

INTRODUCTION TO THE INSTITUTION OF ELECTRICAL & ELECTRONIC ENGINEERS



IEEE 802 STANDARD

ECE 422– DATA COMMUNICATION & COMPUTER NETWORKS

Monday, 14 June 2021

WHERE ARE WE IN THE SYLLABUS?

Wireless Area Networks:

WiMAX: BWA - issues and challenges of WiMAX - network architecture - protocol stack of **IEEE 802.16** - physical layer, MAC layer schemes - differences between **IEEE 802.11** and **IEEE 802.16**; **WLAN:** Fundamentals - technical issues - network architecture - protocol stack of IEEE 802.11 - physical layer, MAC layer mechanism; **WPAN:** Technical issue – system model- protocol stack of **IEEE 802.15**; **Bluetooth:** Network architecture - operation-protocol stack - specification and application models;

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 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	<ol style="list-style-type: none">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: <ol style="list-style-type: none">1. the Society of Wireless Telegraph Engineers (SWTE) and2. 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

Our Global Reach

425,000+
Members



39
Technical Societies



160
Countries



Our Technical Breadth

1,600
Annual Conferences



3,900,000+
Technical Documents



170+
Top-cited Periodicals



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.
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- 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.



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 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.

IEEE LAN Standards

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

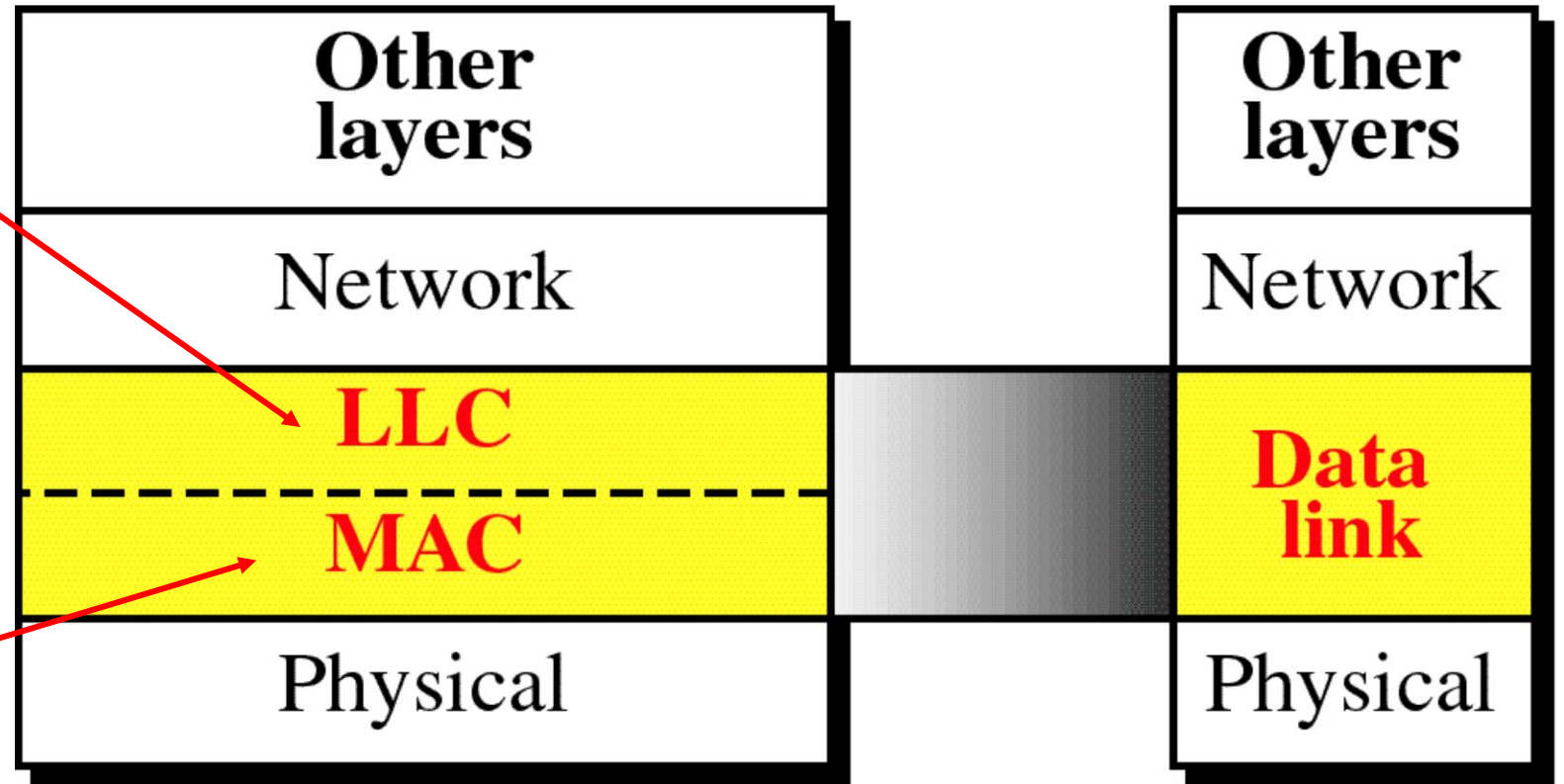
PRJOECT 802 COMPARED WITH OSI MODEL

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, Token bus, etc.



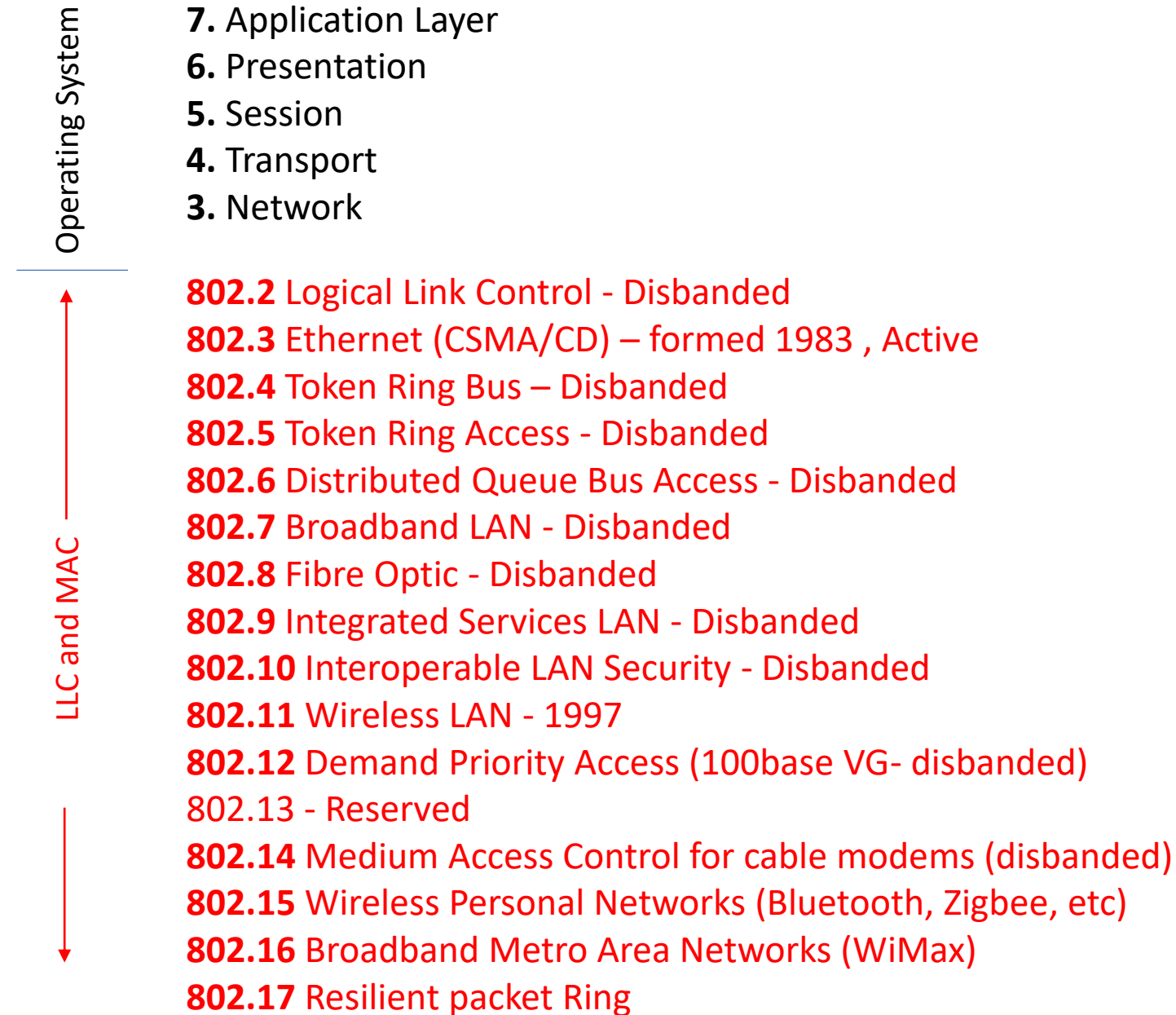
Project 802

OSI Model

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 are 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



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	<ol style="list-style-type: none">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

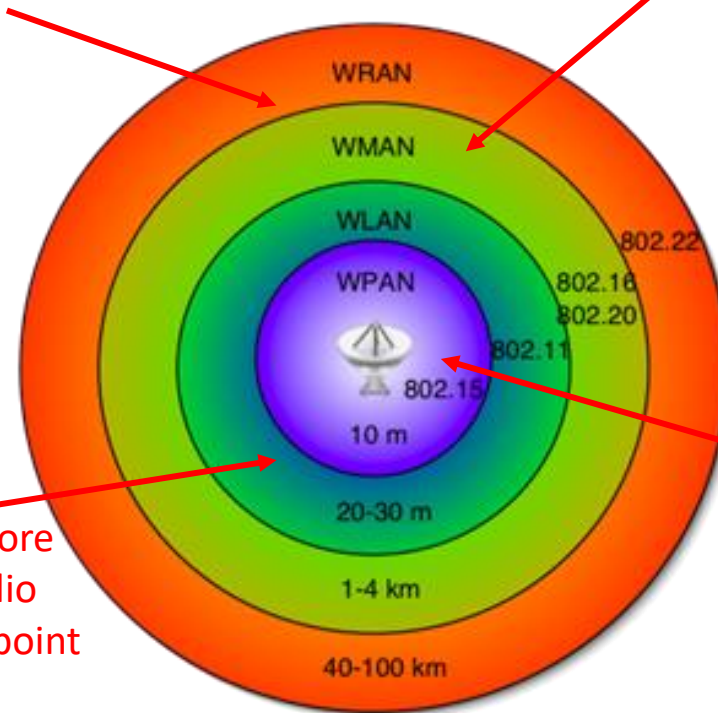
IEEE 802 WIRELESS STANDARDS

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	<ul style="list-style-type: none">• WiMAX Forum
Wireless Local Area Network (WLAN)	IEEE 802.11	<ul style="list-style-type: none">• WiFi Alliance
Wireless Personal Area Network (WPAN)	IEEE 802.15	<ul style="list-style-type: none">• 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)	
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](#)

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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,"