COMP9336/4336 Mobile Data Networking
www.cse.unsw.edu.au/~cs9336 or ~cs4336
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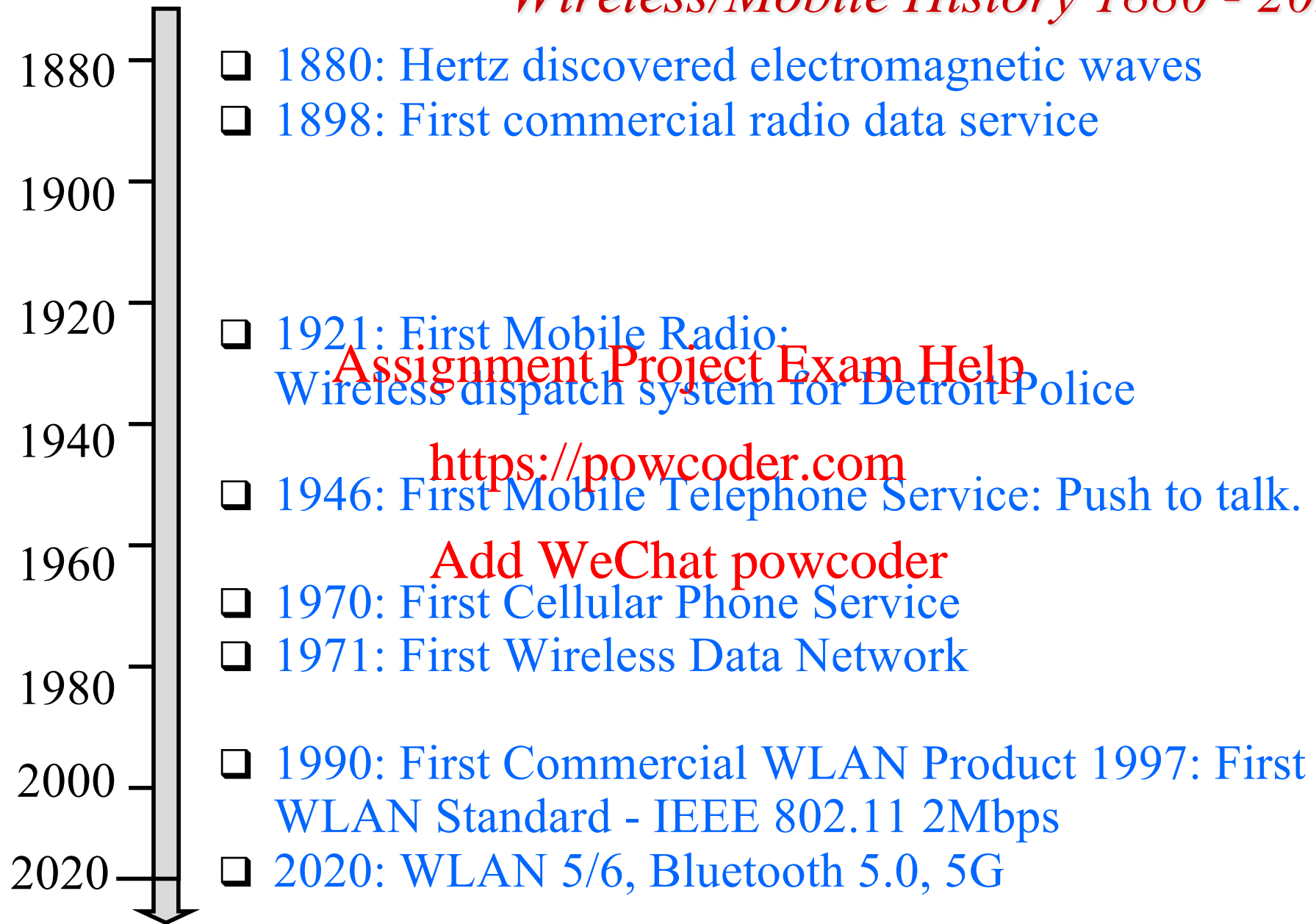
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Trends

in Mobile Data Networking

Wireless/Mobile History 1880 - 2020

Year	
1880	❑ 1880: Hertz discovered electromagnetic waves
	❑ 1898: First commercial radio data service
1900	
1920	❑ 1921: First Mobile Radio: Wireless dispatch system for Detroit Police
1940	❑ 1946: First Mobile Telephone Service: Push to talk.
1960	❑ 1970: First Cellular Phone Service
	❑ 1971: First Wireless Data Network
1980	
2000	❑ 1990: First Commercial WLAN Product 1997: First WLAN Standard - IEEE 802.11 2Mbps
2020	❑ 2020: WLAN 5/6, Bluetooth 5.0, 5G

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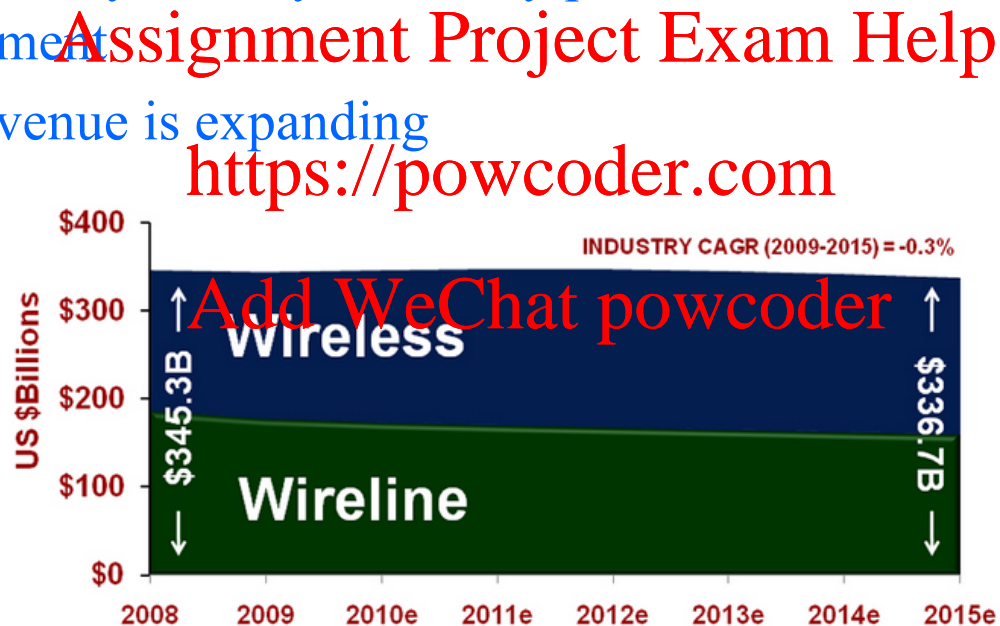
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Access is all wireless

- Wireless, in the form of WiFi, started in 1999.
    - First it was an option.
    - Now it is standard in all computing devices
- Most of the access (end user connectivity) is wireless
- Mobile phones, tablets have multiple wireless technologies: WiFi, Bluetooth, Cellular, but *no wired connectivity*

Wired

Wireless storage

Wireless Display

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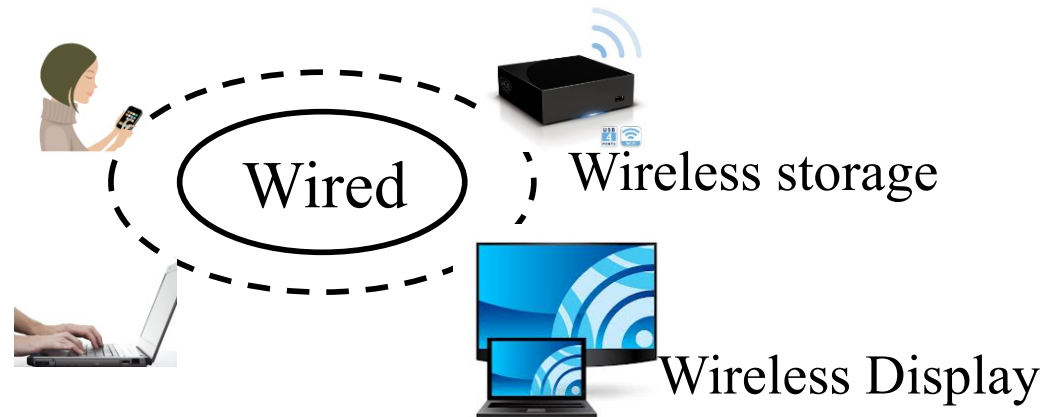
Most Revenue in Wireless

❏ US Wireless industry is valued at $195.5 billion $\geq$ publishing, agriculture, hotels and lodging, air transportation, and motion picture and recording.

❏ Wireless industry directly/indirectly provides more than 2.6% of all US employment

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❏ Wireless revenue is expanding

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Ref: http://www.ctia.org/your-wireless-life/how-wireless-works/wireless-quick-facts

http://atlantic-acm.com/index.php?option=com_content&view=article&id=557%3Avisual-dataline-us-telecom-wireless-and-wireline-service-revenues-2010-2015&catid=46%3A2010-datalines&Itemid=20

Mobile speed forecast

CISCO annual report 2018-2023

- **Wi-Fi speed will triple by 2023**. Globally, the average Wi-Fi speeds will grow from 30.3 Mbps in 2018 to 92 Mbps by 2023.
- **Cellular speeds will more than triple by 2023**. The average mobile network connection speed was 13.2 Mbps in 2018 and will be 43.9 Mbps by 2023.
- The average 5G connection speed will reach 575 Mbps by 2023.

The incredible momentum of WiFi

CISCO report
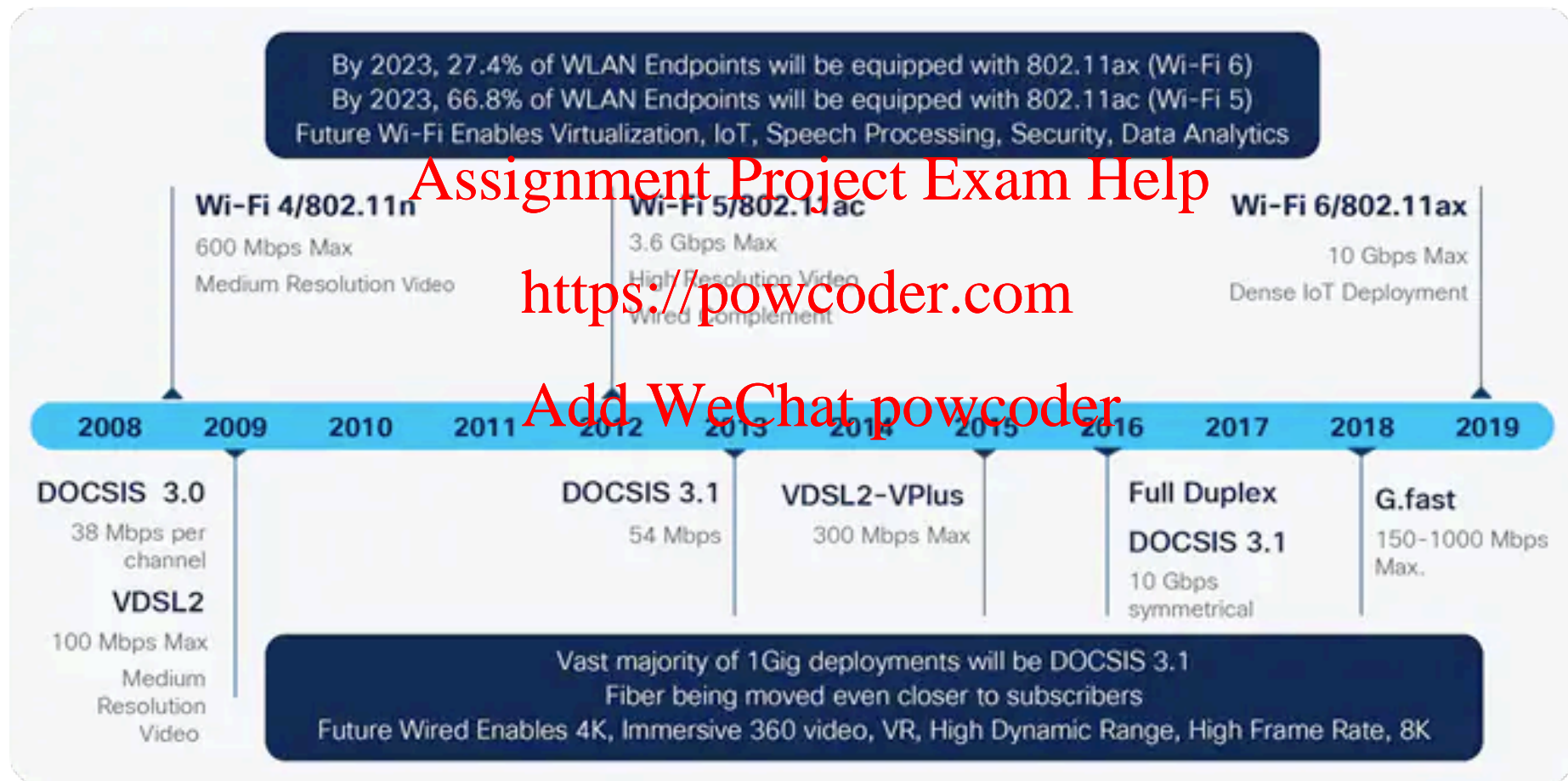
- **Wi-Fi hotspots will grow four-fold from 2018 to 2023**. Globally, there will be nearly 628 million public Wi-Fi hotspots by 2023, up from 169 million hotspots in 2018.

- **Wi-Fi6 hotspots will grow 13-fold from 2020 to 2023** and will be 11 percent of all public Wi-Fi hotspots by 2023.

By 2023, 27.4% of WLAN Endpoints will be equipped with 802.11ax (Wi-Fi 6)
By 2023, 66.8% of WLAN Endpoints will be equipped with 802.11ac (Wi-Fi 5)
Future Wi-Fi Enables Virtualization, IoT, Speech Processing, Security, Data Analytics

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Wi-Fi 4/802.11n
600 Mbps Max
Medium Resolution Video

Wi-Fi 5/802.11ac
3.6 Gbps Max
High Resolution Video
Wired Complement

Wi-Fi 6/802.11ax
10 Gbps Max
Dense IoT Deployment

2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019

DOCSIS 3.0
38 Mbps per channel

VDSL2
100 Mbps Max
Medium Resolution Video

DOCSIS 3.1
54 Mbps

VDSL2-VPlus
300 Mbps Max

Full Duplex
DOCSIS 3.1
10 Gbps symmetrical

G.fast
150-1000 Mbps Max.

Vast majority of 1Gig deployments will be DOCSIS 3.1
Fiber being moved even closer to subscribers
Future Wired Enables 4K, Immersive 360 video, VR, High Dynamic Range, High Frame Rate, 8K

Mobile growth forecast
CISCO annual report 2018-2023

2% CAGR 2018-2023

Billions of Mobile Subscribers

2018	2019	2020	2021	2022	2023
5.1	5.2	5.3	5.5	5.6	5.7

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Mobile Momentum Metrics By 2023

|	More Mobile Users	More Mobile Connections	Faster Mobile Speeds
2018	5.1 Billion	8.8 Billion	13.2 Mbps
2023	5.7 Billion	13.1 Billion	43.9 Mbps
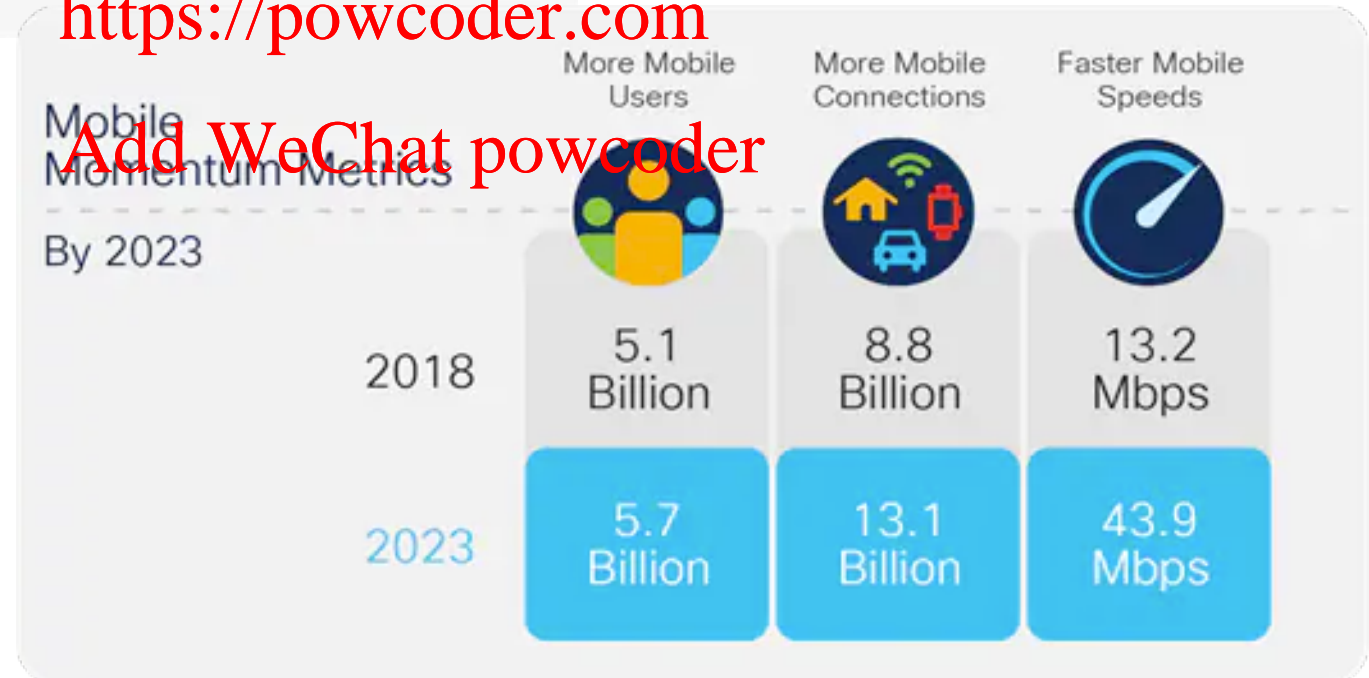
Bluetooth revolution
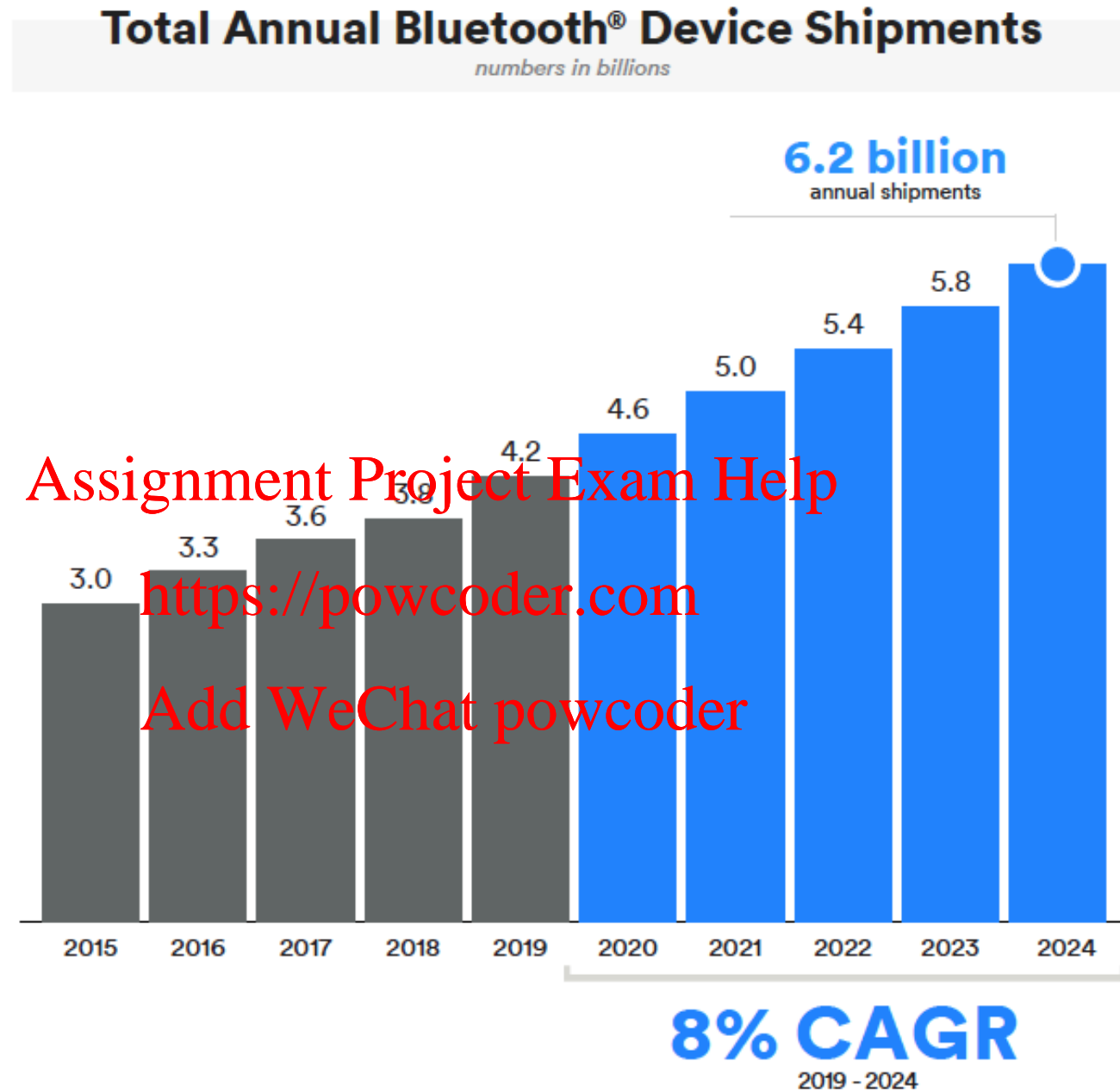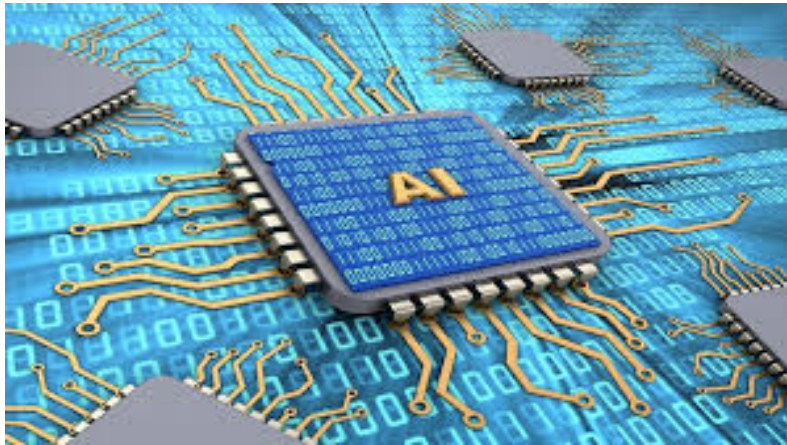
Other trends
New developments

- AI (artificial intelligence) in mobile networking

- Sensor-aided mobile networking

- Drone-aided mobile networking

- Programmable wireless environment

- Simultaneous wireless information and power transfer

- Terahertz wireless networking

- Nanoscale wireless sensor networking

- …
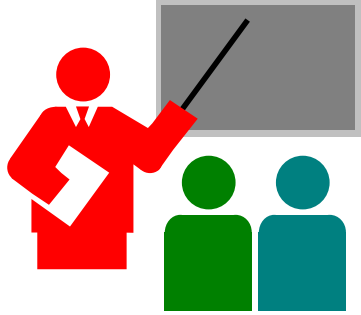
Summary: wireless and mobile trends

1. WiFi has grown worldwide in just 15 years and continues to develop in capacity with innovations in PHY and data link layer

2. Bluetooth has reached the 5 billion milestone in 2020

3. 5th generation of cellular technology is already here in 2020 with massive capacity and new features

4. Wireless speed growth is following Moore's Law

5. Mobile subscriptions are approaching world population

6. Many innovative new technologies are being developed to meet the unabated demand in wireless and mobile communications