



COMMUNITY FOUNDATION
OF
NORTHWEST MISSOURI

Broadband Technology Options

June 15, 2020

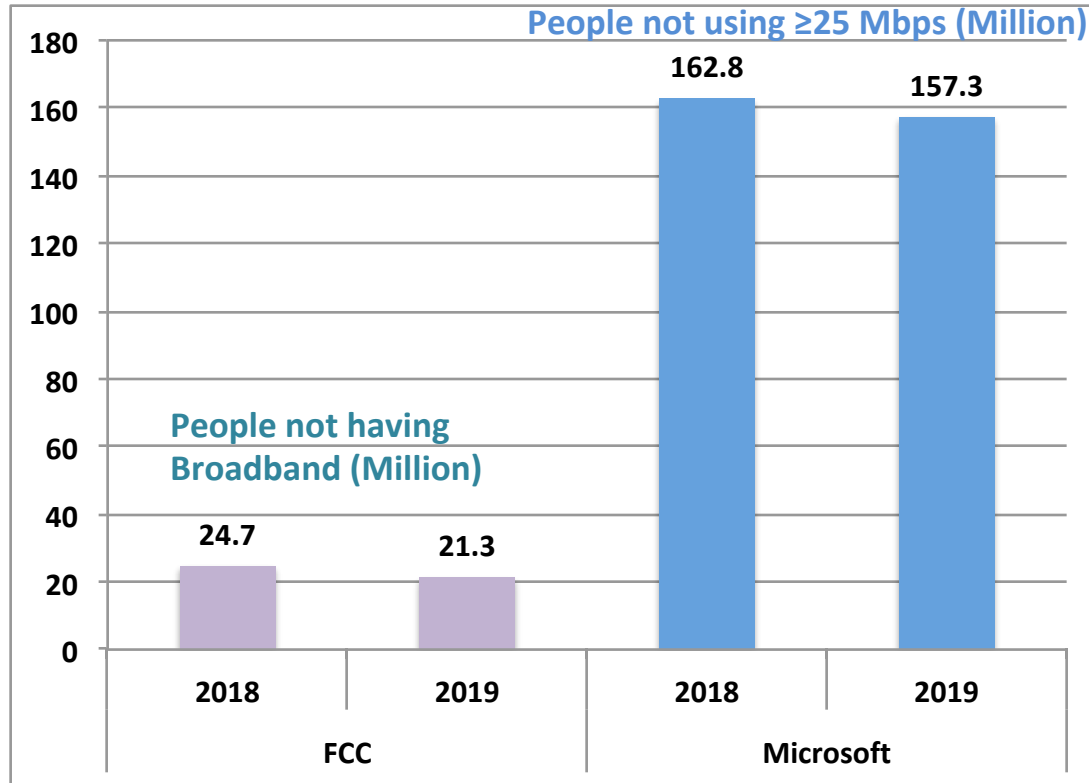
Lav Gupta
UMSL
lavgupta@missouri.edu



University of Missouri System
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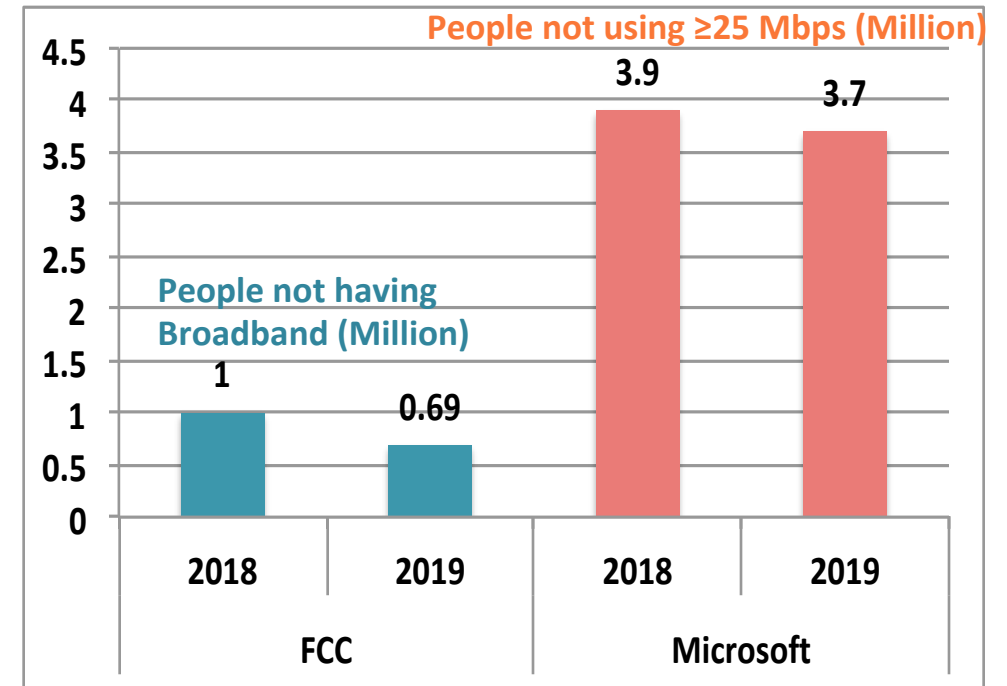
Broadband Availability and Usage

US



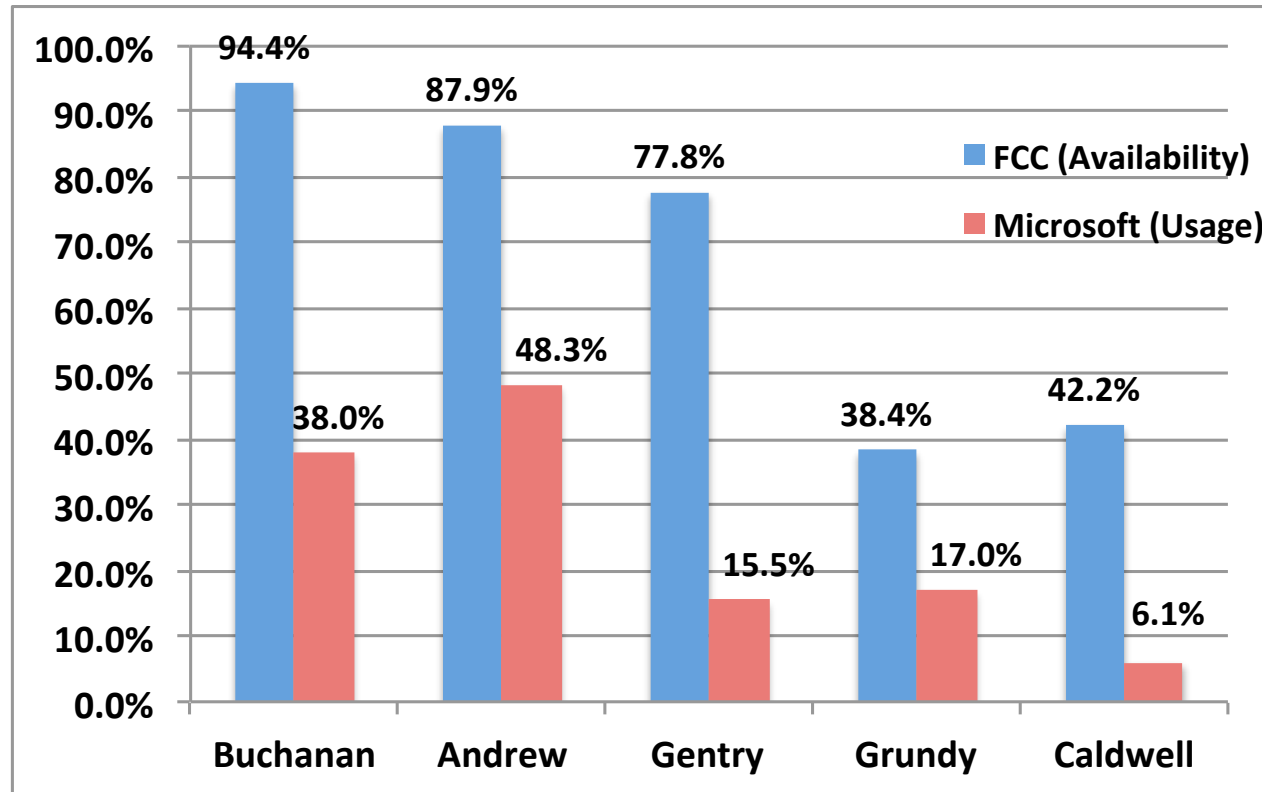
Population 327 Million – 269 M urban 58 M rural

Missouri



Population 6.4 Million – 3.91 M urban 2.23 M rural

NW Counties Broadband Availability and Usage



Classification of Broadband Options by Media

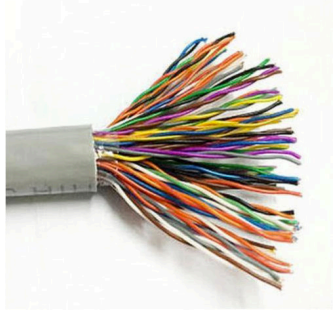
- **Wired**
 - Copper
 - Fiber
 - Power lines
- **Wireless**
 - Fixed
 - Mobile
 - Satellite

Wired - Copper

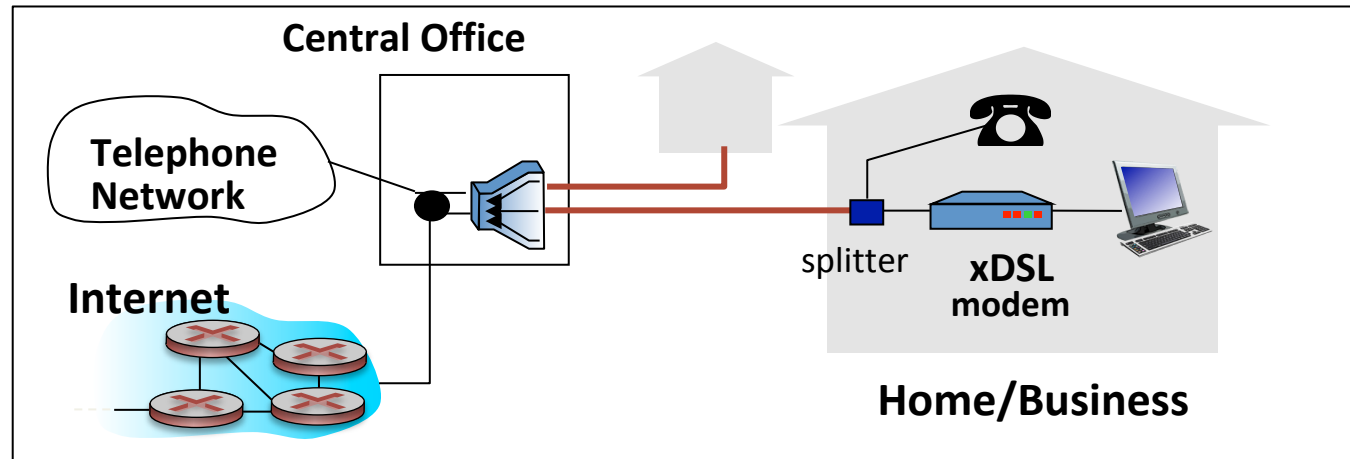
xDSL (Digital Subscriber Line)

Commonly used variants: ADSL2/2+, VDSL, VDSL2

ADSL2+	24 Mbps	<600 meters	10 Mbps	~1.5 miles
VDSL	50 Mbps	<100 meters	6 Mbps	~1.5 miles
VDSL2	200 Mbps	<100 meters	6 Mbps	~1.5 miles



Twisted Pair
Telephone Cable



- Pro: Deployed over existing copper pairs
- Con: Small coverage area around central office
- Con: Old cable pairs with joints may not qualify

Can be used in conjunction with fiber

Wired - Coaxial

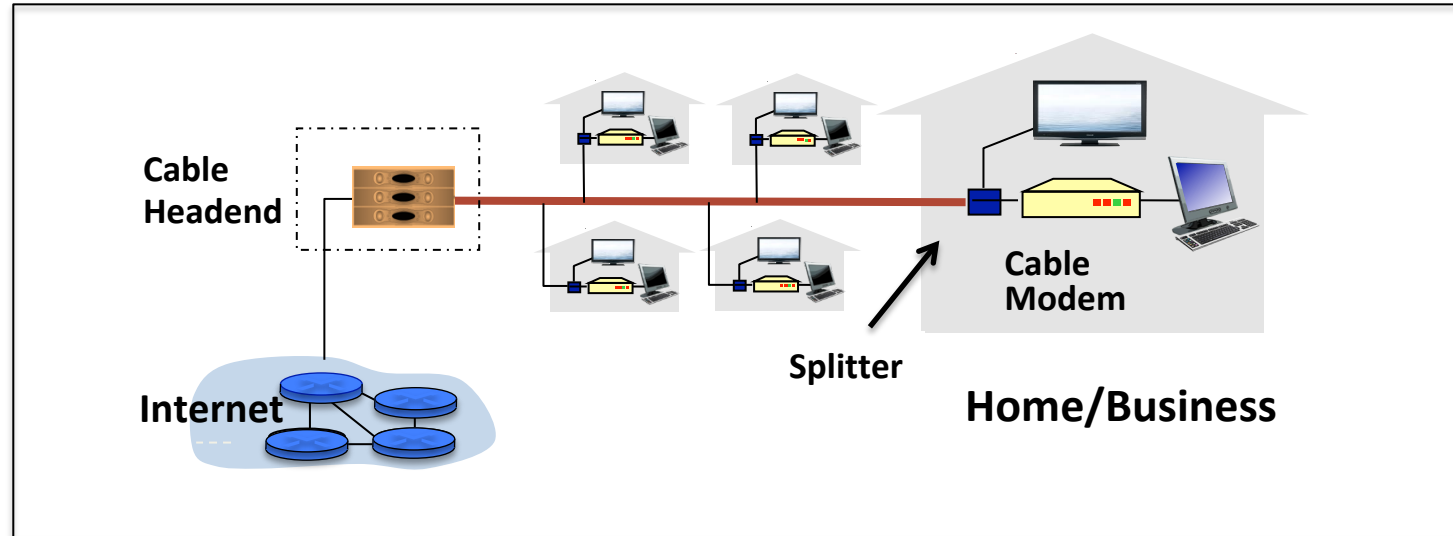
Cable Modems

DOCSIS 2.0 standard
DOCSIS 3.0 standard
DOCSIS 4.0 standard

40 Mbps downstream /30 Mbps upstream
1 Gbps/200 Mbps
10 Gbps/1 Gbps



Coaxial Cable



Pros: High Bandwidth, Affordable, Wide Coverage

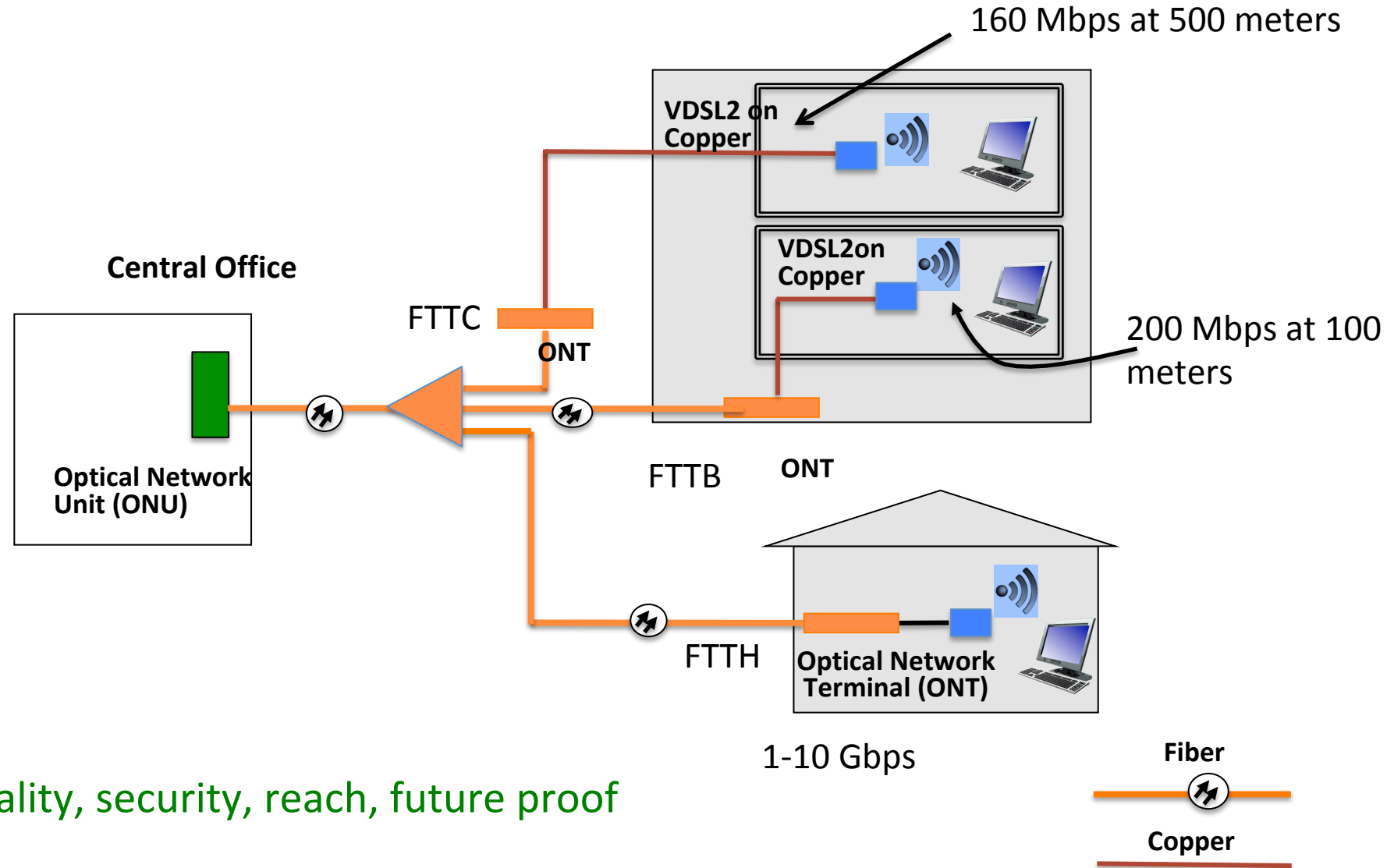
Cons: Shared bandwidth

Wired - Fiber



Fiber Cable

Fiber Optic Access Network



FTTC: Fiber To The Curb
FTTB: Fiber To The Building
FTTH: Fiber To The Home

Pros: High bandwidth, quality, security, reach, future proof

Con: High short term cost

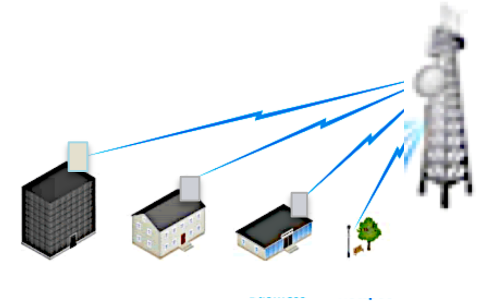
Fixed Wireless

- Uses towers for mounting equipment and antenna

Pro: Broad coverage, fast install

Con: Uses spectrum, requires line of sight

Con: speed 5-50 Mbps with about 10 mile coverage



- Wi-Fi: fixed, short-range technology that is often used in combination with others

Technology	Data Rate
802.11n	54-600Mbps
802.11ac / WiFi5	1 - 3 Gbps
802.11ax / WiFi6	10-12 Gbps



Pro: Ease of access, flexible, less expensive than wired

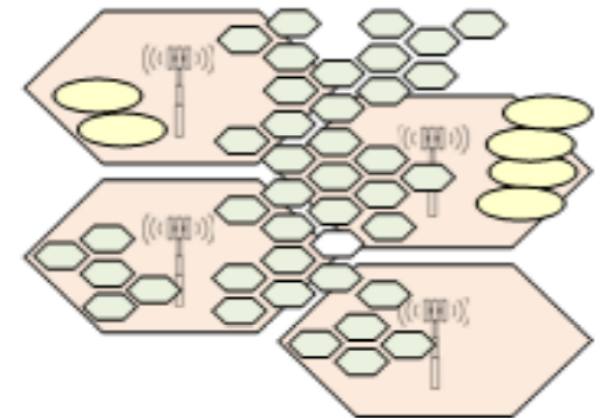
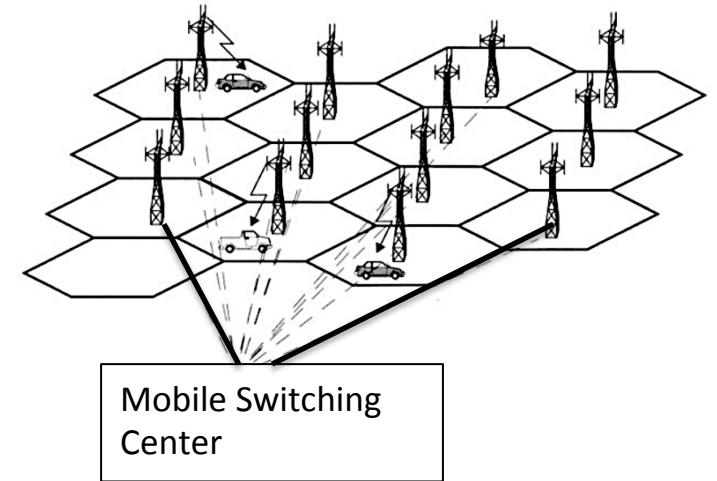
Con: Range typically 150ft. Indoor, 300ft. Outdoor

Con: Low security

Wireless needs wired backbone network

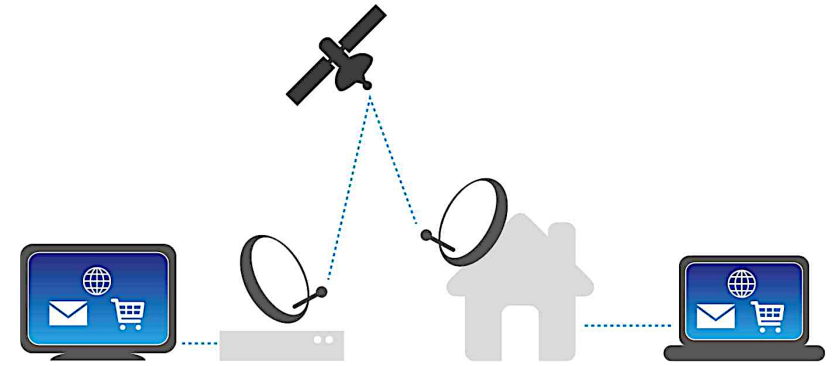
Mobile Wireless

- Accessible from cell towers if provider provides service in your area
 - **4G LTE-A:** Theoretical: 1Gbps, Practical 5-40 Mbps
 - Per user ~ 4 Mbps practical at cell edges
 - **5G:** Theoretical: 20 Gbps, Practical – depends! 400Mbps down to <10Mbps at the edge
 - 5G based on network densification with **small cells** and deep fiber, expensive for rural areas
- Pro: Mobility
- Con: Uses expensive radio spectrum, expensive infrastructure
- Con: Speed reduces drastically away from the tower
- Con: Coverage poor in rural areas



Satellite Internet

- GEO Satellites (22,226 miles)
 - Pro: Wide coverage
 - Con: Cost of satellite \$10m-\$100m
 - Con: low bandwidth, high latency 250ms one way
 - Con: Affected by clouds/rain, obstacles
- LEO Satellites (200-800 miles)
 - OneWeb, SpaceX Starlink, Amazon Kuiper Megaconstellations
 - Planned speeds 100s of Mbps, possibly Gbps
 - SpaceX, 1500 satellites by 2022
 - Expensive receiving equipment for users
 - May not be able to compete with fiber on price/performance



What real choices do we have?

Considering 3Cs (cost, coverage and capacity) + QoS

Wired

- Fiber
- Fiber with Coax or VDSL2

Wireless/Cellular

- LTE-A
- 5G

Thanks