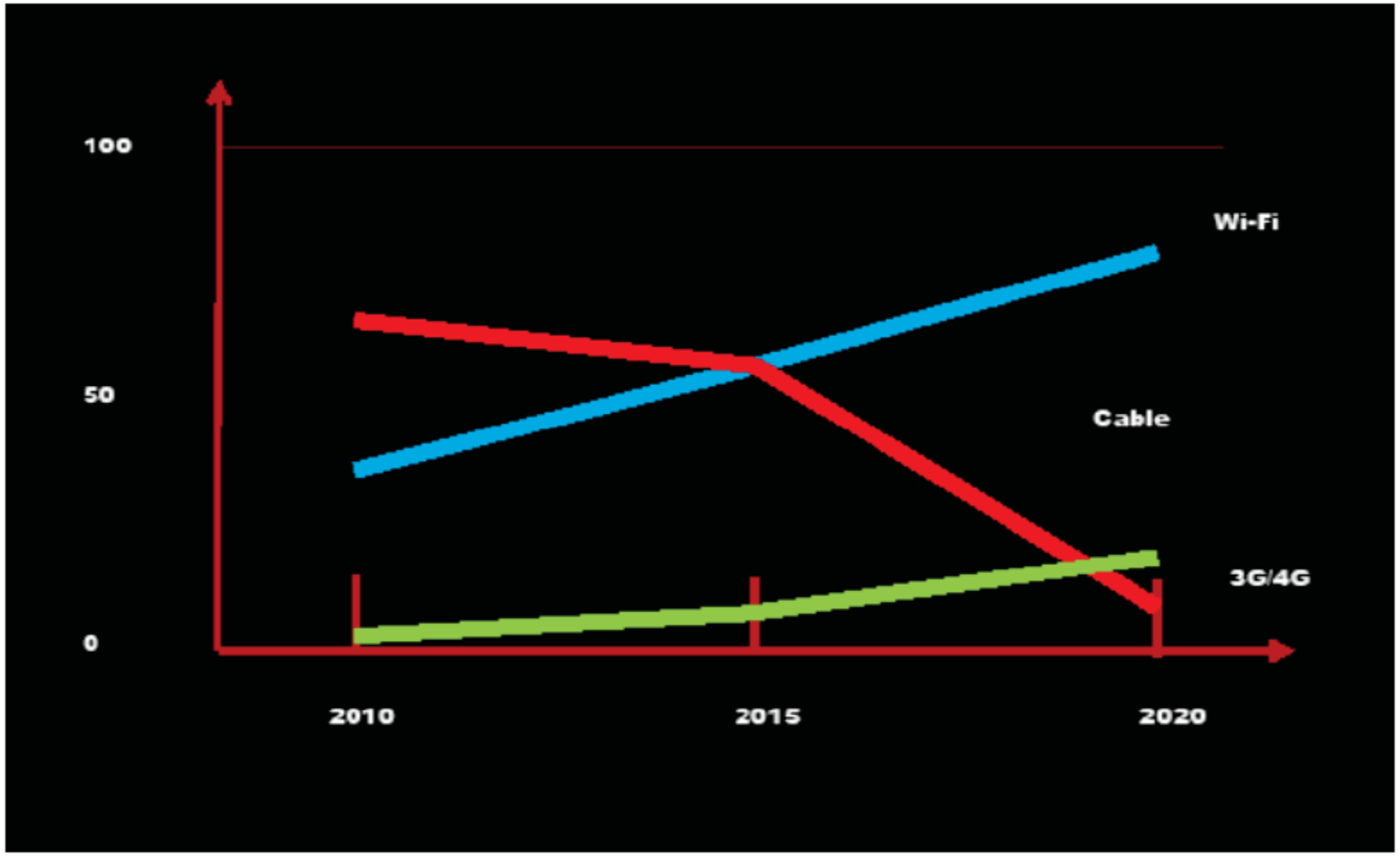
Conceptual Layers in a Wireless Network

- **Physical layer** --- involves the actual signal transmission and reception over the propagation channel.
- **Datalink Link layer** --- deals with signal at the output of the base station receiver, performs radio resource management, power control, rate allocation, call admission, error control etc.
- **Networks layer**: a protocol stack that includes handoff management, location management, traffic management and traffic control.
- **Application layer**: communicating, distributed processes running in end systems (hosts), e.g., e-mail, Web, P2P file sharing, instant messaging



Current Issues

- Internet is increasing exponentialy
- Internet traffic and the bandwidth double in every 18 months
- The bandwidth is about 100 Tbits/s
- More wireless voice traffic than wired traffic
- Computer Telephony Integration (CTI)
- Switched telephony network to IP NGN networks (multiservices convergent networks)
- Modem triple play (voice, data, TV)
- Quadruple play: triple play + mobile telephony
- Virtualization of the access point, green networks
- IP Multimedia System (IMS) architecture: full IP arichitecture



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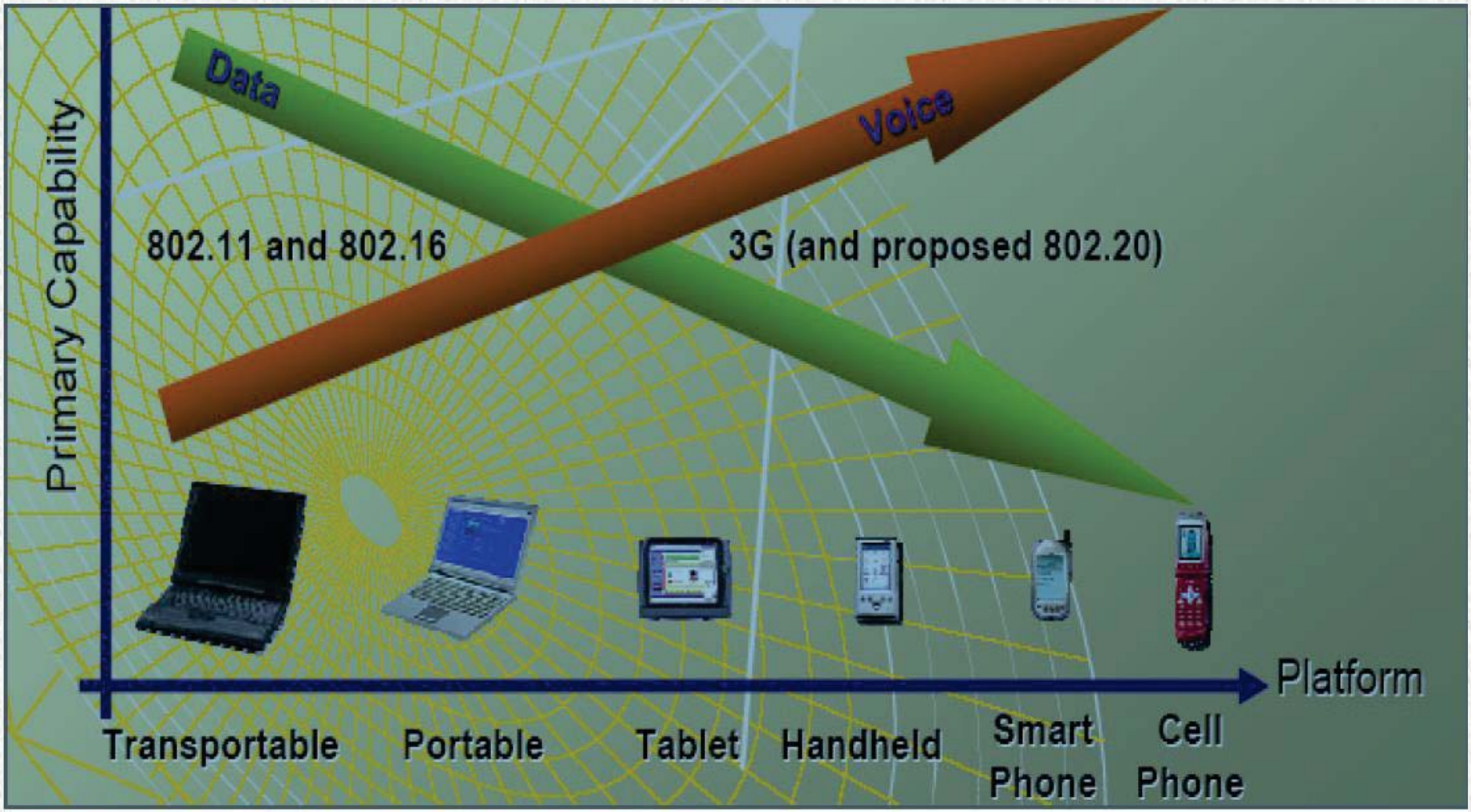
Data
Voice
802.11 and 802.16
3G (and proposed 802.20)
Primary Capability
Platform
Transportable
Portable
Tablet
Handheld
Smart Phone
Cell Phone

Flexible Organic Light Emitting Diode (OLED) – Holographic / Laser keyboard

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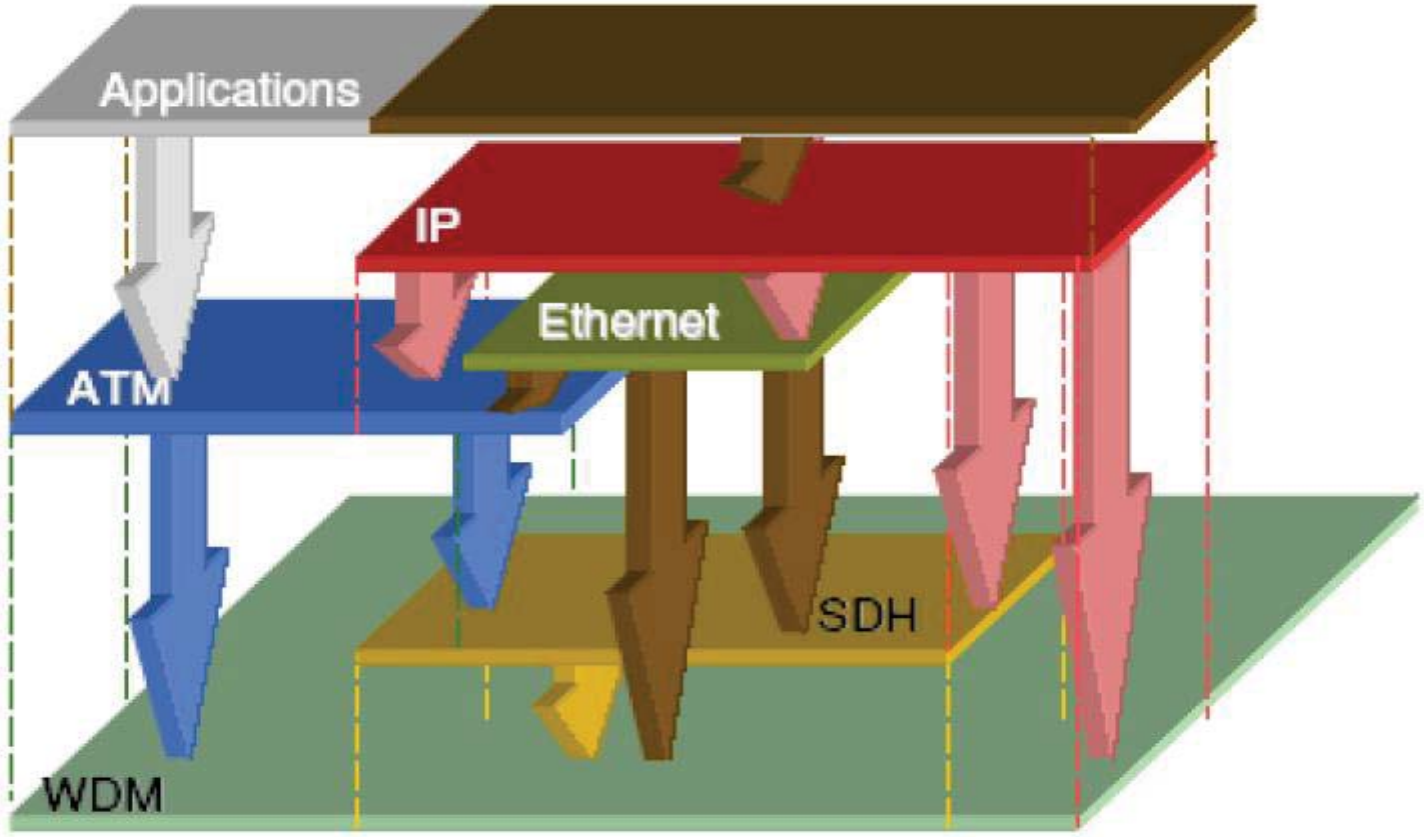

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