Broadband and Use Cases

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Agenda

- Broadband Fundamentals

- Broadband Technologies

- Use Case needs

- 5G and Wi-Fi 6E and use cases

- Conclusion

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Why Broadband

- Broadband is Good for Society
    - **Economic growth:** Increasing broadband penetration boosts economic growth ~ 1% or more.[1]
        - [Connected nation study](#)
    - **Jobs:** In Latin America, increasing penetration 5.5% to 7.7% would generate estimated 378,000 new jobs.[2]
    - **Health care:** Telemedicine provides better access to care, reduces travel, and facilitates rapid diagnosis and treatment.[3]
    - **Education:** Household Internet access is associated with better educational performance.[4]
    - **SME's:** Studies show that broadband promotes small and medium enterprises.[5]
    - [Improves social outcomes](#)

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Broadband Objectives

- We encourage widespread, affordable, high quality broadband for all – focused on both deployment and adoption, including infrastructure, devices and training, and WF development/education
  - Competitive markets
  - Abundant spectrum for broadband
  - Targeted government programs to address market failures

- Intel works with policy makers and partners to unlock the benefits of broadband and ICT for all:
  - Private networks using fixed wireless
  - Workforce development and STEM
  - AI for youth
  - Founding member of N50 program
  - Appointed member of Oregon Broadband Advisory Committee
  - Experts on broadband commission WG
  - Broadband Publications

What is Broadband

- Broadband is high speed connection to the internet
  - What is high speed?
    - FCC (current) definition - 25 Mbps download, 3 Mbps Upload
    - NTIA definition - below 25/3 = unserved, below 100/20 underserved

Download:	56kbps (dial-up)	256kbps	2Mbps	40Mbps	100Mbps
Google home page (160 KB)	**23 seconds**	5 seconds	**0.64 seconds**	0.03 seconds	0.01 seconds
ITU home page (750KB)	107 seconds	23 seconds	3 seconds	0.15 seconds	0.06 seconds
5MB music track	12 minutes	3 minutes	20 seconds	1 second	0.4 seconds
20MB video clip	**48 minutes**	10 minutes	**1 minute**	4 seconds	1.6 seconds
CD / low quality movie (700MB)	28 hours	6 hours	47 minutes	2 minutes	56 seconds
DVD / high quality movie (4GB)	1 week	1.5 days	4.5 hours	13 minutes	5 minutes

United Nations Connectivity Targets for 2030

- Achieving universal and meaningful digital connectivity —the possibility for everyone to enjoy a safe, satisfying, enriching, productive and affordable online experience— is key for enabling digital transformation and meeting the Sustainable Development Goals.

Universality targets

100%	of population aged 15+ uses the Internet
	of households have Internet access
	of businesses use the Internet
	of schools are connected to the Internet
	of population is covered by a mobile network of the latest technology [1]
	of population aged 15+ owns a mobile phone
>70%	of population aged 15+ has basic digital skills
>50%	of population aged 15+ has intermediate digital skills

Technology targets

|	
100%	of fixed-broadband subscriptions are 10 Mb/s or faster [3]
20 Mb/s	Minimum download speed at every school
50 kb/s	Minimum download speed available per student [4]
200 GB	Minimum data allowance for every school

Affordability targets

2%	Entry-level broadband subscription costs less than 2% of gross national income per capita
	Entry-level broadband subscription costs less than 2% of average income of the bottom 40% of population

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Key Elements of Broadband

- Broadband = Deployment and Adoption
- 5 A's of Broadband
  - Access = infrastructure (Networks and Devices)
  - Affordability
    - High cost areas
    - Low income
  - Awareness/Interest
    - What can BB do for me = knowledge and enticing applications
    - Will my ID and data be safe = security
  - Ability
    - How do I do this = Digital skills teaching
  - Additional factors
    - fear
    - embarrassment
    - language barriers
    - Lack of communal support

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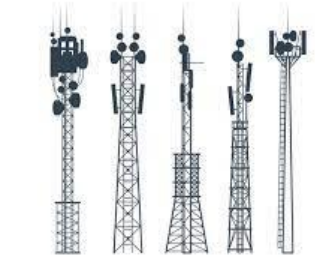
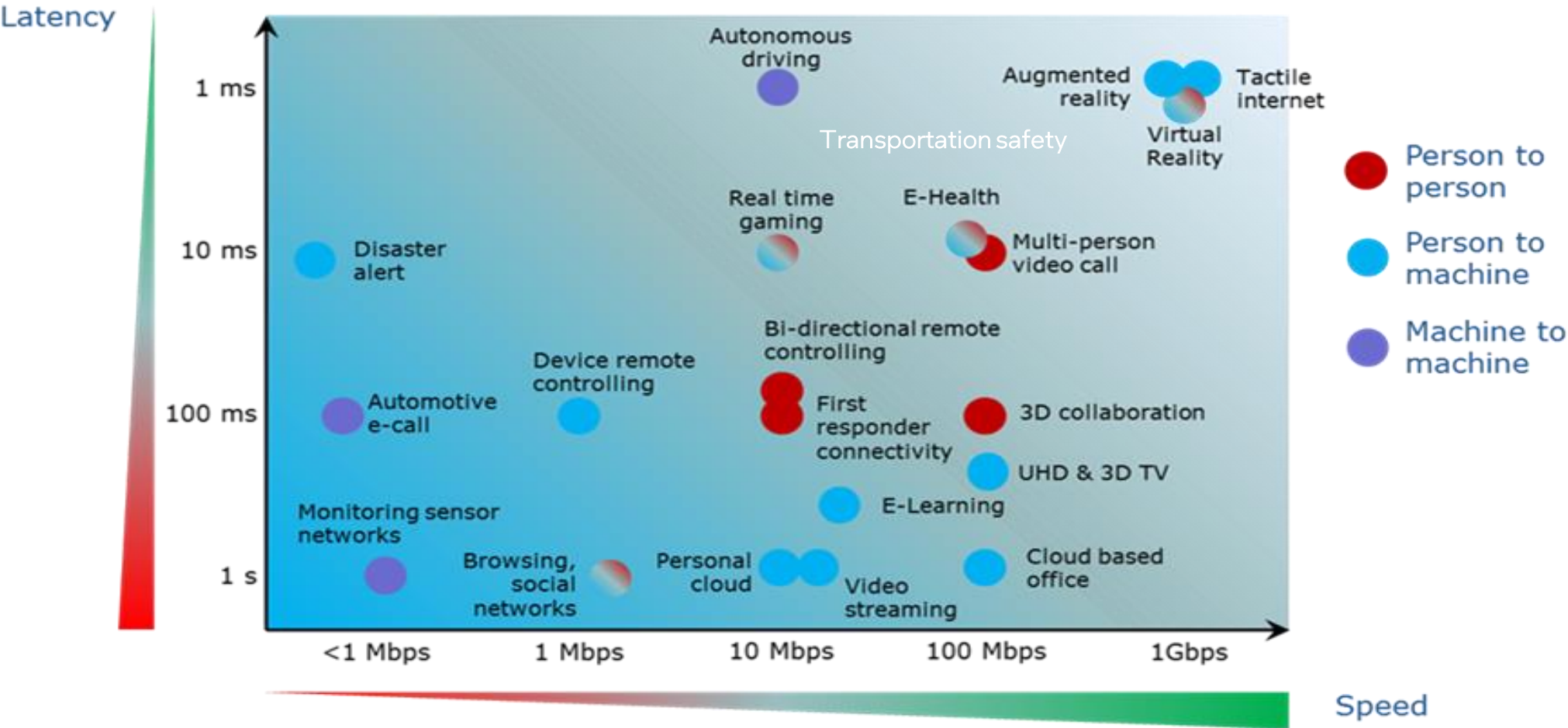# Tools for Broadband Deployment and Adoption

- National Broadband Plans
  - Raul Katz study shows planning grew broadband in LAR
  - Malaysia BB grew 20% after national plan in place
- Broadband Mapping
- Make Spectrum Available
- Encourage sharing of ROWs
- Incentives
  - Use of existing USF
  - Direct govt funding
  - Tax reductions
  - Share govt ROWs
- Demand Creation Programs
  - Digital literacy
  - Targeted Applications

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Broadband Technologies

- Digital Subscriber Line (DSL)
- Cable Modem
- Fiber
- Terrestrial Wireless
  - Mobile Wireless Broadband
  - Wireless Local Area Networks (WLANs)
  - Fixed Wireless Access
- Satellite

Broadband Use Cases

Need for speed and latency for use of applications and services by a single user

Latency

- 1 ms — Autonomous driving; Augmented reality; Tactile internet; Virtual Reality; Transportation safety
- 10 ms — Disaster alert; Real time gaming; E-Health; Multi-person video call
- 100 ms — Automotive e-call; Device remote controlling; Bi-directional remote controlling; First responder connectivity; 3D collaboration; UHD & 3D TV; E-Learning
- 1 s — Monitoring sensor networks; Browsing, social networks; Personal cloud; Video streaming; Cloud based office

Speed: <1 Mbps — 1 Mbps — 10 Mbps — 100 Mbps — 1Gbps

Legend:
- Person to person
- Person to machine
- Machine to machine

Source: Commission analysis based on GSMA and EIB

Statistics on Mobile and Wi-Fi Networks

▪ 95% of the world's population now living within range of a mobile broadband network.

▪ 4G network coverage reached to 88 per cent of the world's population.

▪ In Q4 2021, 5G reached 660 million subscriptions globally.

▪ Wi-Fi networks are everywhere (homes, schools-universities-classrooms, offices-enterprises, industries, public hotspots, villages, hospitals, airplanes-airports, industries)

▪ There will be nearly 628 million public Wi-Fi hotspots by 2023, up from 169 million hotspots in 2018.

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5G and Wi-Fi 6: High-Speed Wireless Technologies

- 5G and Wi-Fi 6 are complementary and provide higher speeds, lower latency, and increased capacity over their predecessors.

- Wi-Fi is used primarily indoors and local places—for example, inside a home or workplace

- Generally, 5G will support use cases that require longer ranges

- 5G may offer a broadband alternative to fiber and cable for home users.

- Wi-Fi has a lower cost to deploy, maintain, and scale—especially where access points need to serve more users

Main Usage Scenarios of 5G

- ITU-R has defined the following main usage scenarios for IMT for 2020 and beyond in their Recommendation ITU-R M.2083
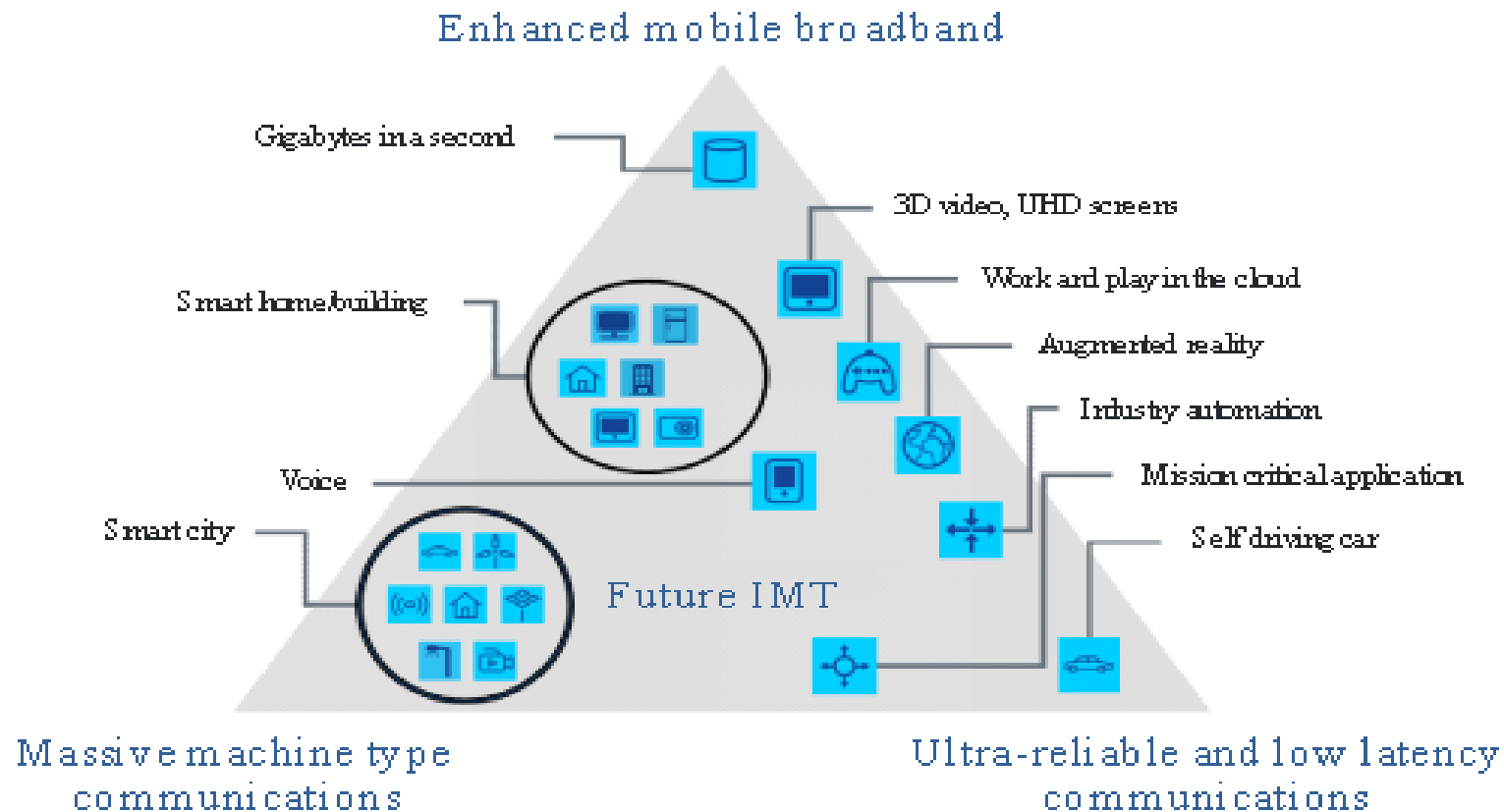
Schools and Communities
## Bridging the Digital Divide

→ Challenge

- 1 in 4 students forced to drop remote learning in 2020 due to marginal or non-existent internet access
- Wi-Fi hotspots are "choked/saturated" by inadequate capacity
- Discounted public internet access is spotty/unreliable
- Lack of reliable internet prevents community access to "life-line" services – tele-medicine, job training, remote learning, nutrition counseling

→ Solution

- Deploy CBRS-enabled private wireless network covering school and adjacent communities
- Leverage open access CBRS spectrum to make prices realistic for underserved communities

→ Impact

- Helped underserved communities gain reliable internet access
- Achieved TCO of $3/user/month post-deployment
- In a survey from pilot program, 9/10 students would recommend private wireless solution for remote learning to friends and family
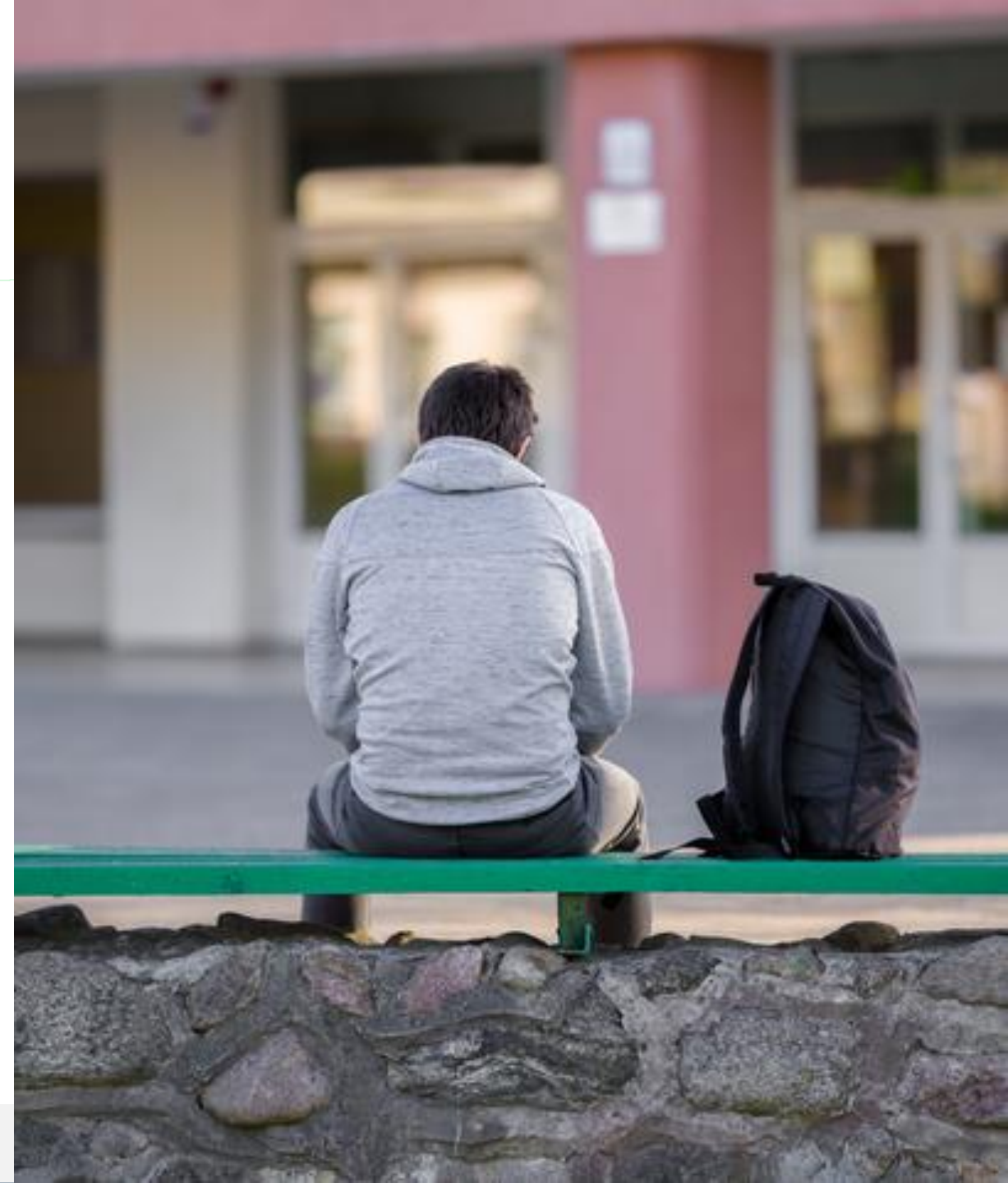
California School Deployment

1.5X better coverage and 1/3 of the targeted cost versus project goal

The project was scoped to demonstrate performance and coverage of our private LTE solution across a target set of student users in underserved communities.

Coverage effectiveness : 1.5x

POC Targeted area   POC covered area

	Key Metric	PoC Goal	As Measured (average)	% Better than PoC Goal
1	Bandwidth (downlink) - Mbps	35 Mbps	>90 Mbps	> 2.5x note: Traditional SPs observed @ 0-5 Mbps with 25% locations having no coverage (> 18x better)
2	Bandwidth (uplink) - Mbps	1 Mbps	4.5 Mbps	> 4.5x
3	Latency (ms) one way	< 150ms	45ms	> 3.3x
4	Jitter (ms) – measure of packet loss	< 30ms	15ms	> 2x
5	Coverage - in square miles	MV – 0.04 mi²	MV – 0.06 mi² coverage exceeded	>1.5x
6	Cost - TCO (cost/user) projection	$10/user/month	$3/user/month!	>3x

User Experience (brackets rows 1–4)

Italy - 5G Demos in Milan

5G connected ambulance

Live remote-operated surgery

https://www.vodafone.com/business/news-and-insights/blog/gigabit-thinking/remote-surgery-robotics-and-more-how-5g-is-helping-transform-healthcare
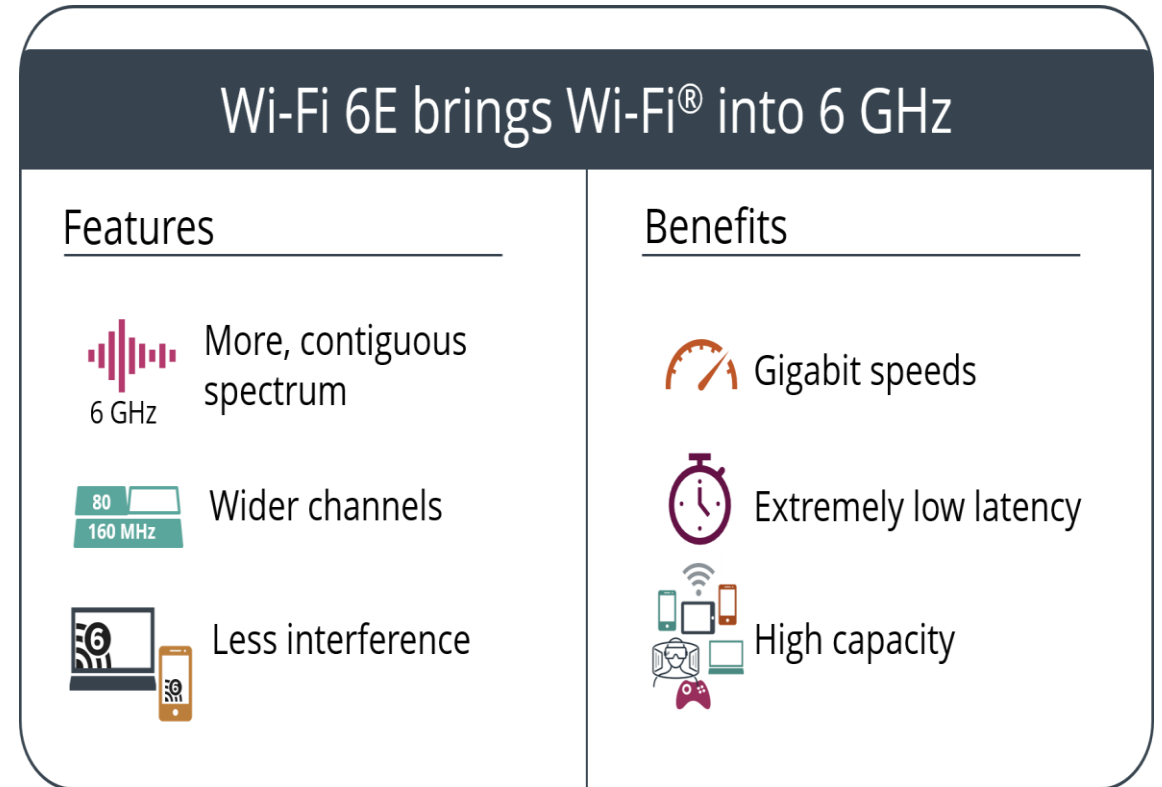
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Swisscom - Fibre Optics Through the Air (FWA)

- FWA to extend the fixed network infrastructure and thus increase the availability of ultra-fast broadband.

- Jolimont holiday chalet in the Valais village of Champéry now have an excellent Internet connection.

- Swisscom was able to install a fixed Internet connection via 5G for the site with fixed wireless access technology

- With fast Internet over 5G, fixed wireless access helps to make even remote communities inclusive, secure, resilient and sustainable.

- Swisscom's Internet booster relays the mobile signal to the WLAN router.

Wi-Fi 6E Advantages

- Low latency is key to seamless experiences in real-time applications like videoconferencing and gaming. Latency is up to 75 percent lower than with Wi-Fi 5

- 6x faster than Intel® Wi-Fi 5 on managed networks and nearly 3x faster than Wi-Fi 5 for home and consumer use.

- Greater reliability and efficiency, as this spectrum can only be used by Wi-Fi 6E devices and is not impacted by legacy device traffic.

Wi-Fi 6E brings Wi-Fi® into 6 GHz

| Features	Benefits
6 GHz — More, contiguous spectrum	Gigabit speeds
80 / 160 MHz — Wider channels	Extremely low latency
Less interference	High capacity

Wi-Fi 6E Use Cases

Wi-Fi delivers a range of opportunities across a variety of sectors including smart homes, automotive, healthcare, enterprise, government, and industrial IoT environments.

- **Healthcare:** Connect healthcare workers and patients on campus, so it seems like everyone is in the same room

- **Manufacturing:** Day to day network access from the office or the floor and immersive collaboration or training in real-time

- **Education:** Learn better with immersive learning (AR/VR)

- **Home:** nearly 3x greater wireless connection speeds than Wi-Fi 5, all without interference from other household devices

- **Business-Offices:** cloud and collaboration applications more responsive while giving teams speeds up to 6x faster than Wi-Fi 5 for file sharing, backups, and updates

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Wi-Fi 6 Trial in India – Education in Rural Areas

- C-DOT and Intel ran this trial which focuses on the capability of Wi-Fi 6
- 1.7 Gbps is achieved in 160 MHz
- It is recommended to upgrade the legacy network to Wi-Fi 6 network

Class room setup for Wi-Fi 6 Trial

Class Room 2

Class Room 1

Content Server
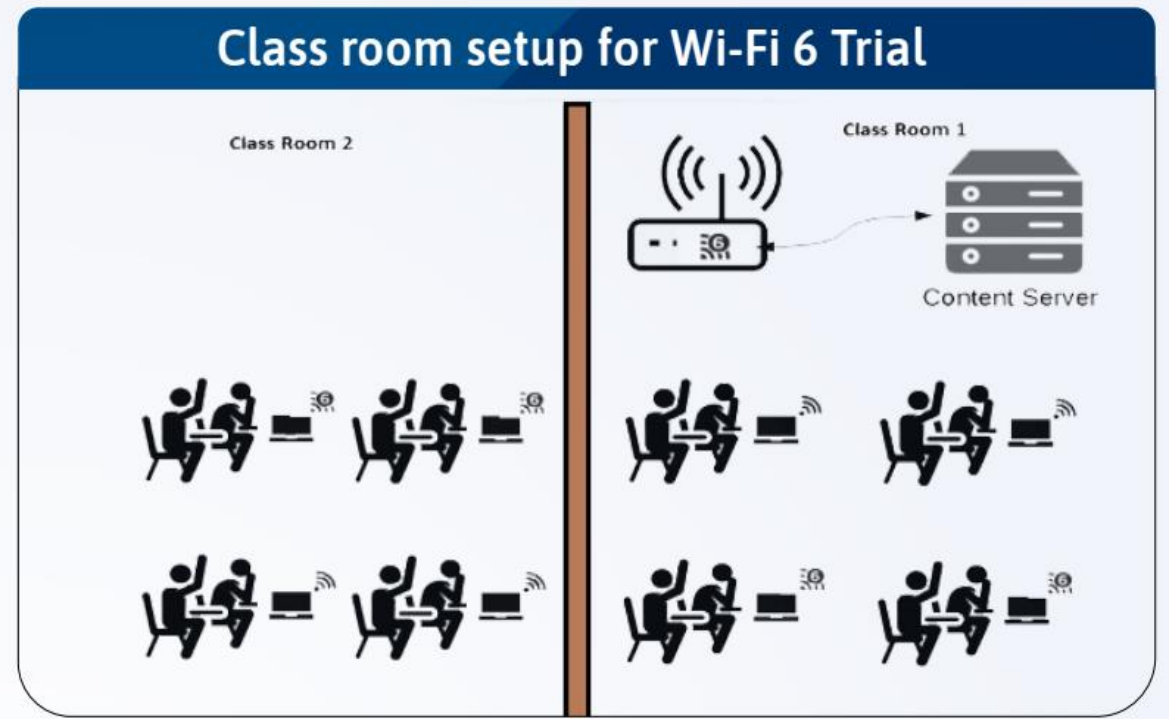
Public Wi-Fi Hotspots

Different governments have launched nationwide or citywide free public Wi-Fi hotspots (in collaboration with telecom operators)

- Telmex deployed in coordination with the Government of Mexico City, more than 20,500 public Wi-Fi sites, (Received Guinness World Record as the city with the most free Wi-Fi hotspots in the world)
- Rwanda's Smart Kigali Initiative
- India: Prime Minister's WANI Wi-Fi public network
- European Union's Wi-Fi4EU
- Saudi Arabia's National Public Wi-Fi Hotspot
- South Korea's National Public Wi-Fi Project including Seoul City

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India BharatNet Project

- BharatNet world's largest rural broadband connectivity program to provide national optical fibre network connectivity to all 625.000 villages across India

- The last mile connectivity, with a total of 700,000 Wi-Fi hotspots to cover all 625,000 villages

- India Government: ICT applications such as e-Commerce, e-Banking, e-Governance, e-Education and Tele-medicine require high speed Internet connectivity.

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Conclusion

- High-speed and high-quality broadband technologies support new use cases

- 5G and Wi-Fi 6E are two key complementary high-speed wireless broadband technologies (outdoor, indoor-local)

- We need to accelerate deployment of high-speed broadband networks for new use cases and digital transformation

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