The Latest on 5G and the Outlook for 6G

January 2025

Iain Gillott
(512) 796-1675
iain@iGR-Inc.com

iGR

Agenda

- Brief History of cellular
- Current wireless architecture deployments
- How the newer 5G networks are deployed
- 5G Advanced and 6G
- Importance of spectrum….and the prospects for more
- Impact of AI

A Brief History of Cellular

- 1946 Bell System launched – supported calls from cars
  - Launched in St. Louis
  - Support three calls – in the whole city!
  - By end of 1946, expanded service to 25 cities
  - Calls switched manually
- First automatic mobile phone system launched in 1948
- 1964 IMTS introduced
  - Improved Mobile Telephone Service
  - Direct calling and automatic channel switching
- First cell phone call claimed by Motorola (by engineer Martin Cooper) on April 3rd, 1973
- World's first commercial cellular network launched in Saudi Arabia in 1981

- First commercial U.S. network launched 1983 in Chicago
  - Motorola handset cost $3,500 to $4,000
- Ericsson launches its first handheld mobile phone in 1987
- Nokia also introduces first mobile phone in 1987
- 3G launched 2001
- 3G Blackberry launched 2002
- Apple iPhone launched 2007
- 4G launched 2009
- 5G launched 2019

iGR

3

Bandwidth demand continues to rise

Average Smartphone-Only Mobile Data Use (MB/month), 2023-2028

Total U.S. Mobile Data Traffic, 2023-2028 (TB/Month)

Source: iGillottResearch, Inc. 2025
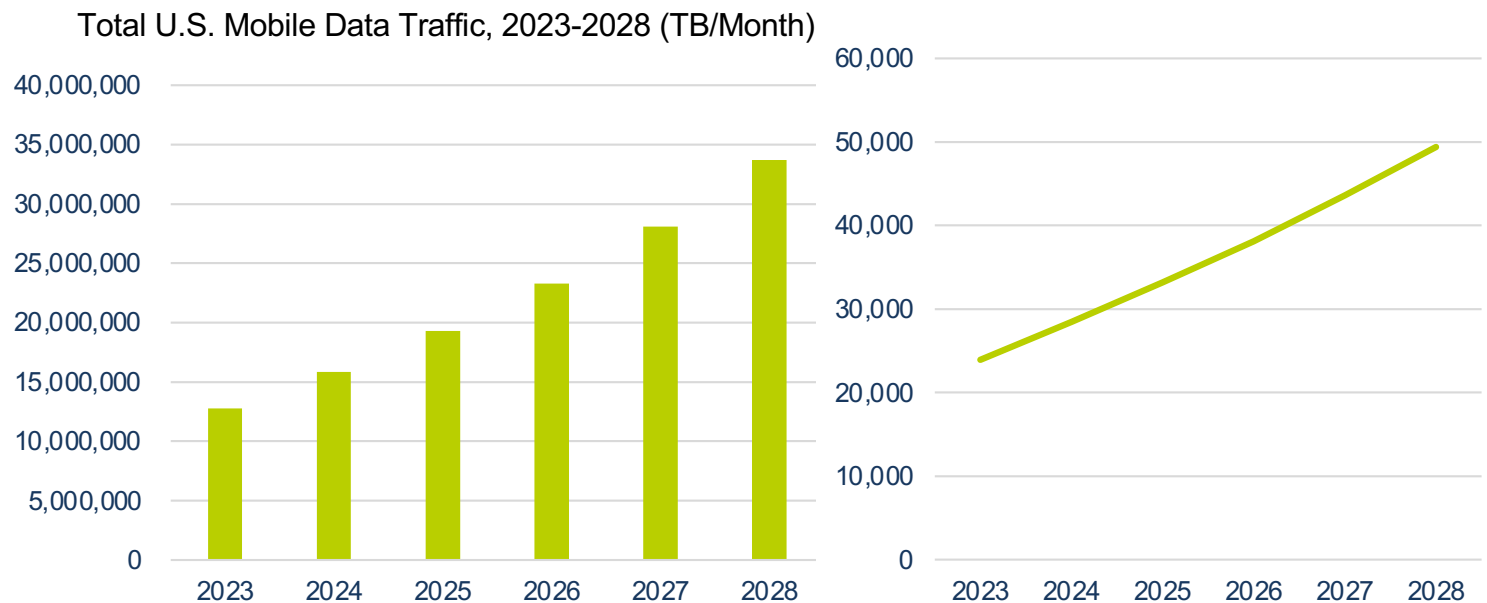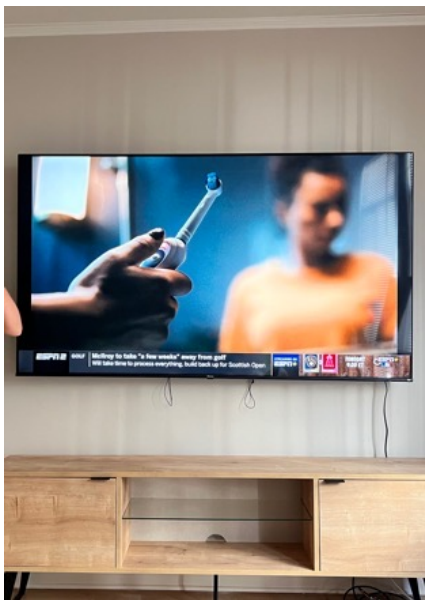
Orion Nebula
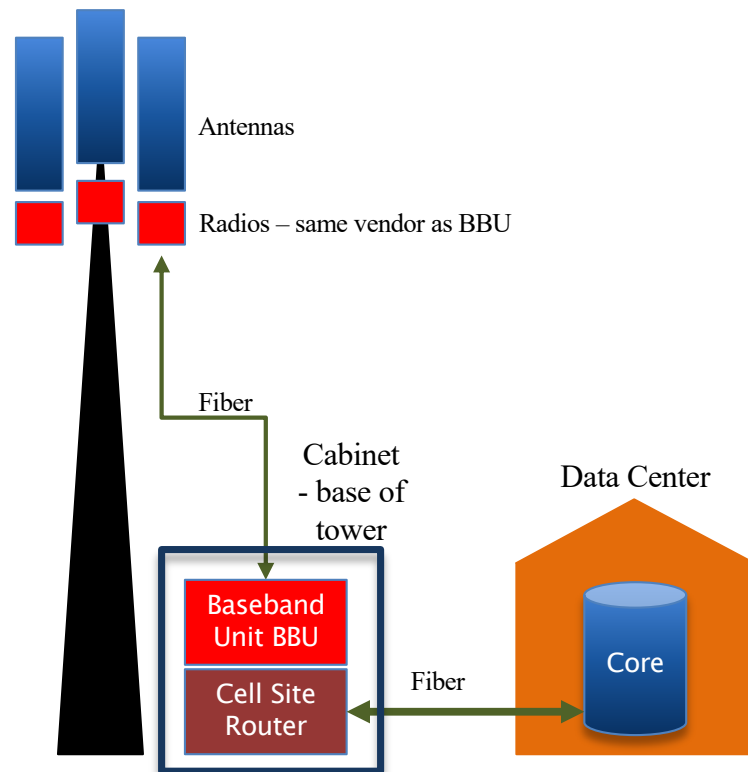

- Messier 42
- Visible with naked eye
  - Looks like a fuzzy star
- Clouds of dust and gas coalese into stars
- About 2,000x mass of the Sun
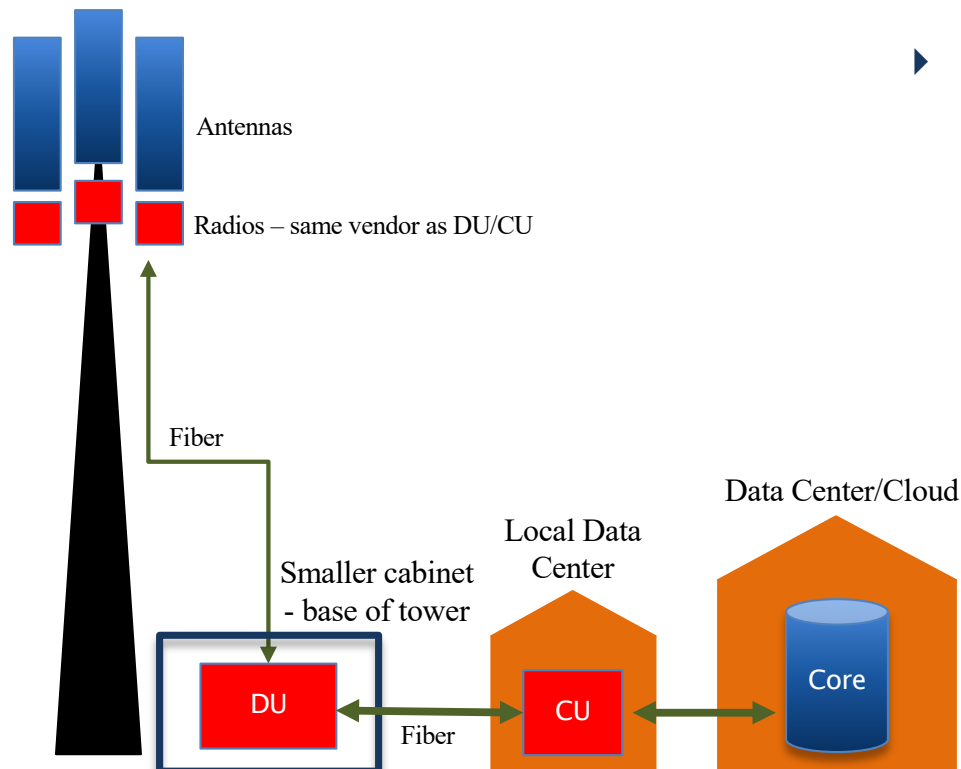- 1,344 ly from Earth

How is the physical network built

- RAN – Radio Access Network
  - The RAN is the final link between the network and the phone
  - RAN is the visible piece and includes the antennae we see on towers, on top of buildings or in stadia, plus the base stations
- Uses spectrum
- Different bands used
- Different propagation
  - How the radio signal travels through the air
- Each band needs a radio and an antenna
  - Transmit and receive

RAN Architecture

Antennas

Radios – same vendor as BBU

Fiber

Cabinet - base of tower

Data Center

Baseband Unit BBU

Cell Site Router

Fiber

Core

▸ Traditional up to 4G

◦ 3 sectors per cell site
  - Some cells have more sectors, usually up to 6
◦ Radios located as near to antennas as possible
◦ One radio per sector per band
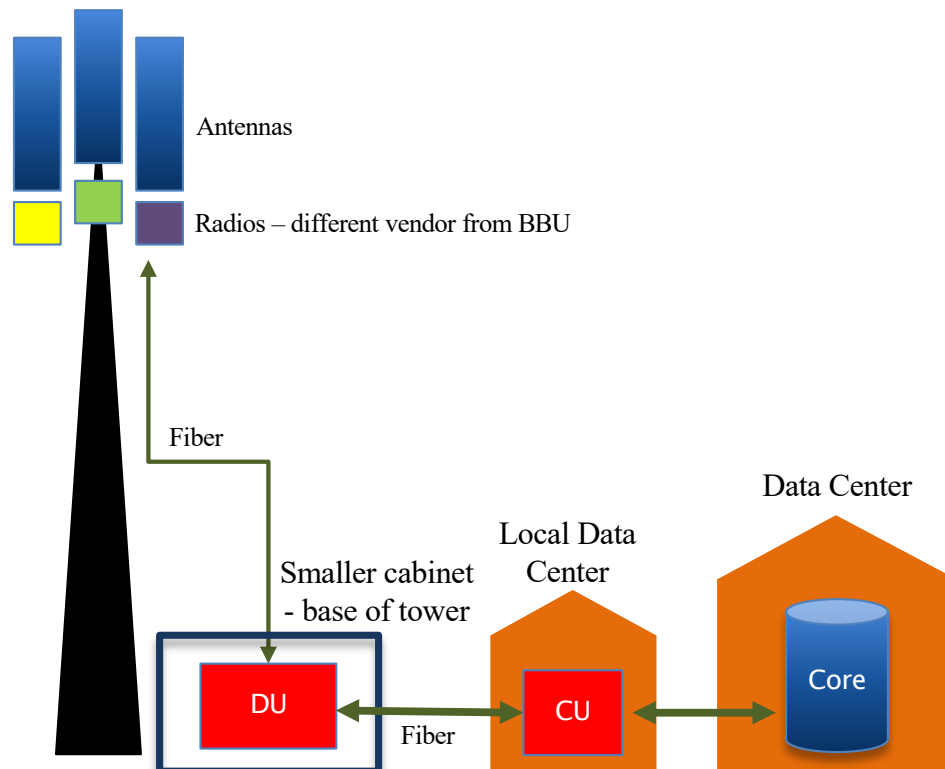◦ Newer radios are multi-band and higher capacity

Cloud RAN

Antennas

Radios – same vendor as DU/CU

Fiber

Smaller cabinet
- base of tower

DU

Fiber

Local Data
Center

CU

Data Center/Cloud

Core

▸ Cloud RAN
  ◦ Started with late 4G/5G
  ◦ Software-based solution
  ◦ Off-the-shelf compute hardware
  ◦ BBU function split between CU (centralized unit) and DU (distributed unit)
    • DU at cell site or local data center
    • CU in local data center or cloud
  ◦ Less equipment at base of tower
    • Lower power requirement
    • Small cabinet required
  ◦ Core traditionally located in data center or Cloud

iGR

8

Open RAN

Antennas

Radios – different vendor from BBU

Fiber

Smaller cabinet - base of tower

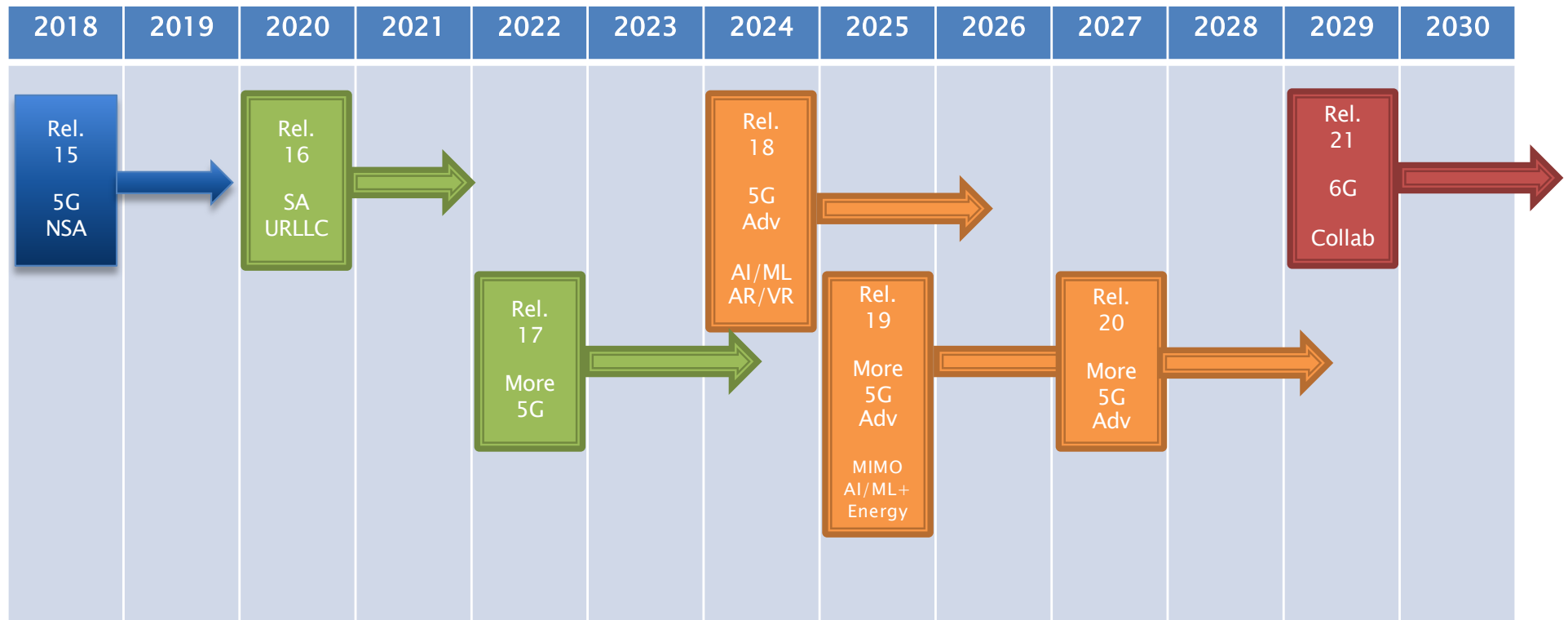Local Data Center

Data Center

DU

CU

Core

Fiber

▸ Open RAN
  ◦ Software-based solution
  ◦ Off-the-shelf compute hardware
  ◦ Radio and BBU by different vendors
  ◦ BBU function split between CU (centralized unit) and DU (distributed unit)
    • DU at cell site or local data center
    • CU in local data center
  ◦ No Cell Site Router required
  ◦ Less equipment at base of tower
    • Lower power requirement
    • Small cabinet required
  ◦ Core traditionally located in data center
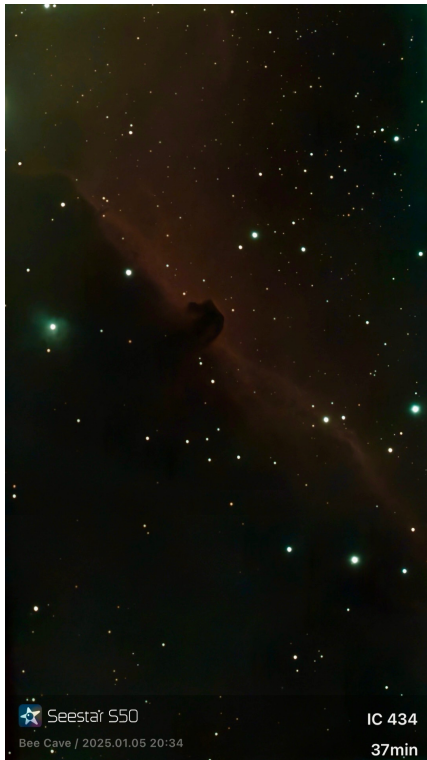 ◦ Typically deployed as Cloud RAN

5G is now about monetization, not deployment

- Depending on who you talk to, 5G networks have either
  - Underdelivered and not lived up to the hype
  - OR have yet to deliver on their true promise
- 5G deployments continue with expanded coverage and capacity (densification)
- But industry has shifted to 5G monetization
  - How to recoup the investment?
  - New services/apps to generate new income?
  - New investment vehicles/partners?
  - 5G private networks?
  - 5G network slicing apps?

iGR

3GPP 5G and 6G Releases

2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030

Rel. 15 — 5G NSA (2018)

Rel. 16 — SA URLLC (2020)

Rel. 17 — More 5G (2022)

Rel. 18 — 5G Adv / AI/ML AR/VR (2024)

Rel. 19 — More 5G Adv / MIMO AI/ML+ Energy (2025)

Rel. 20 — More 5G Adv (2027)

Rel. 21 — 6G Collab (2029)

Horsehead Nebula

▸ Barnard 33

▸ Also in Orion, just south of Orion's Belt (the three stars you see in a line)

▸ 1,375 ly from Earth

▸ Discovered by Williamina Fleming in 1888

  ◦ A single mother from Scotland working for Harvard on the classification of astronomical phenomena
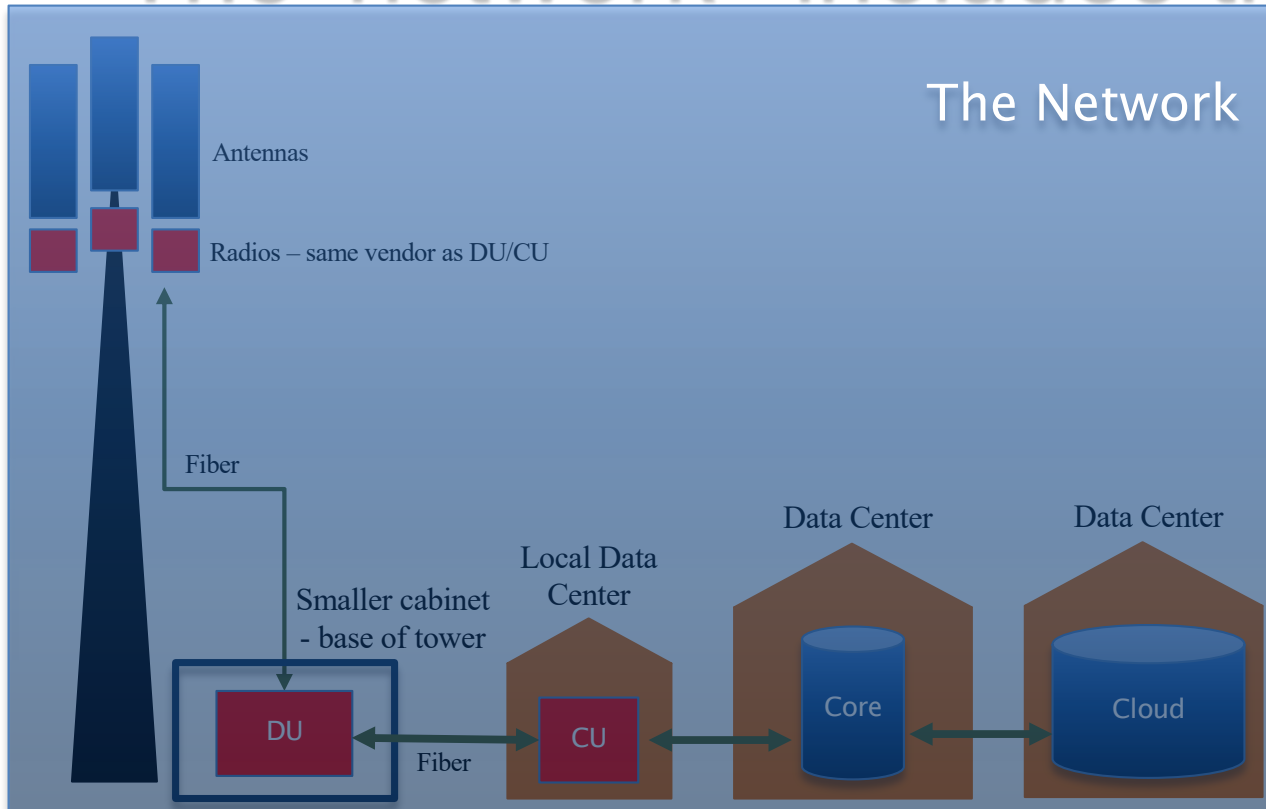
There are no new 'easy' spectrum bands left

- FCC does not have spectrum authority at present
- FCC, NTIA both working to identify new spectrum to auction
  - 5GA and 6G
  - Need big chunk of spectrum
- Dish possible source of additional spectrum
- There is no 'easy' spectrum left that can be auctioned/sold
  - Everything will require some form of sharing structure
  - This will make it hard to make available to the industry
- Best case for new spectrum in the hands of MNOs to be used? 2030...and that is best case

The Sun

Seestar S50
Bee Cave / 2025.01.05 15:20
Sun

- ▸ Dark spots are 'sun spots' – areas of magnetic flux on the surface
  - ◦ Solar flares and coronal mass ejections originate here
- ▸ 1 au from Earth or 8 light minutes
- ▸ About 4.6 billion years old
- ▸ In another 5 billion years or so, the hydrogen will run out
  - ◦ The Sun will begin to die
  - ◦ Will take another 2 – 3 billion years or so
- ▸ www.spaceweather.com tells you what is happening on the Sun ☺

iGR

The 'network' includes the data center

The Network

Antennas

Radios – same vendor as DU/CU

Fiber

Smaller cabinet - base of tower

DU

Fiber

Local Data Center

CU

Data Center

Core

Data Center

Cloud

- ▸ Discussion at the FCC TAC in December
- ▸ Today's networks do not end at the data center - they INCLUDE the data center
- ▸ 'Wireless infrastructure' is therefore antenna-radio-tower/small cell - base station - fiber - data center
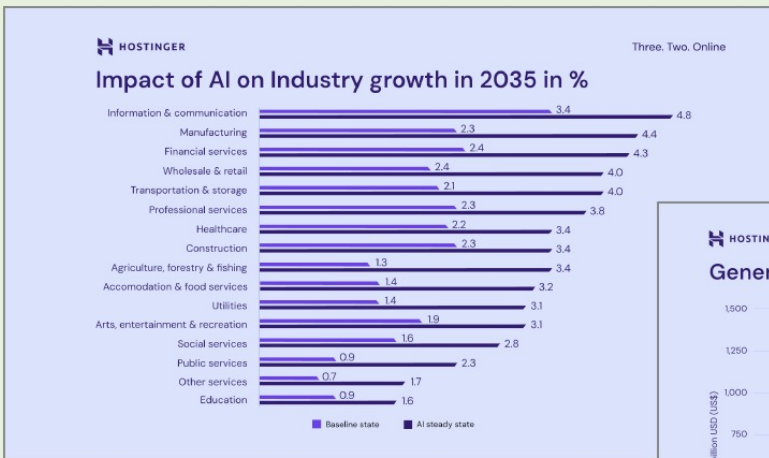
iGR

AI is only just getting started

- The AI we have today is basic and we have not seen the full impact
- For the telecom industry, AI is answering chats in customer care and composing emails
- Any network analysis and subsequent recommendations/changes are acted on manually
- Next stage is where the AI does the analysis, makes recommendations and then actions them
- Final stage is where the network is completely zero-touch - the networks are self-designing, self-administering, fully automated and pro-active
- This will take a while - probably 10-plus years… But within our careers

Information & Communication industry has the most to gain from AI

▶ One interesting chart (attached) shows the impact on various industries over the next 10 years - I&C was the top

▶ Is the impact due to companies using AI (i.e. for chatbots in customer care or billing apps, etc) OR is the impact due to OTHER industries needing more data centers and telecom networks to use their AI?

▶ The answer is 'Yes and Yes'

  ◦ Yes telcos and associated companies will use AI in their own operations
  ◦ But the info & comms industry also gains with more demand for data centers, communications, towers, infrastructure, software etc needed to actually run everyone's AI

▶ Wireless infrastructure is critical to the success of AI and vice versa

AI/ML: Impacts on the Future of ICT and the FCC's Critical Role

Impact of AI on Industry growth in 2035 in %

Generative AI Market Growth

Source: https://www.hostinger.com/tutorials/ai-statistics

We have to make better use of what we have

- Current networks and spectrum will have to support us for five more years, even allowing for 5G Advanced (which is an upgrade, not a new air interface)
- What does this mean?
  - More fiber and data centers to do the processing
  - Get more out of a tower - more colocation of equipment
  - Densification...
  - ....to get the results/data/apps/AI to the users
- How can we maximize the benefit of these strategies? How can our networks support the increased processing/communications needed for AI? What do the economics of these networks look like?
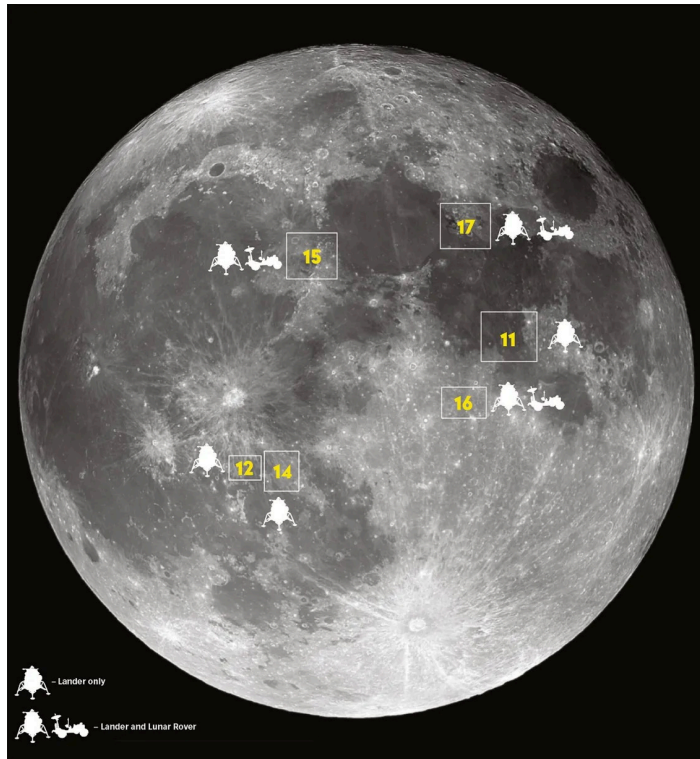
iGR

The Moon

- 239,000 miles from Earth
- Over time, tidal forces have synchronized the lunar month and lunar day, so the same side always faces the Earth
- About 50 million years younger than the Earth

Apollo Landing Spots

▸ Apollo landing locations

▸ Apollo 11: July 29th, 1969 - Apollo 17: December 17th, 1972

▸ Just 12 people have set foot on the Moon, all American men

▸ Lunar landings (manned and unmanned and crashed) completed by USA, USSR, Russia, Israel, Japan, India, China, Luxembourg, ESA,

▸ Image source: www.skyatnightmagazine.com

Questions?

iGR