INTRODUCTION TO THE INSTITUTION OF ELECTRICAL & ELECTRONIC ENGINEERS

IEEE 802 STANDARD

ECE 422– DATA COMMUNICATIONS & COMPUTER NETWORKS

Tuesday, 14 April 2026

WHERE ARE WE IN THE SYLLABUS…

Course Content:

Introduction: Overview of Data Communications and Networking.

Physical Layer: Analog and Digital, Analog Signals, Digital Signals, Analog versus Digital, Data Rate Limits, Transmission Impairment, More about signals.

Digital Transmission: Line coding, Block coding, Sampling, Transmission mode.

Analog Transmission: Modulation of Digital Data; Telephone modems, modulation of Analog signals.

Multiplexing: FDM, WDM, TDM.

Transmission Media: Guided Media, Unguided media (wireless).

Data Link Layer: Error Detection and correction - Types of Errors, Detection, Error Correction; Data Link Control and Protocols-Flow and Error Control, Stop-and-wait ARQ. Go-Back-N ARQ, Selective Repeat ARQ, HDLC. Point-to-Point Access- Point–to-Point Protocol (PPP), PPP Stack, Multiple Access Random Access, Controlled Access, Channelization.

Network Layer: Host to Host Delivery: Internetworking, addressing and Routing Network Layer Protocols: ARP, IPV4, ICMP, IPV6 and ICMPV6

Transport Layer: Process to Process Delivery: UDP; TCP congestion control and Quality of service.

Application Layer: Client Server Model, Socket Interface, Domain Name System (DNS): Electronic Mail (SMTP) and file transfer (FTP) HTTP and WWW.

Local area Network: Ethernet - Traditional Ethernet, Fast Ethernet, Gigabit Ethernet; Token bus, token ring; Wireless LANs - IEEE 802.11, Bluetooth virtual circuits: Frame Relay and ATM.

Industrial Communication and Control Networks: Transmission methods, Network topology, Contemporary networks – Profibus, Controller Area Network (CAN), DeviceNet, CANopen, Actuator Sensor Interface (AS-1),Industrial Ethernet.

WHAT IS IEEE?

- **The IEEE (Institute of Electrical and Electronics Engineers) is** the world's largest technical professional society -- promoting the development and application of electrotechnology and allied sciences for the benefit of humanity, the advancement of the profession, and the well-being of our members.“

IEEE
Advancing Technology for Humanity

- IEEE inspire a global community to innovate for a better tomorrow through its more than 423,000 members in over 160 countries, and its highly cited publications, conferences, technology standards, and professional and educational activities.

- IEEE is the trusted “voice” for engineering, computing, and technology information around the globe.

HISTORY OF IEEE

YEAR	INSTITUTION	FOUNDING MEMBERS
1884	**American Institute of Electrical Engineers(AIEE)** formed in Philadelphia	1. **Norvin Green** of Western Union, came from telegraphy and was first president. 2. **Thomas Edison**, came from **power,** 3. **Alexander Graham** Bell represented the telephone industry.
1912	**Institute of Radio Engineers (IRE)** formed in New York City.	Among its founding organizations were: 1. The Society of Wireless Telegraph Engineers (SWTE) and 2. The Wireless Institute (TWI).
1963	**AIEE and the IRE merged** to form the **Institute of Electrical and Electronics Engineers, or IEEE**	At its formation, IEEE had 150,000 members, 140,000 of whom resided in the United States.

IEEE AT A GLANCE - 2021

As of 2021, IEEE had:

1. Over 409,000 members in more than 160 countries, more than 60 percent of whom are from outside the United States
2. More than 125,000 Student members
3. 343 Sections in ten geographic Regions worldwide
4. 2,615 Chapters that unite local members with similar technical interests
5. 3,565 Student Branches at colleges and universities in over 100 countries
6. 3,182 Student Branch Chapters of IEEE technical Societies
7. 608 affinity groups

IEEE - IEEE at a Glance

BENEFITS OF IEEE MEMBERSHIP

Only IEEE members get exclusive access to the largest library of electrical engineering, computer science, and electronics technical literature, as well as technology trends, industry news, and events.

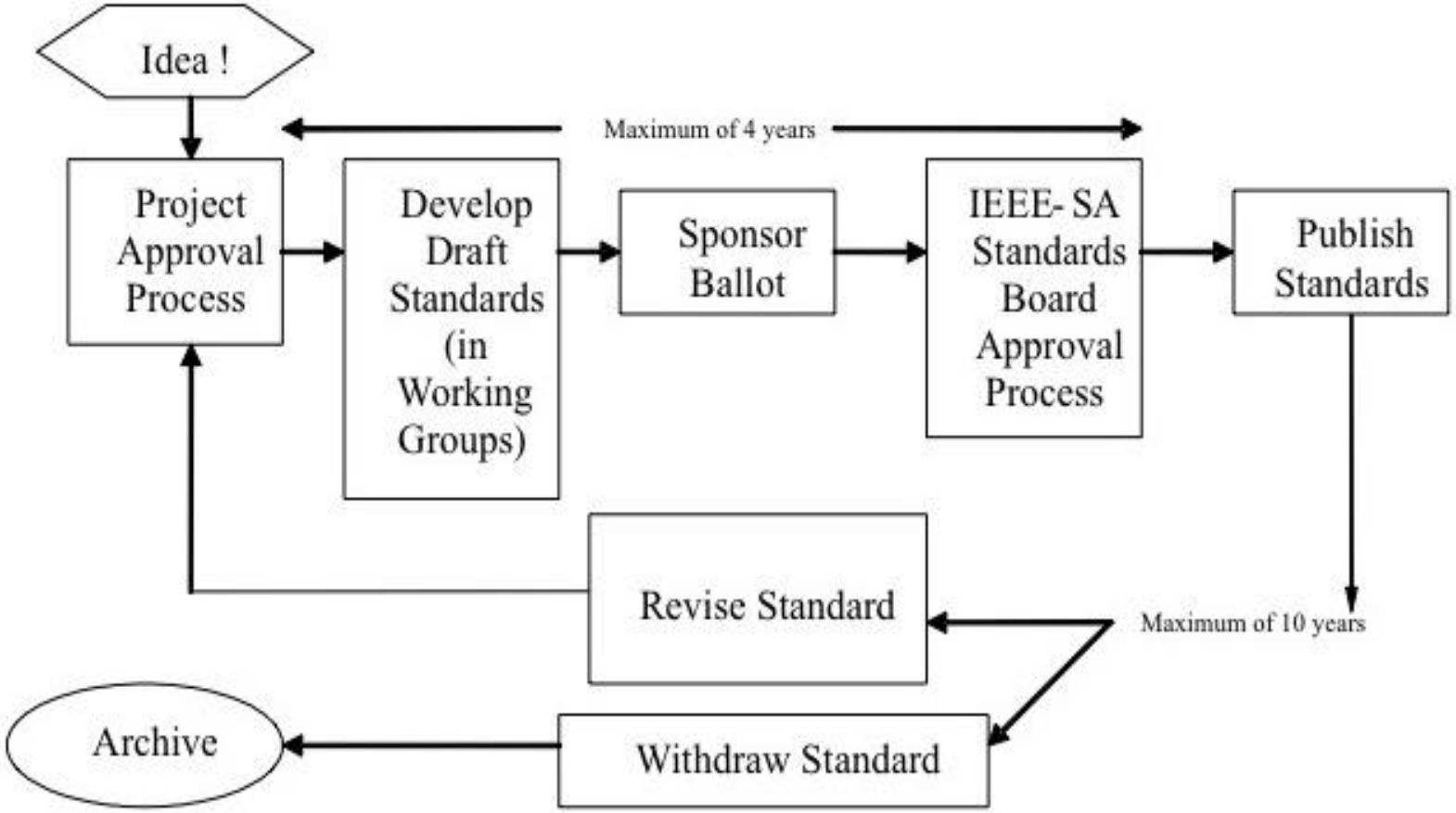
- **IEEE SPECTRUM MAGAZINE**
  - Get insights into technology advances and innovation, and the dedicated professionals driving continued innovation through this award-winning monthly magazine.
- **IEEE.TV**
  - Watch over 2,500 videos covering technology, engineering, author interviews, product news, and conferences.
- **IEEE *XPLORE*® DIGITAL LIBRARY**
  - Get members-only discounted access to nearly 4-million documents spanning journals and magazines, conference proceedings, standards, and more.
- ***IEEE POTENTIALS* MAGAZINE**
  - Learn about career strategies, the latest in research, and how theories relate to practical applications, as well as important technical developments and their global impact.
- ***PROCEEDINGS OF THE IEEE***
  - Access the most highly-cited general interest journal in electrical engineering and computer science.
- **IEEE *ACCESS*®**
  - Examine results of original research and development across all fields of interest through this award-winning, multidisciplinary, all-electronic, archival journal.

WHAT ARE STANDARDS?

- **Standards** are published documents that establish specifications and procedures designed to maximize the reliability of the materials, products, methods, and/or services people use every day.

- Standards address a range of issues, including but not limited to various protocols to help maximize product functionality and compatibility, facilitate interoperability and support consumer safety and public health.

IEEE STANDARD DEVELOPMENT PROCESS



1. Once a draft standard has been finalized, reviewed, and approved by the Working Group, it is submitted to the Sponsor for Sponsor balloting. Upon successful completion of the Sponsor ballot, the draft is submitted to the Review Committee.
2. The balloted draft is reviewed by the Committee and then submitted to the Standards Board for approval. After submission, review and acceptance, the approved standard is published and made available for distribution and purchasing.

WHAT IS A WORKING GROUP?

- **Working Groups** develop (create and write) the standard. Working Groups are open to anyone to participate.
- For individual standards projects, IEEE or IEEE-SA (Standard Association) membership is not required to participate.
- For corporate standards projects, IEEE-SA corporate membership is required.
- Overall, Working Groups strive for broad representation of all interested parties and encourage global participation.
- Working Groups have a chairperson who facilitates the group discussions and offers leadership and guidance to the Working Group. He/she also serves as the contact person for technical questions about the standard.

BRIEF INTRODUCTION TO NETWORK STANDARDS

- **1983:** the International Standards Organization (ISO) developed a network model called Open Systems Interconnection (OSI) Reference Model, which defined a framework of computer communications.
- The Institute of Electrical and Electronic Engineers (IEEE) developed a set of LAN standards, known as IEEE Project 802, which the ISO accepted as international standards.
- The IEEE LAN standards addressed only the lowest two layers, the physical and data link layers, of the ISO/OSI model.

7. Application Layer
6. Presentation
5. Session
4. Transport
3. Network

IEEE LAN Standards

2(a) IEEE 802.2 Logical Link Control
2(b) Medium Access Control
1. Physical Layer

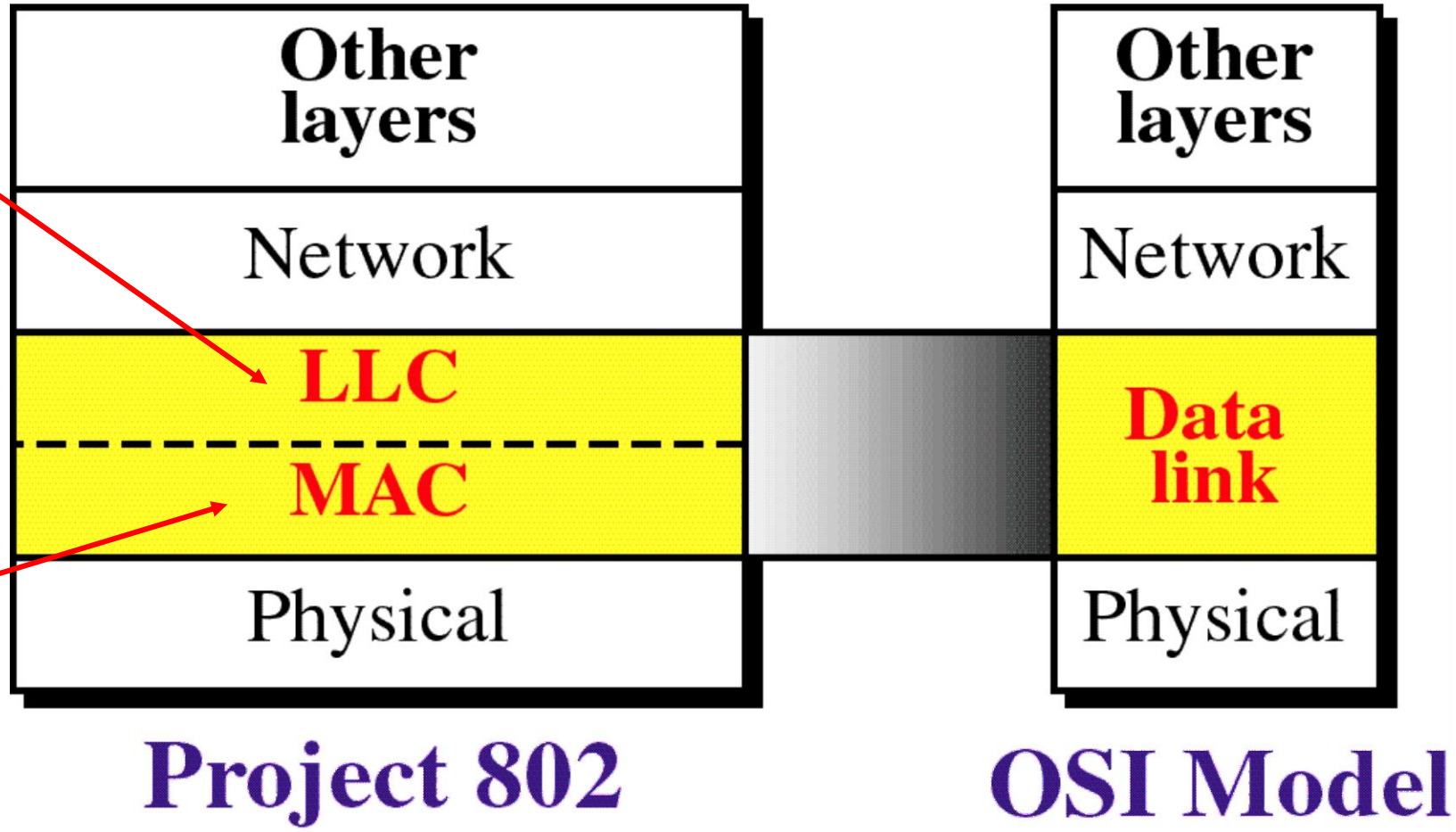
IEEE PROJECT 802

1. **The computer society of the IEEE** started the 802 project to set up standards to enable intercommunication between equipment from a variety of manufacturers.
2. **Project 802** does not seek to replace any part of the OSI model but enhances Layer 2.
3. The IEEE has subdivided the data link layer into two sub layers:
   a) Logical link control(LLC)
   b) Medium access control(MAC)

PRJOECT 802 COMPARED WITH OSI MODEL

Logical Link Control (LLC) is the same for all IEEE defined LAN, WANs and WRANs.

Medium Access Control (MAC) contains a number of distinct modules carrying proprietary information specific to the LAN being used, e.g. Ethernet, WiFi, etc.



PROJECT 802 AND LOCAL AREA NETWORKS

1. A Local area Network is the data communication system that allows a number of independent devices to communicate directly with each other in a limited geographical area.
2. LANs were initially dominated by four architecture:
   a) Ethernet
   b) Token Bus
   c) Token Ring
   d) Fiber distributed data interface
3. Token Bus, Token Ring and Ethernet are therefore part of project IEEE 802.

IEEE 802 STANDARD

Operating System

7. Application Layer
6. Presentation
5. Session
4. Transport
3. Network

LLC and MAC

802.2 Logical Link Control - Disbanded
802.3 Ethernet (CSMA/CD) – formed 1983 , Active
802.4 Token Ring Bus – Disbanded
802.5 Token Ring Access - Disbanded
802.6 Distributed Queue Bus Access - Disbanded
802.7 Broadband LAN - Disbanded
802.8 Fibre Optic - Disbanded
802.9 Integrated Services LAN - Disbanded
802.10 Interoperable LAN Security - Disbanded
802.11 Wireless LAN - 1997
802.12 Demand Priority Access (100base VG- disbanded)
802.13 - Reserved
802.14 Medium Access Control for cable modems (disbanded)
802.15 Wireless Personal Networks (Bluetooth, Zigbee, etc)
802.16 Broadband Metro Area Networks (WiMax)
802.17 Resilient packet Ring

SUMMARY OF 802 PROJECT WORKGROUPS/01

STANDARD	NAME	TOPIC
802.1	Internetworking-Active	Routing, bridging and network-to-network communication
802.2	Logical Link Control -Disbanded	Error and flow-control over data frames
802.3	Ethernet LAN-Active	Ethernet media and interfaces
802.4	Token bus LAN-Disbanded	Token bus media and interfaces
802.5	Token ring LAN-Disbanded	Token ring media and interfaces
802.6	Metropolitan Area Network (MAN) - Disbanded	Metropolitan Area Network technologies, addressing and services
802.7	Broadband Technical Advisory Group-Disbanded	Broadband networking media, interfaces and related equipment
802.8	Fibre Optic Technical Advisory Group-Disbanded	Fibre Optic media used in token passing networks e.g. FDDI
802.9	Integrated Voice and Data Networks	Integration of voice and data over a single network medium.
802.10	Network Security-Disbanded	Network access control, encryption, certification and related security topics
802.11	Wireless Local Area Networks	Standards for wireless local area networking also known as WiFi.

SUMMARY OF 802 PROJECT WORKGROUPS/02

STANDARD	NAME	TOPIC
802.12	High Speed Networking-Disbanded	100 Mbps plus technologies
802.13	Reserved	
802.14	Cable broadband Networks-Disbanded	Co-axial cable based broadband networks
802.15	Wireless Personal Area Networks-Active	Wireless networking of portable and mobile computing devices such as PCs, Personal Digital Assistants (PDAs), etc.
802.16	Broadband Wireless Access-Active	Development and deployment of broadband Wireless Metropolitan Area Networks.
802.17	Resilient Packet Ring-Hibernating	Resilient Packet Ring (RPR) networks in Local, Metropolitan, and Wide Area Networks for resilient and efficient transfer of data packets at rates scalable to many gigabits per second.
802.18	Radio Regulatory Technical Advisory Group (RR-TAG)-	Monitoring and participating in radio regulatory matters worldwide as an advocate for IEEE 802.
802.19	Wireless Coexistence	Reviewing coexistence assurance (CA) documents produced by working groups developing new wireless standards for unlicensed devices.
802.20	Mobile Broadband Wireless Access (MBWA)-Hibernating	Specification of physical and medium access control layers of an air interface for interoperable mobile broadband wireless access systems, operating in licensed bands below 3.5 GHz,

SUMMARY OF 802 PROJECT WORKGROUPS/03

STANDARD	NAME	TOPIC
802.21	Media access Independent Services	1. Developing an extensible Media access Independent Services framework (i.e., function and protocol) that enables the optimization of services including handover service when performed between heterogeneous IEEE 802 networks. 2. Facilitate services above when networking between IEEE 802 networks and Cellular networks.
802.22	Wireless Regional Area Networks	Developing a wide variety of standards to enable spectrum sharing.
802.23	Emergency Services Working Group	Developing a media independent framework within IEEE 802 to provide consistent access and data that facilitate compliance to applicable civil authority requirements for communications systems that include IEEE 802 networks.
802.24	Vertical Applications Technical Advisory Group (TAG)	Advises on application categories that use IEEE 802 technology and are of interest to multiple IEEE 802 WGs

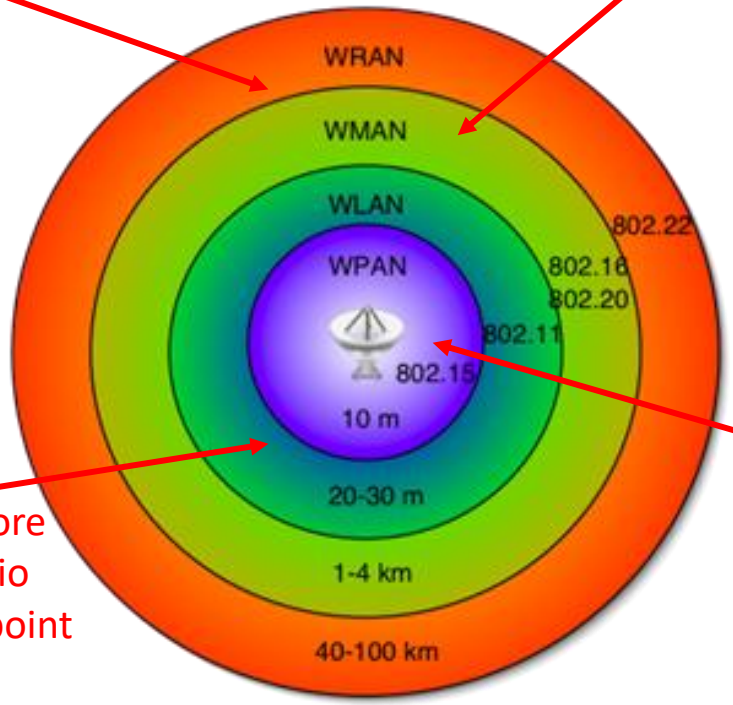
IEEE 802 WIRELESS STANDARDS

Wireless Regional Area Network (WRAN)

1. Uses underutilized parts of the radio frequency (RF) spectrum to provide Internet connectivity for homes and businesses, particularly in underserved areas.
2. Uses cognitive radio capabilities, enabling access points to negotiate with one another to avoid interference.

Wireless Metropolitan Area Network (WMAN)

1. WMAN has an intended coverage area of approximately the size of a city.
2. Typically owned by a single entity such as an Internet service provider (ISP), government entity, or large corporation. Access to a WMAN is usually restricted to authorized users or subscriber devices. WiMAX is the most widely used form of WMAN.



Wireless Local Area Network (WLAN)

1. A distribution method for two or more devices that use high-frequency radio waves and often include an access point to the Internet.
2. A WLAN allows users to move around the coverage area, often a home or small office, while maintaining a network connection

Wireless Personal Area Network (WPAN)

1. A network for interconnecting devices centered around an individual person's workspace.
2. Communication is limited to about 10 meters
3. Bluetooth and Zigbee are the most widely used form of WPAN.

SCOPE OF IEEE 802 WIRELESS CONSORTIA

NAME	WORKGROUP	TECHNOLOGY/INDUSTRY CONSORTIA WEBSITE
Wireless Metropolitan Area Network (WMAN)	IEEE 802.16	• WiMAX Forum
Wireless Local Area Network (WLAN)	IEEE 802.11	• WiFi Alliance
Wireless Personal Area Network (WPAN)	IEEE 802.15	• Zigbee Alliance • Bluetooth Technology • WiMedia Alliance
Wireless Regional Area Network (WRAN)	IEEE 802.22	

IEEE 802 WORKGROUP WEBSITES

WORKGROUP	WEBSITE
IEE 802.1 802 LAN/MAN architecture, internetworking and Security Workgroup	http://www.ieee802.org/1/
IEEE 802.11 Wireless local area networks - The Working Group for WLAN Standards	http://www.ieee802.org/11/
IEEE 802.15 Wireless Specialty Networks (WSN)	http://www.ieee802.org/15/
IEEE 802.16 Working Group on Broadband Wireless Access Standards.	http://www.ieee802.org/16/
IEEE 802.18 Radio Regulatory Technical Advisory Group (RR-TAG)	http://www.ieee802.org/18/
IEEE 802.20 Mobile Broadband Wireless Access (MBWA)	http://www.ieee802.org/20/
IEEE 802.21 is developing an extensible Media access Independent Services (MIS) framework (i.e., function and protocol) that enables the optimization of services including handover service when performed between heterogeneous IEEE 802 networks. It also facilitates these services when networking between IEEE 802 networks and Cellular networks.	http://www.ieee802.org/21/
IEEE 802.22 Working Group on Wireless Regional Area Networks - Enabling Broadband Wireless Access Using Cognitive Radio Technology and Spectrum Sharing in White Spaces.	http://www.ieee802.org/22/

LIST OF IEEE SOCIETIES /01

1. IEEE Aerospace and Electronic Systems Society
2. IEEE Antennas & Propagation Society
3. IEEE Broadcast Technology Society
4. IEEE Circuits and Systems Society
5. IEEE Communications Society
6. IEEE Components, Packaging & Manufacturing Technology Society
7. IEEE Computational Intelligence Society
8. IEEE Computer Society
9. IEEE Consumer Electronics Society
10. IEEE Control Systems Society
11. IEEE Dielectrics & Electrical Insulation Society
12. IEEE Education Society
13. IEEE Electromagnetic Compatibility Society
14. IEEE Electron Devices Society
15. IEEE Engineering in Medicine and Biology Society
16. IEEE Geoscience and Remote Sensing Society
17. IEEE Industrial Electronics Society
18. IEEE Industry Applications Society
19. IEEE Information Theory Society
20. IEEE Instrumentation and Measurement Society

LIST OF IEEE SOCIETIES /02

21. IEEE Intelligent Transportation Systems Society
22. IEEE Magnetics Society
23. IEEE Microwave Theory and Techniques Society
24. IEEE Nuclear and Plasma Sciences Society
25. IEEE Oceanic Engineering Society
26. IEEE Photonics Society
27. IEEE Power & Energy Society
28. IEEE Power Electronics Society
29. IEEE Product Safety Engineering Society
30. IEEE Professional Communication Society
31. IEEE Reliability Society
32. IEEE Robotics and Automation Society
33. IEEE Signal Processing Society
34. IEEE Society on Social Implications of Technology
35. IEEE Solid-State Circuits Society
36. IEEE Systems, Man, and Cybernetics Society
37. IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society
38. IEEE Vehicular Technology Society

REFERENCES

1. Cal Eklund, Roger B. Marks,Subbu Ponnuswamy, Kenneth L. Stanwoood, NocoJ.M. vanWaes, "..\..\Books\WiMAX\WirelessMAN-Inside the IEEE 802 16 Standard for Wireless Metropolitan Area Networks.pdf," IEEE, May-06, ISBN:0738148423.

2. Jeffrey G. Andrews, Arunabha Ghosh, Rias Muhamed, "Fundamentals of WiMAX: Understanding Broadband Wireless Networking," Prentice-Hall, ISBN:0132225522.

3. Loutfi Nuaymi, "WiMAX: Technology for Broadband Wireless Access,"