20TH ANNIVERSARY | Wireless Global Congress

WGC AMERICAS

JUNE 19 - 22 2023

WI-FI INNOVATION:
FOR OPERATORS, ENTERPRISE, PLACES AND THINGS

Renaissance Las Vegas Hotel, USA

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Tiago Rodrigues

President & CEO, Wireless Broadband Alliance

Welcome address

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WGC Americas Speakers

Tiago Rodrigues
Wireless Broadband Alliance

Michael Lee Sherwood
Caesers Entertainment

Matt MacPherson
Cisco

Eric McLaughlin
Intel Corporation

Bill Marino
Boingo Wireless

J R Wilson
AT&T

Dr. Derek Peterson
Boingo Wireless

Rajat Ghai
Comcast

Time	Presentation
9:00 AM (PST)	**Welcome address – President & CEO Wireless Broadband Alliance** Tiago Rodrigues, President & CEO, Wireless Broadband Alliance.
9:15 AM (PST)	**Las Vegas: Harnessing Innovation to Create The City of the Future** Michael Lee Sherwood, Chief Innovation Technology Officer, City of Las Vegas.
9:30 AM (PST	**Future Wireless use cases – Consuming 1200MHz in dense networks** Matt MacPherson, Wireless CTO, Cisco.
9:50 AM (PST)	**The Future of Enterprise Wi-Fi** Eric McLaughlin, VP & GM Wireless Solutions Group, Client Computing Group, Intel Corporation.
10:10 AM (PST)	**The Role of AI in 5G & Wi-Fi 6 Network Management** Bill Marino, VP Data Engineering, Boingo Wireless.
10:30 AM (PST)	**Panel: Delivering Value to Customers through Next Gen Wi-Fi Networks** JR Wilson, Chairman, Wireless Broadband Alliance, Vice President, Tower Strategy and Roaming, AT&T Services; Dr Derek Peterson, CTO, Boingo Wireless; Rajat Ghai, Vice President - Xfinity Wi-Fi Engineering, Comcast.
11:00 AM (PST)	**COFFEE & NETWORKING**

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Michael Lee Sherwood

Chief Innovation Technology Officer, City of Las Vegas

Las Vegas: Harnessing Innovation to Create The City of the Future

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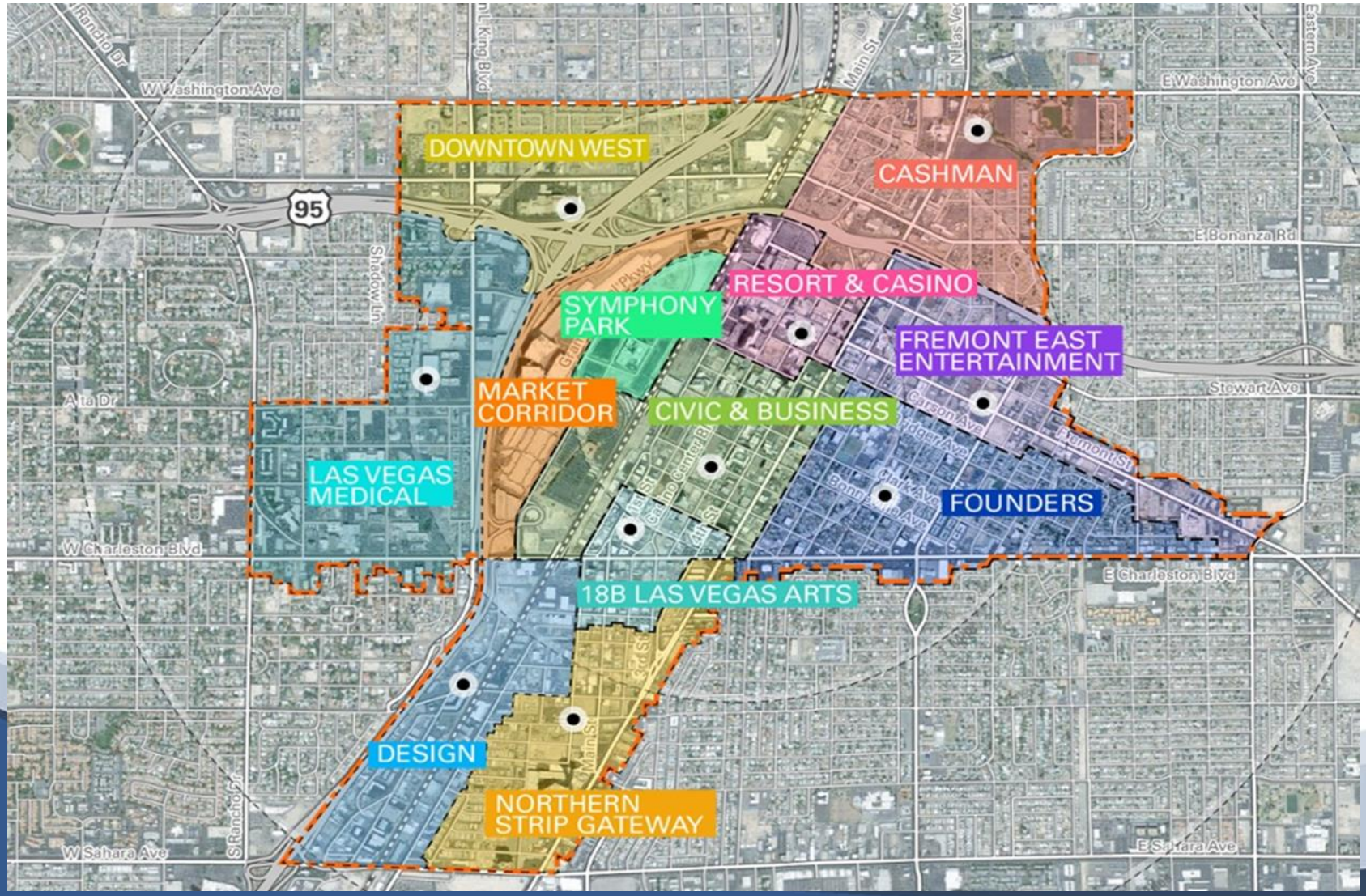
Unleashing Potential
Revolutionizing Municipal Infrastructure

BACKGROUND

- INNOVATION DISTRICT ESTABLISHED IN 2016
- INTERNATIONAL INNOVATION CENTER OPENED IN 2019
- IIC@VEGAS SUBJECT OF INTEREST WORLD-WIDE
- PRESS AND PROFESSIONAL PUBLICATTION COVERAGE
- SECOND IIC@VEGAS OPENED IN 2020

Overview of Innovation District

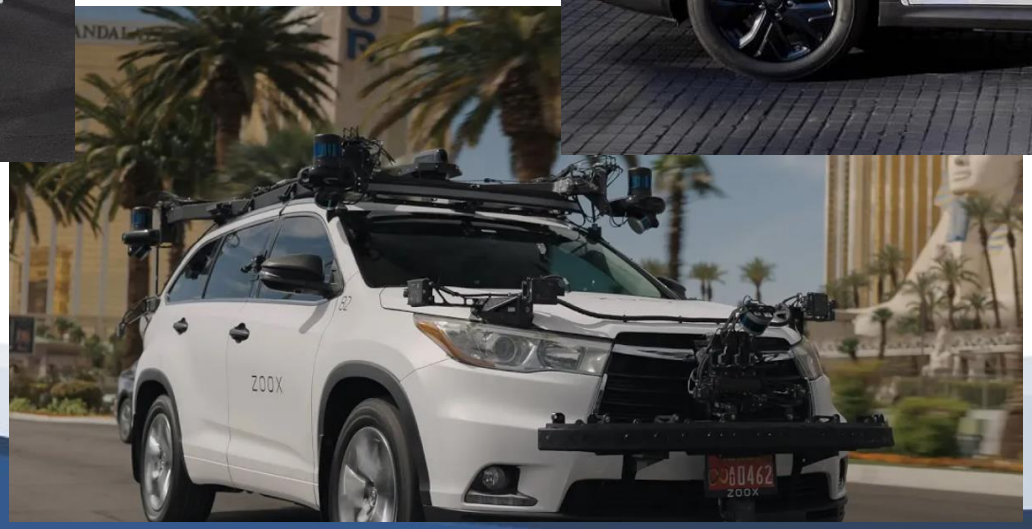


Areas of Focus

Social	Economic Development	Education
Public Safety	Mobility	Health & Wellness

Autonomous Vehicles
Past to Present and Beyond

2017

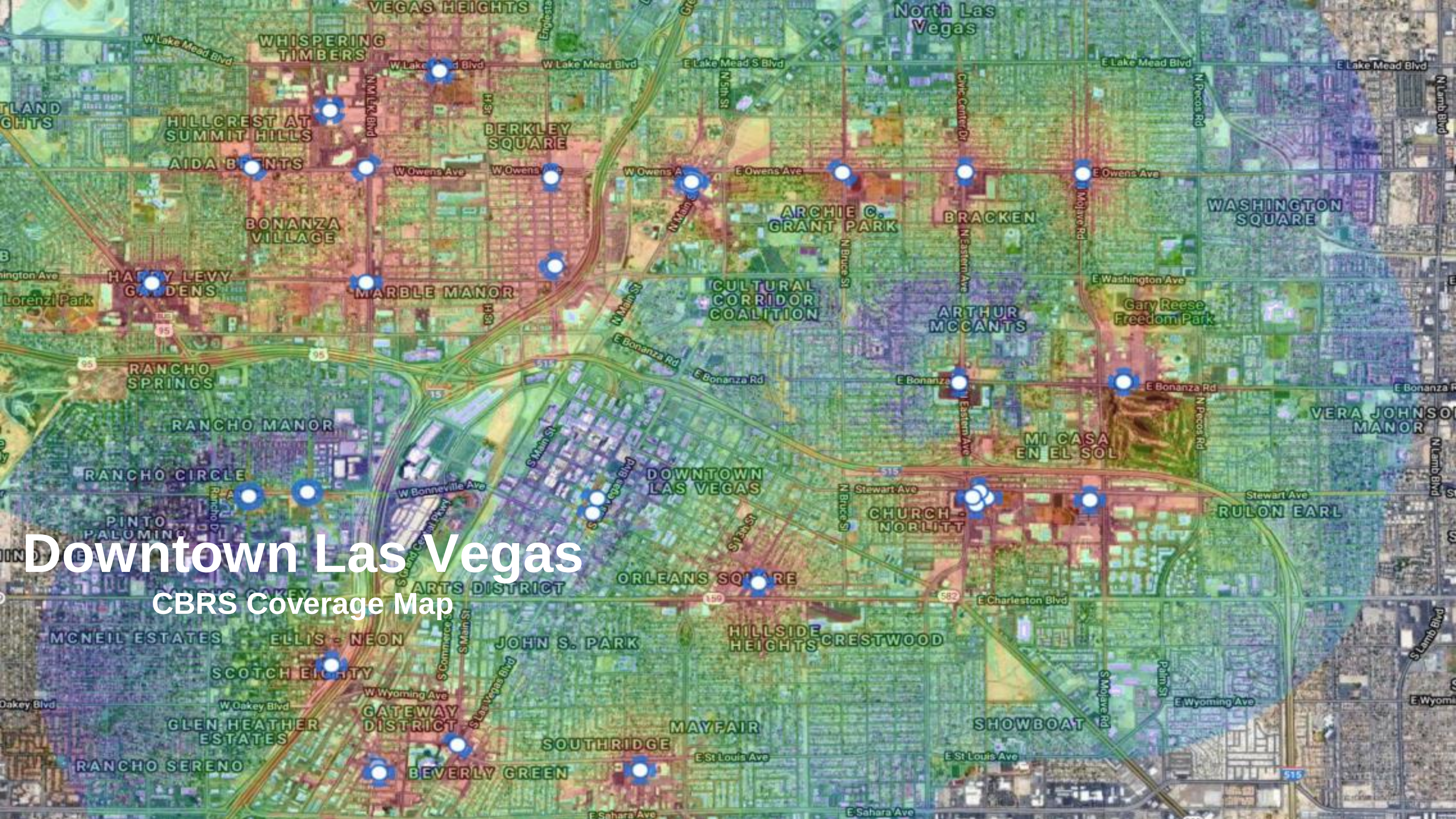


Present

CITY OF LAS VEGAS NEVADA


cruise

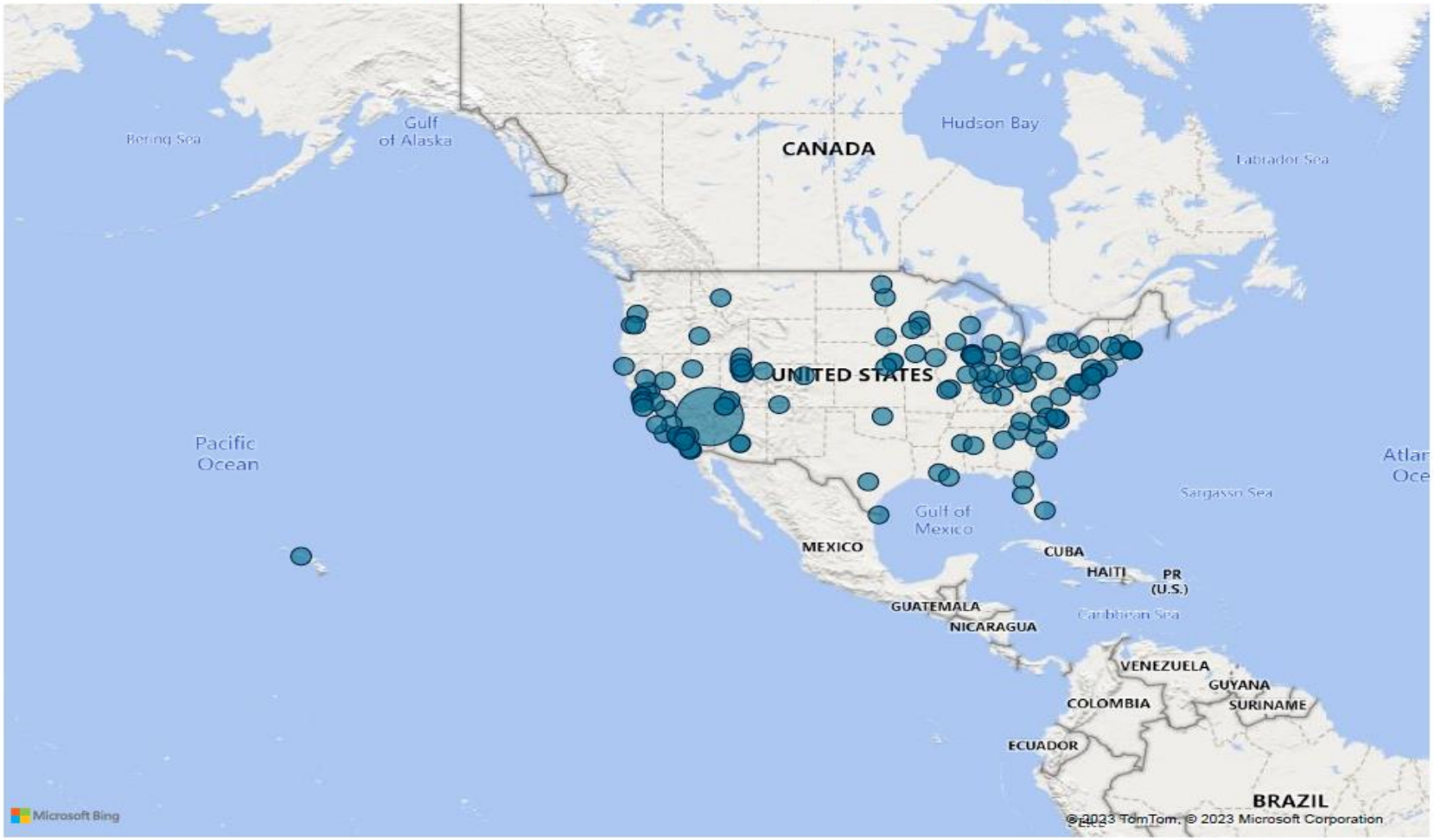

prime


Downtown Las Vegas
CBRS Coverage Map
VEGAS HEIGHTS
North Las Vegas
WHISPERING TIMBERS
HILLCREST AT SUMMIT HILLS
BERKLEY SQUARE
AIDA B NTS
BONANZA VILLAGE
ARCHIE C. GRANT PARK
BRACKEN
WASHINGTON SQUARE
HA Y LEVY G DENS
Lorenzi Park
MARBLE MANOR
CULTURAL CORRIDOR COALITION
ARTHUR MCCANTS
Gary Reese Freedom Park
RANCHO SPRINGS
RANCHO MANOR
VERA JOHNSON MANOR
MI CASA EN EL SOL
DOWNTOWN LAS VEGAS
RANCHO CIRCLE
CHURCH - NORLITT
RULON EARL
PINTO PALOMINO
ARTS DISTRICT
ORLEANS SQ RE
MCNEIL ESTATES
ELLIS - NEON
JOHN S. PARK
HILLSIDE HEIGHTS
CRESTWOOD
SCOTCH EI TY
GATEWAY DISTRICT
MAYFAIR
SHOWBOAT
GLEN HEATHER ESTATES
SOUTHRIDGE
RANCHO SERENO
BEVERLY GREEN
W Lake Mead Blvd
E Lake Mead S Blvd
E Lake Mead Blvd
W Owens Ave
E Owens Ave
E Washington Ave
E Bonanza Rd
Stewart Ave
W Bonneville Ave
E Charleston Blvd
W Wyoming Ave
E Wyoming Ave
W Oakey Blvd
E St Louis Ave
E Sahara Ave

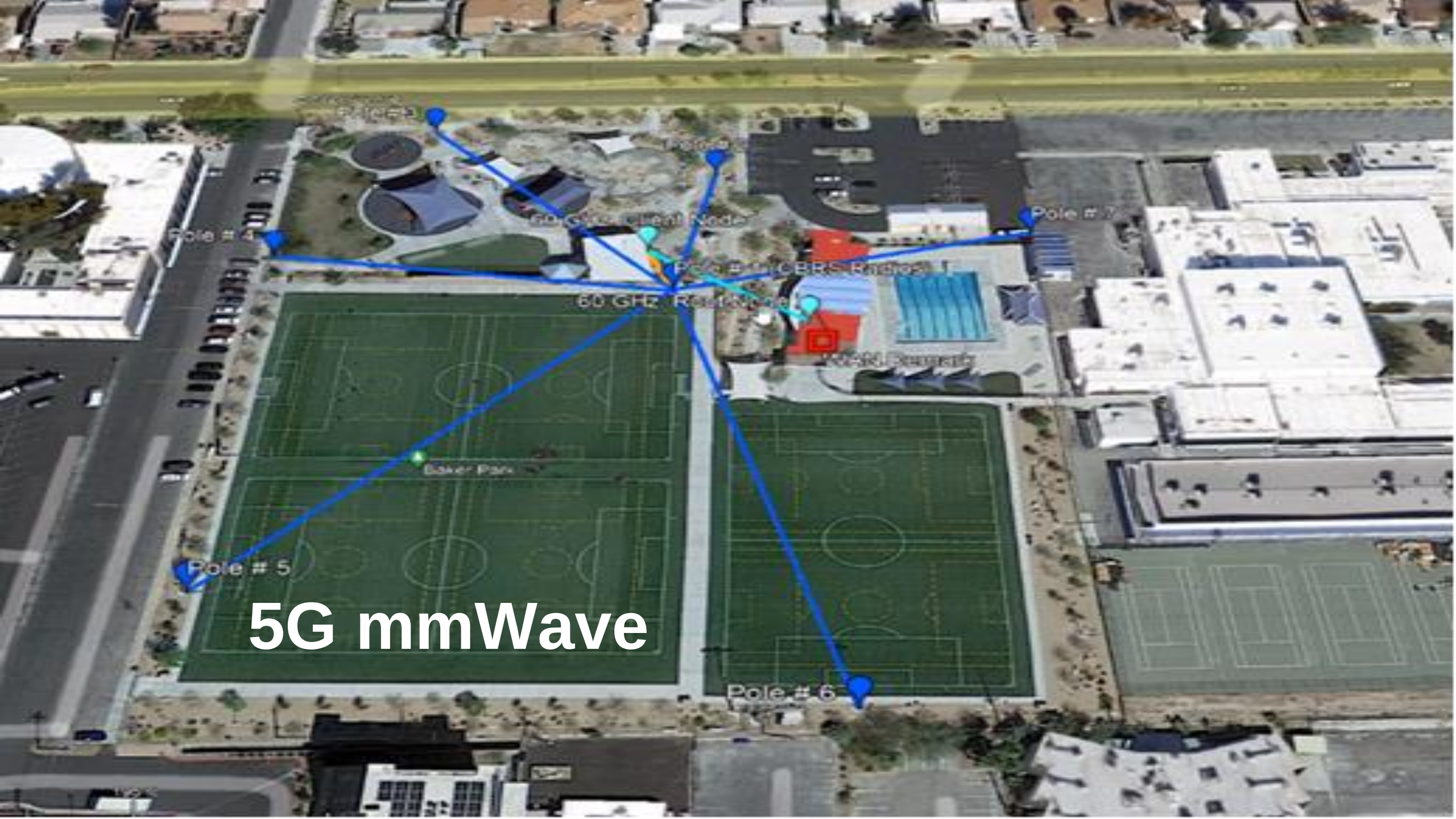
Eduroam

City of Las Vegas May 2023- Service Provider

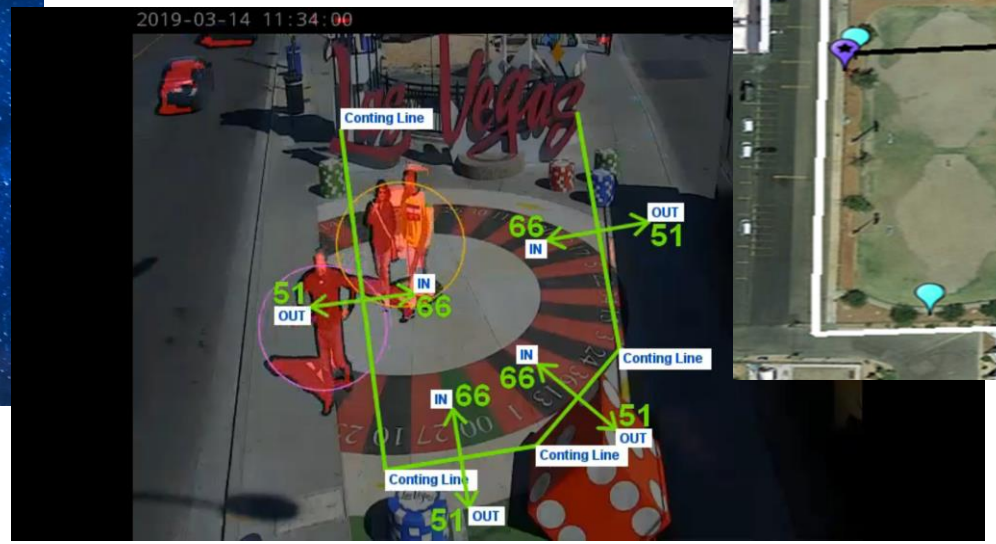
Number of distinct guest devices by institution of origin



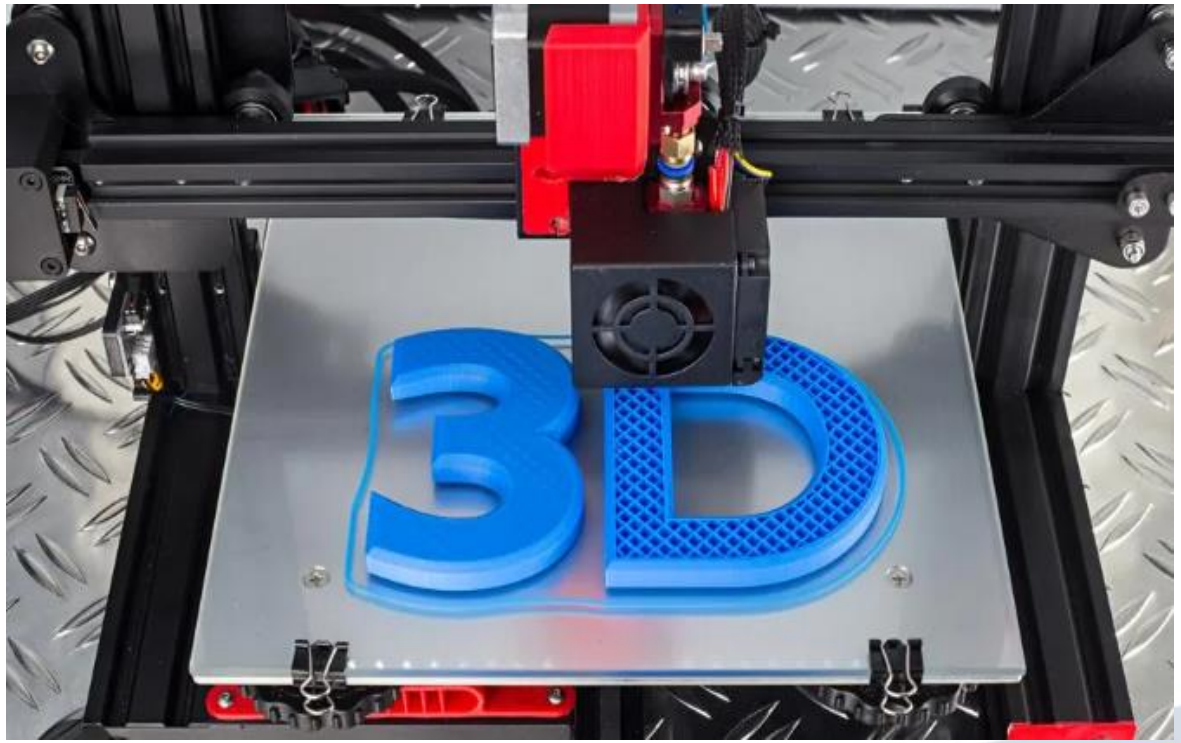
Institution Name	% of Total
University of Nevada-Las Vegas	79.26%
Brigham Young University-Provo	1.62%
California State University-Fullerton	1.03%
Southern Utah University	0.94%
University of California-Los Angeles	0.81%
University of California-Berkeley	0.77%
Virginia Polytechnic Institute and State University	0.64%
California State Polytechnic University-Pomona	0.51%
California State University-Sacramento	0.51%
University of San Diego	0.47%
University of Minnesota-Twin Cities	0.43%
Georgia Institute of Technology-Main Campus	0.38%
University of Maryland-College Park	0.38%
Utah State University	0.38%
Chapman University	0.34%
University At Buffalo	0.34%
University of California-Santa Barbara	0.34%
University of Iowa	0.34%
California State University-Long Beach	0.30%
Indiana University	0.30%
North Carolina State University at Raleigh	0.30%
San Diego State University	0.30%
University of Colorado at Boulder	0.30%
University of Kentucky	0.30%
University of Nevada-Reno	0.30%
Salt Lake Community College	0.26%
Weber State University	0.26%
University of California-Davis	0.21%
Total	**100.00%**

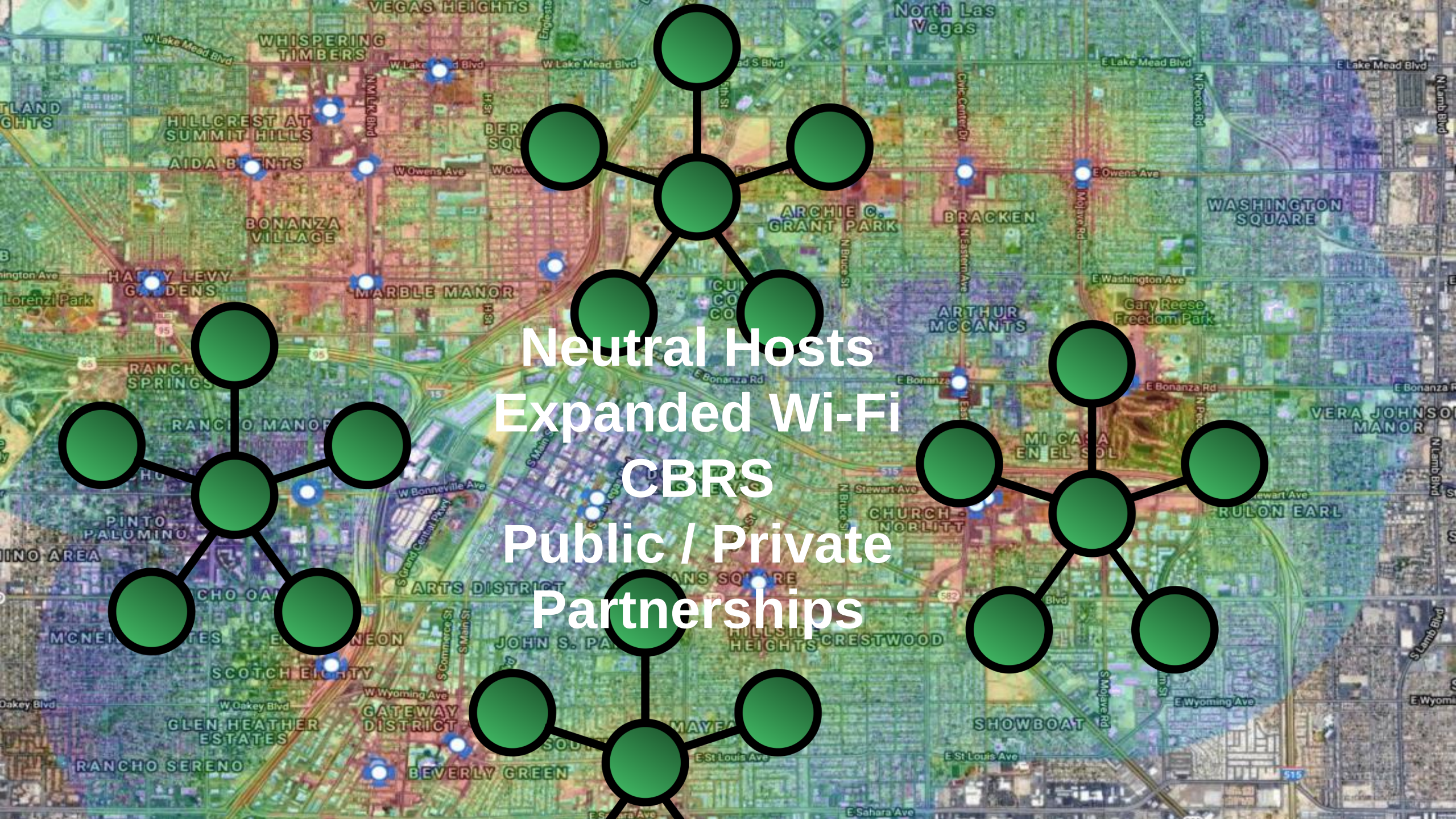

Pole # 4
Pole # 5
Pole # 6
Pole # 7
Baker Park
5G mmWave

Testing of Technologies



Maker Center




Neutral Hosts
Expanded Wi-Fi
CBRS
Public / Private
Partnerships

Improved Outcomes

Rapid Deployment

Real-time Insights

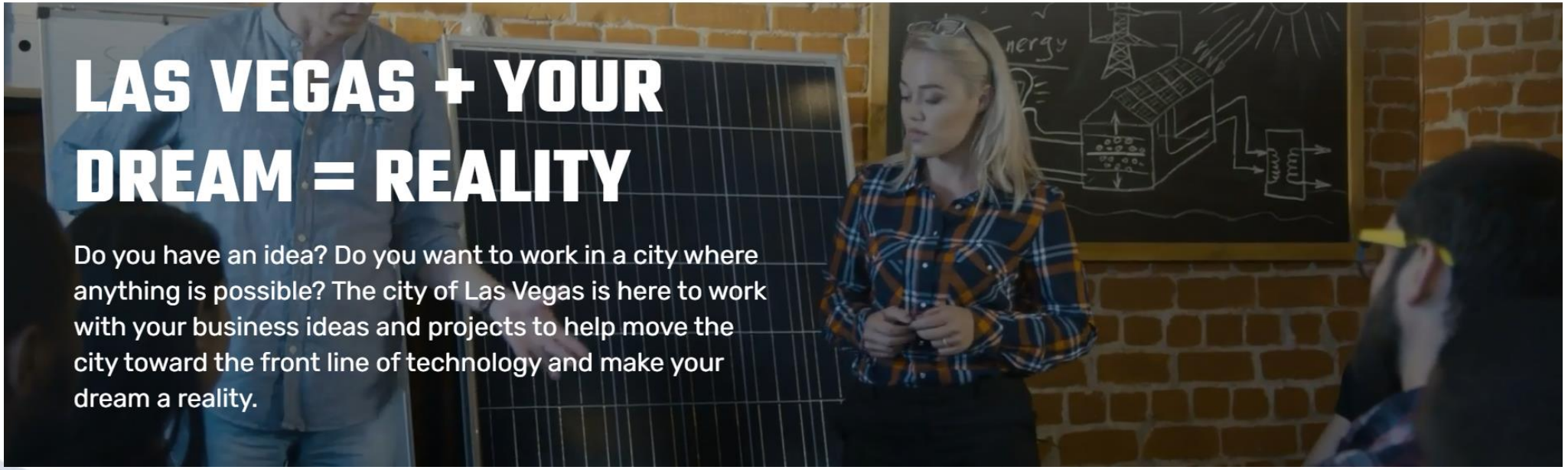
Predictive Analytics

Data Driven Decisions

Increased Citizen Engagement

Operational Efficiencies

www.innovate.vegas



Michael Lee Sherwood

Chief Innovation and Technology Officer

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Matt MacPherson

Wireless CTO, Cisco.

Future Wireless use cases –
Consuming 1200MHz in dense networks

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Future Wireless use cases

Consuming 1200MHz in dense networks

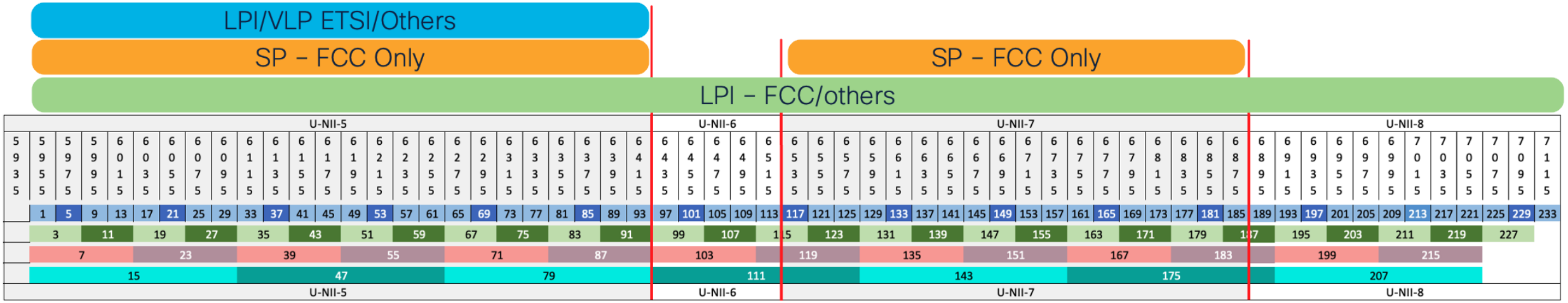
Matt MacPherson, Cisco Wireless CTO

WBA Wireless Global Congress

June 2023

Wi-Fi6E: The new 6 GHz band

- Two main proposals being reviewed or accepted by world regulators
  - FCC = 1200 MHz
  - ETSI = 500 MHz



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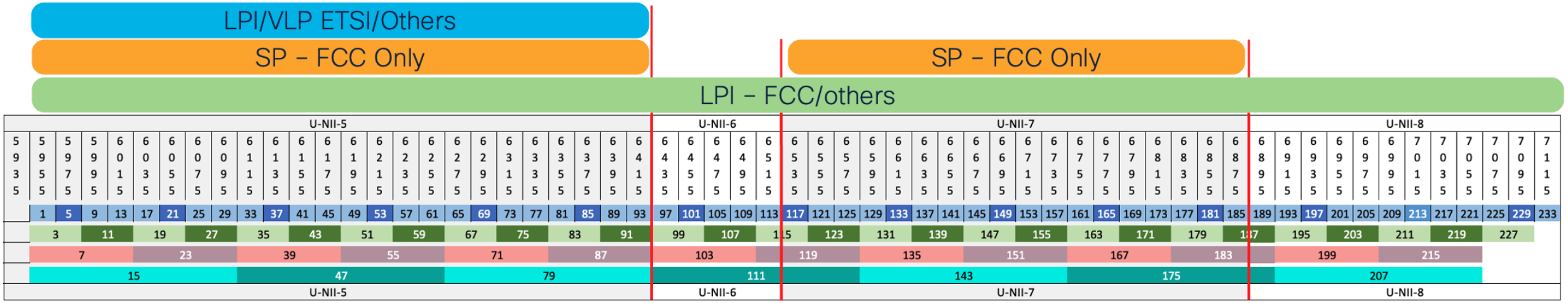
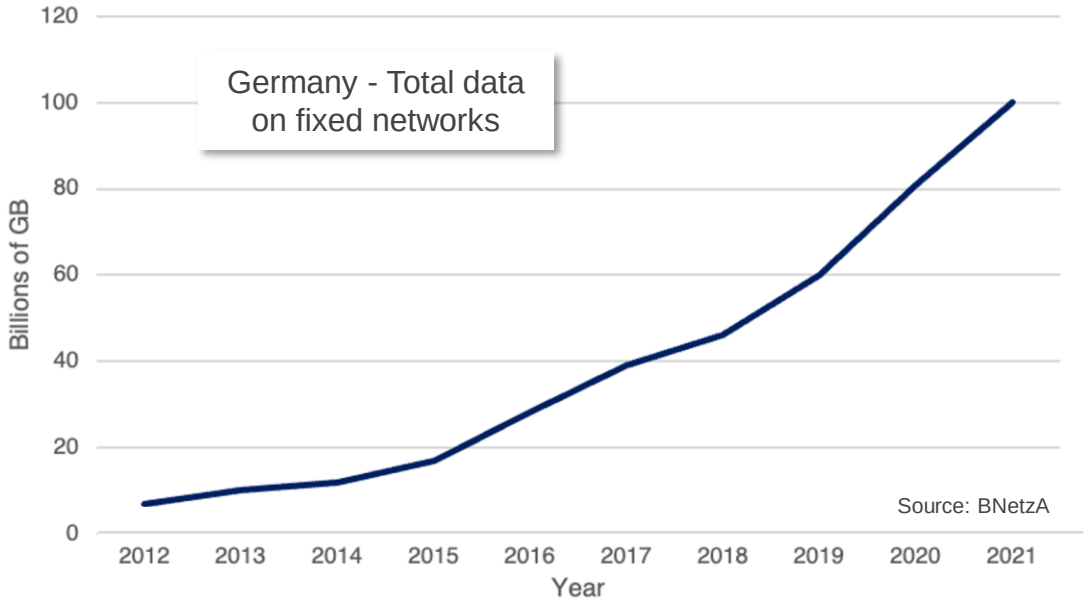
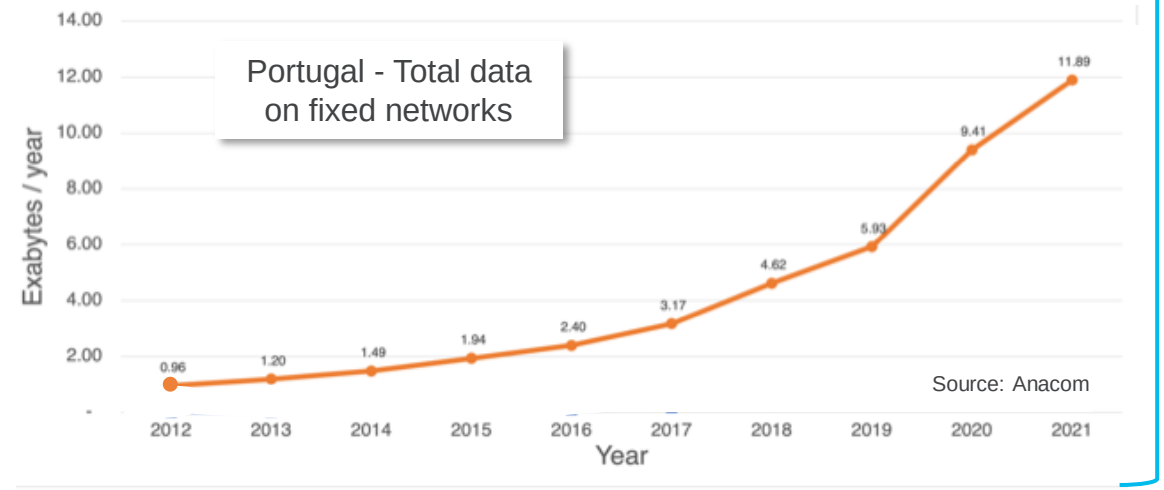


Why would you ever need 1200 more MHz in 6GHz for unlicensed?!?

Trends & Use cases

Data Consumption Trend

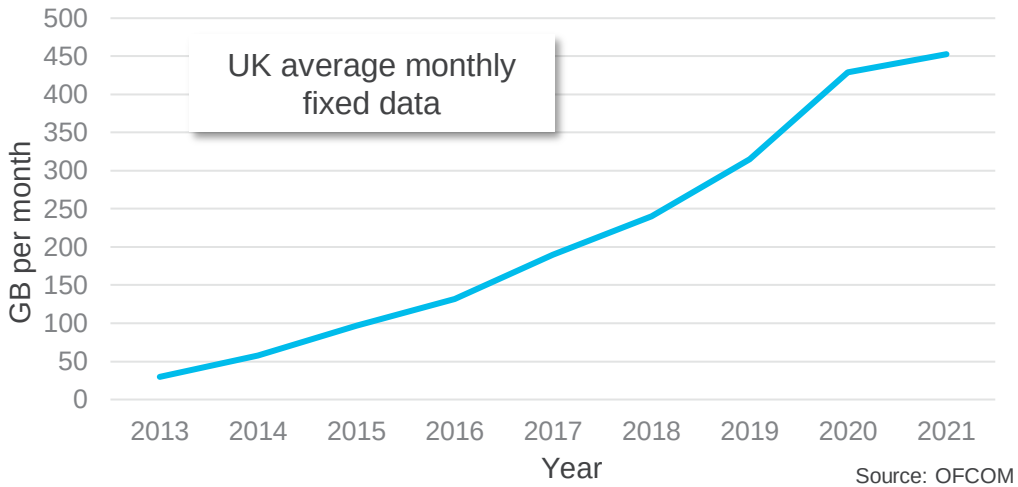




Country Consumption

Wi-Fi relays 92.3% of the overall fixed broadband traffic in Europe

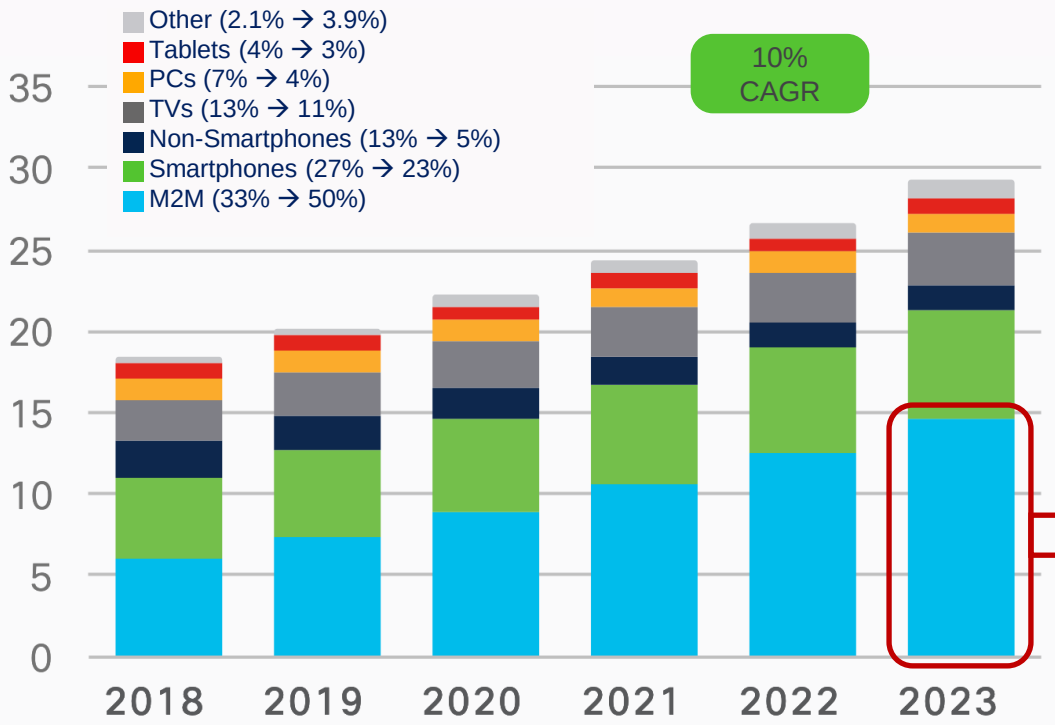
Subscriber Consumption



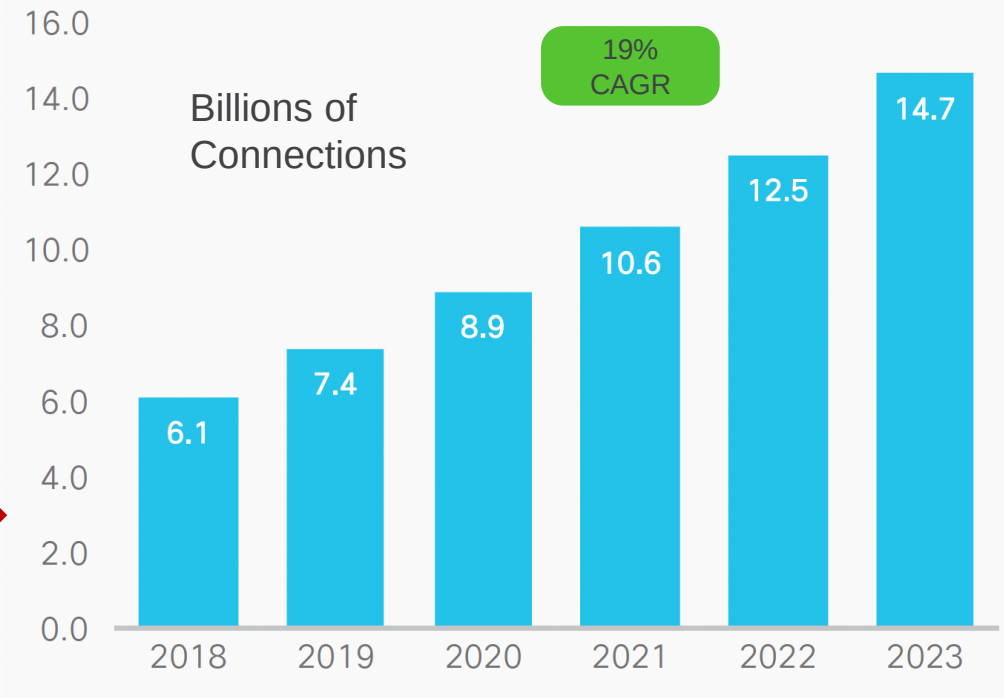
Density Evolution

An Explosion of Access and Devices

Billions of Devices



Global M2M (IOT) Connection Growth



Globally, Wi-Fi 6 hotspots will grow 13-fold from 2020-2023, 11% of all public hotspots by 2023

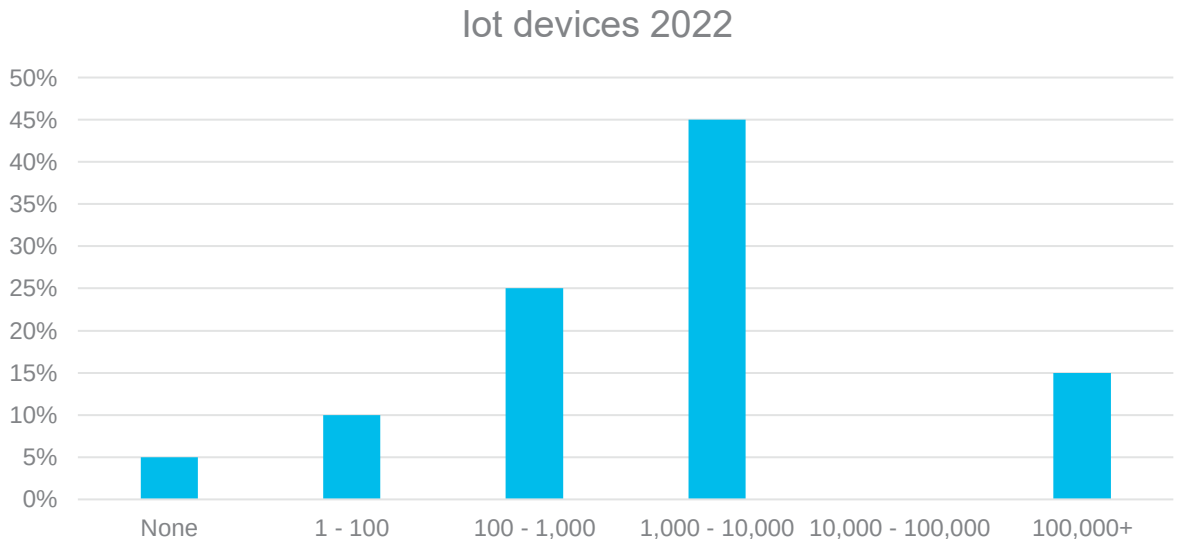
5G devices and connections will be over 10% of global mobile devices and connections by 2023.

Source: Cisco Annual Internet Report (2018-2023)

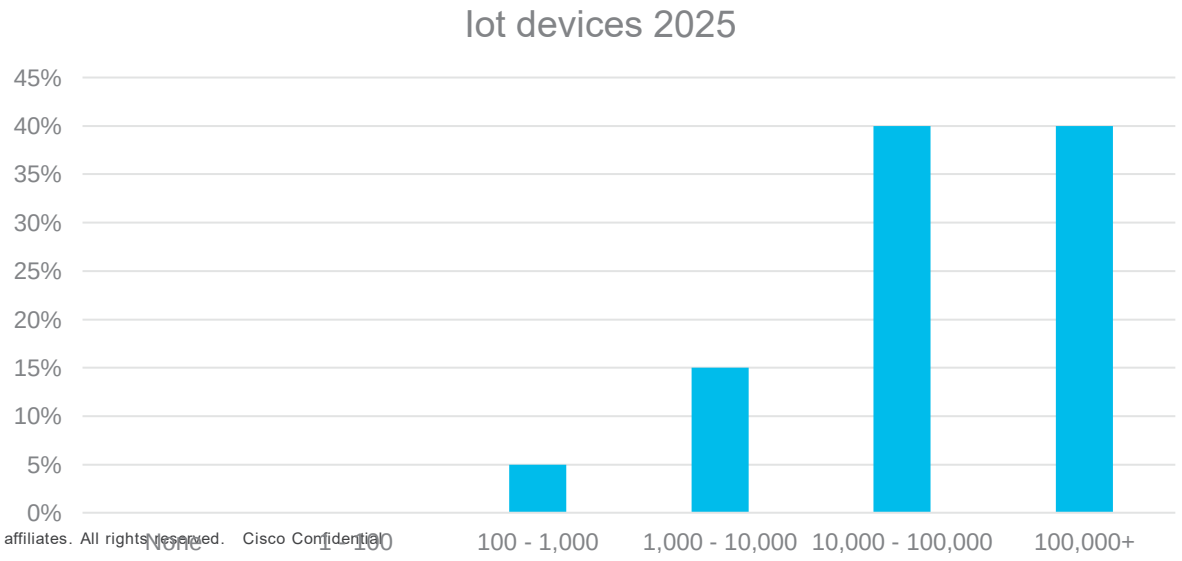
IoT in the large enterprise

What our customers told us at Cisco Live US

2022



2025



Drivers:

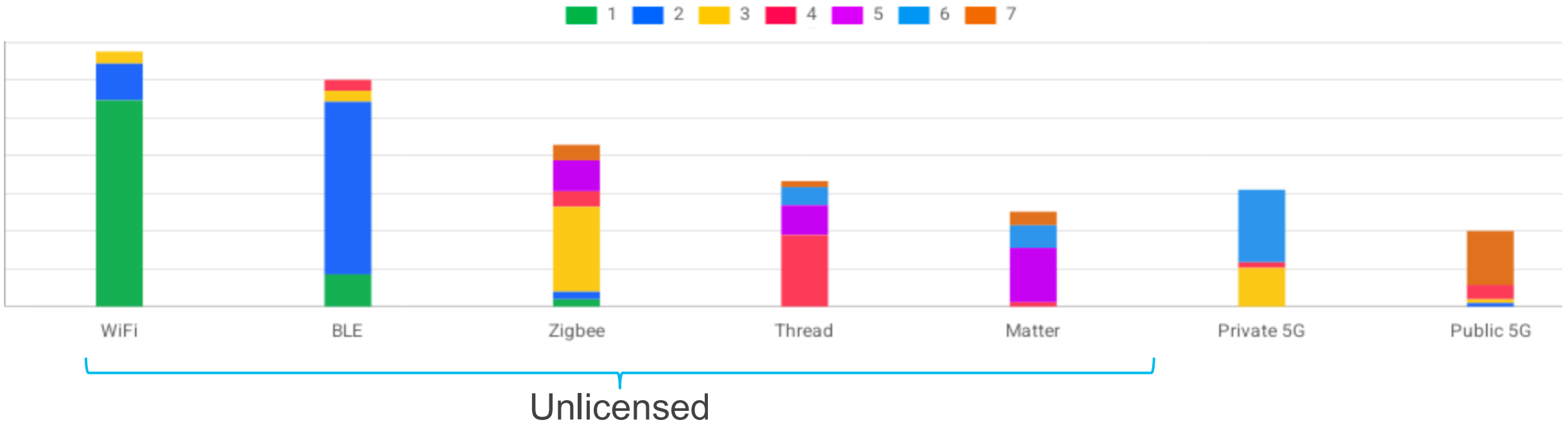
1) **Hybrid work & sustainability**
   - Lower seat occupancy
   - Environmental monitoring & Control

2) **Smart value chains**
   - Healthcare
   - Retail
   - Hospitality

3) **Automation**
   - Manufacturing
   - Supply chain
   - Operations

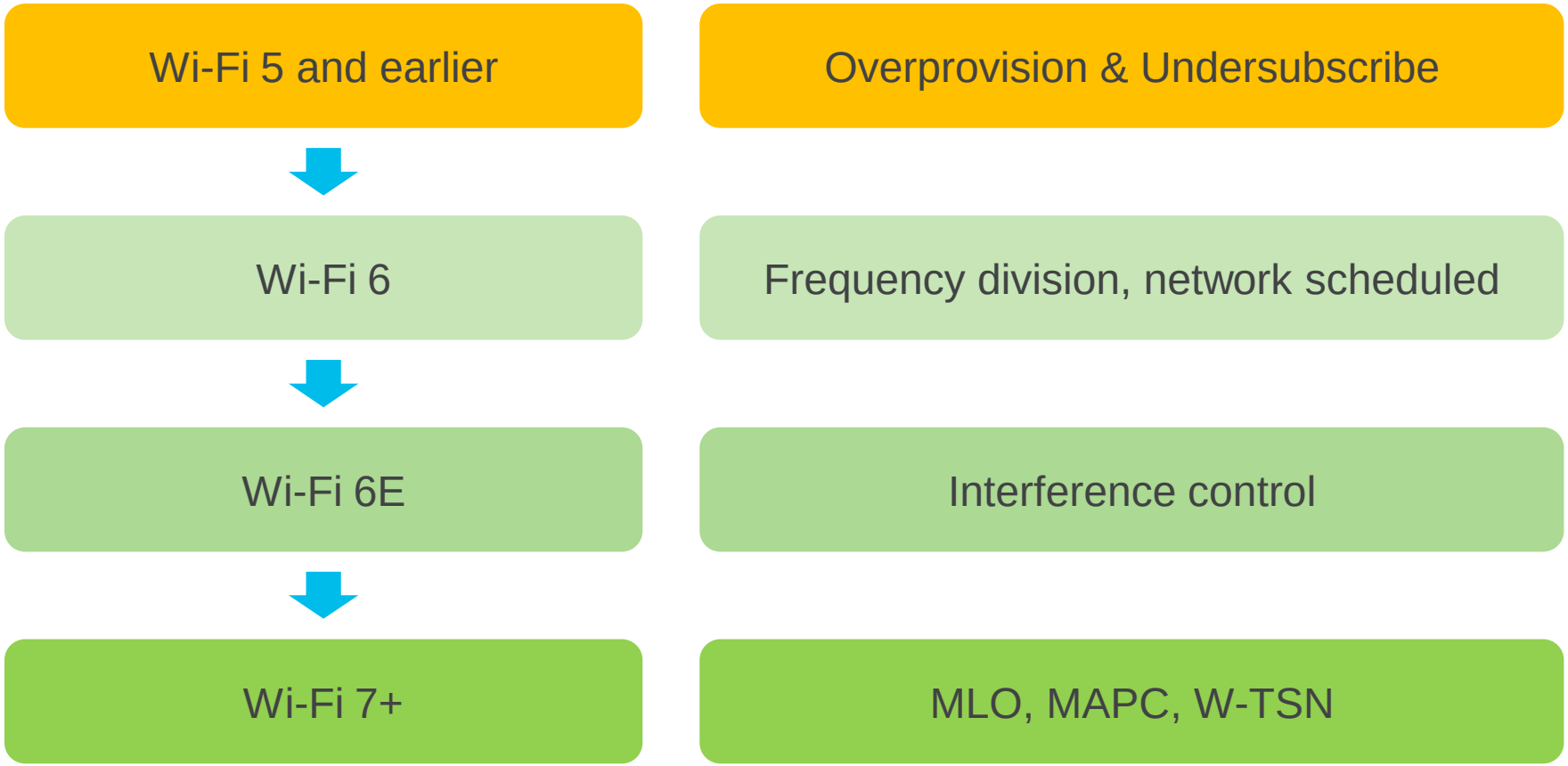
IoT wireless technology ranking

Survey of Cisco customers – what IoT access is most important to you?



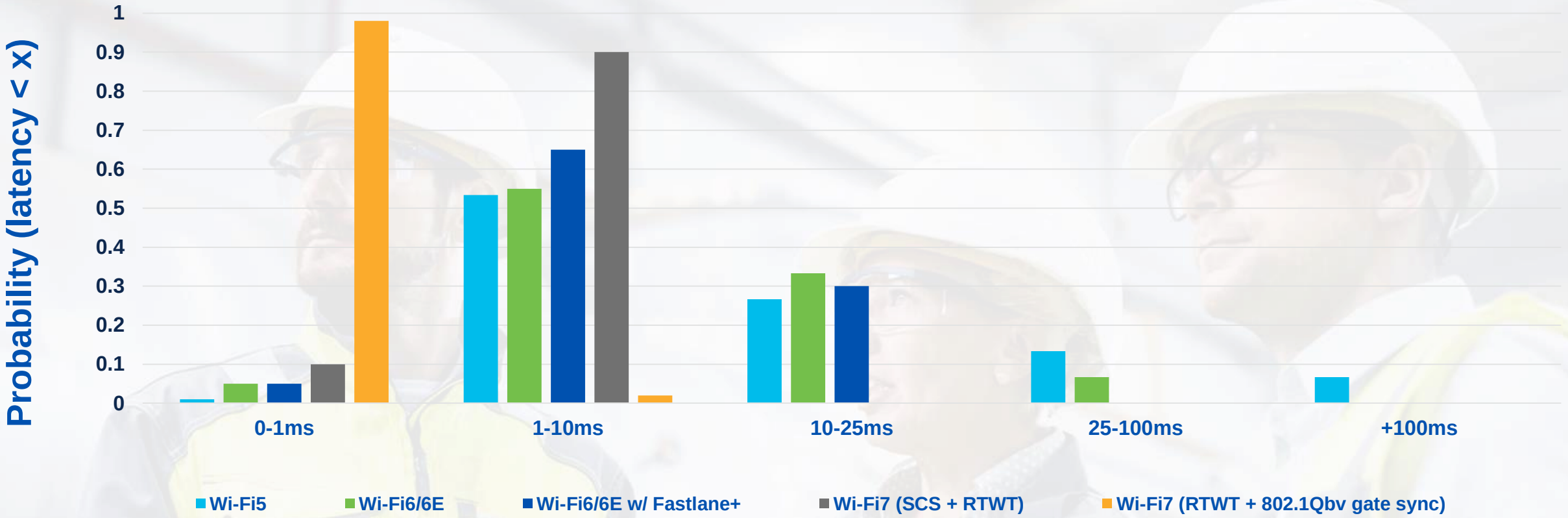
Wi-Fi Stack Progression

A gross over-simplification



Determinism… expanding wireless use-cases

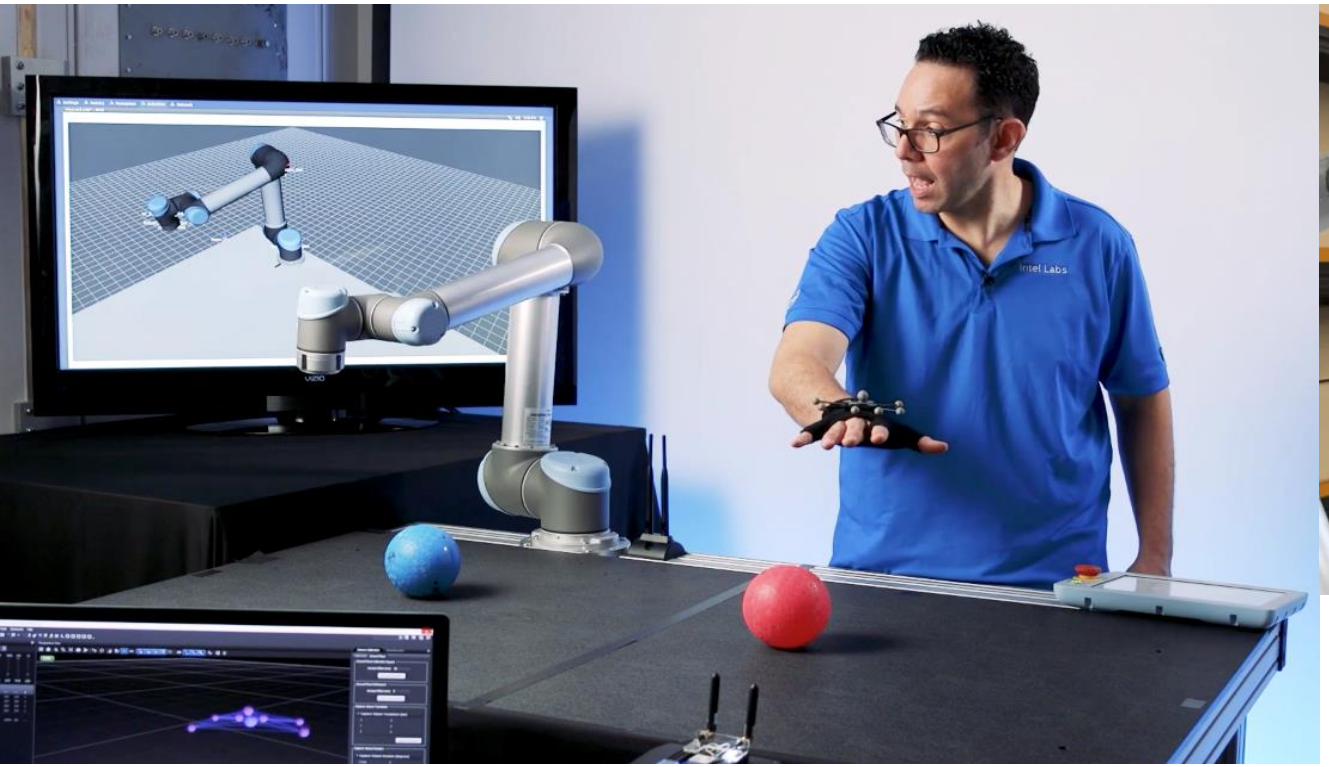
First solved with Apple with FastLane+, and Intel with W-TSN, and Wi-Fi 7 and 8



Bounded Latency, even in high-traffic scenarios

Source: https://mentor.ieee.org/802.11/dcn/22/11-22-0634-00-00be-802-11be-enhancements-for-tsn-time-aware-scheduling-and-network-management-considerations.pptx

Industrial IOT (IIOT) and deterministic Wi-Fi



AMR (Autonomous Mobile Robot)
AMR (w/ positioning)
AMR (w/ Wi-Fi6E + 5G)

- Intel and Cisco are collaborating to enable Time-Sensitive-Network (TSN) applications like remote control of robotics for manufacturing in Wi-Fi6 networks
- These applications rely on the new **deterministic/bounded** (<2ms) of WiFi6-TSN

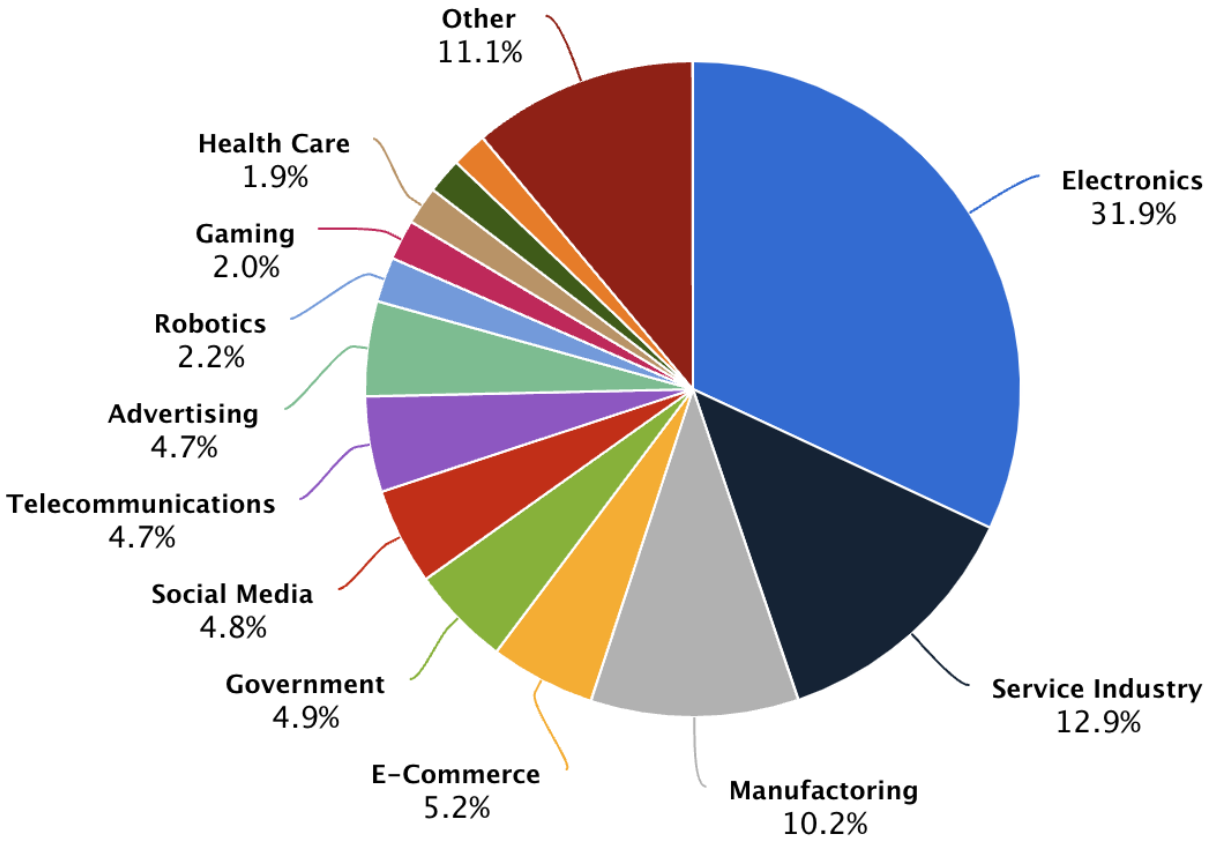
Safety (remote control)

Digital Immersion is here

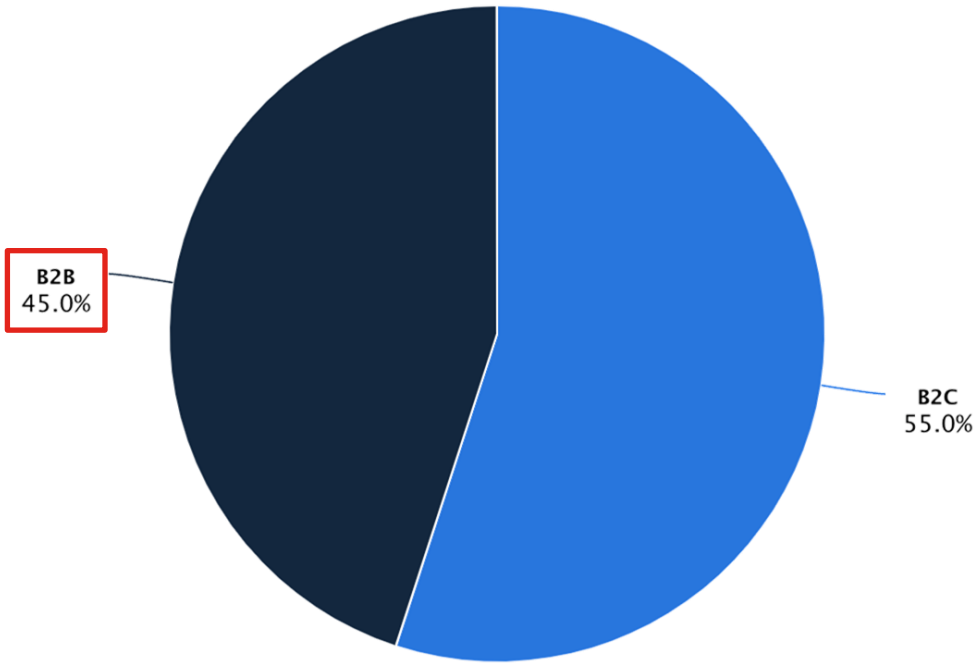
Augmented/Virtual/Mixed Reality
(e.g., Collaboration, IOT, Industrial, Robotics)

And it is not just gaming … Industry Revenue Share

Revenue-share per Industry (B2B and B2C)

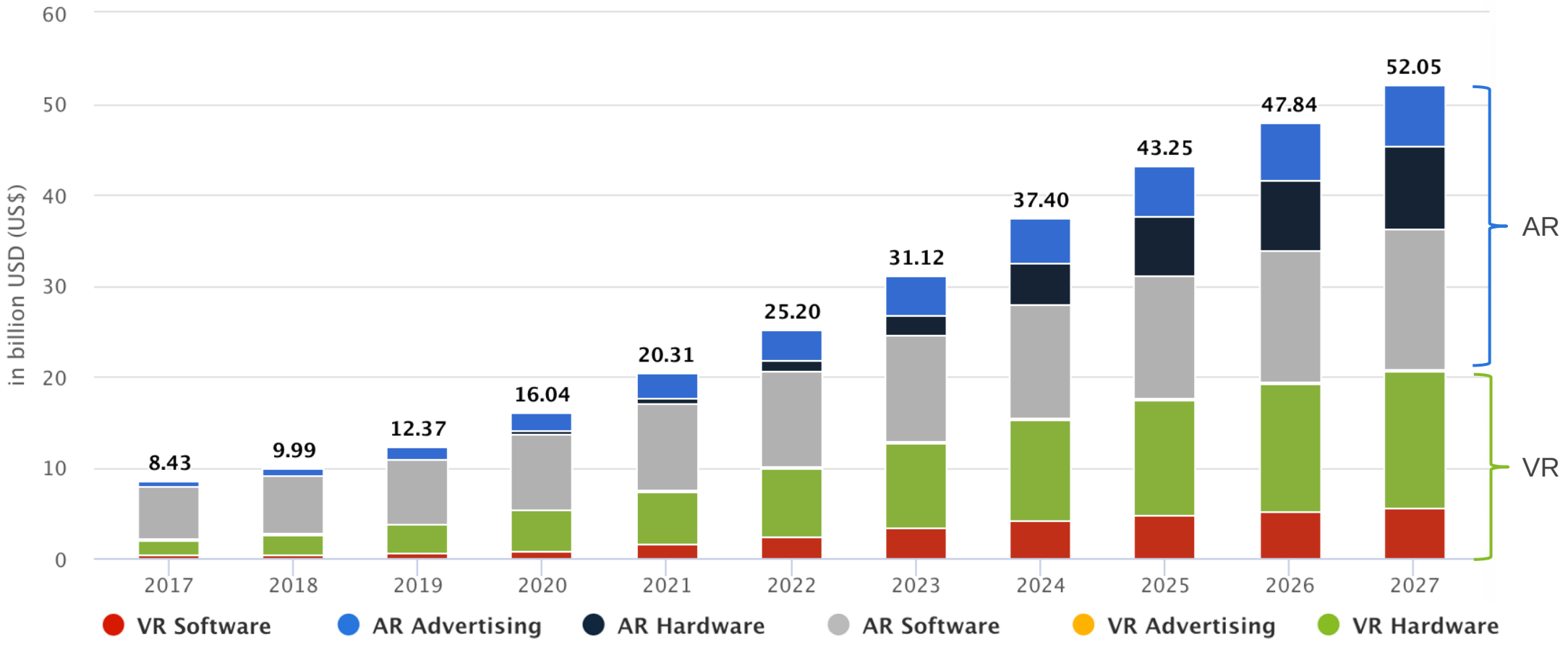


B2B vs B2C



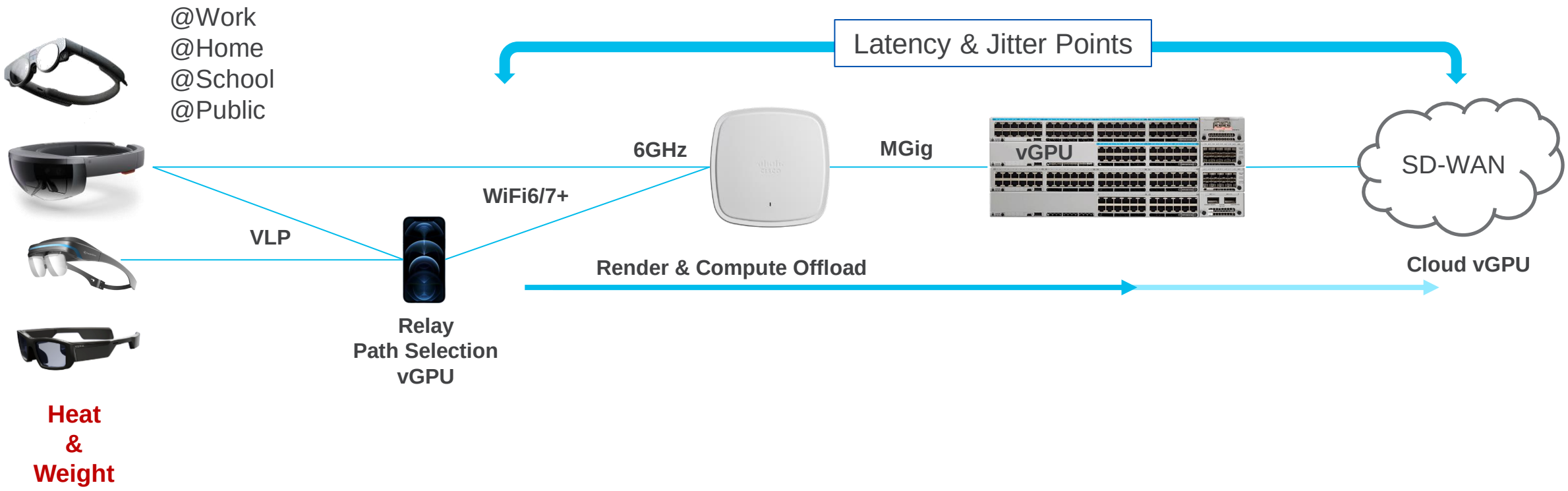
Source: Statista, Oct 2022c

AR/VR/MR Revenue by Segment



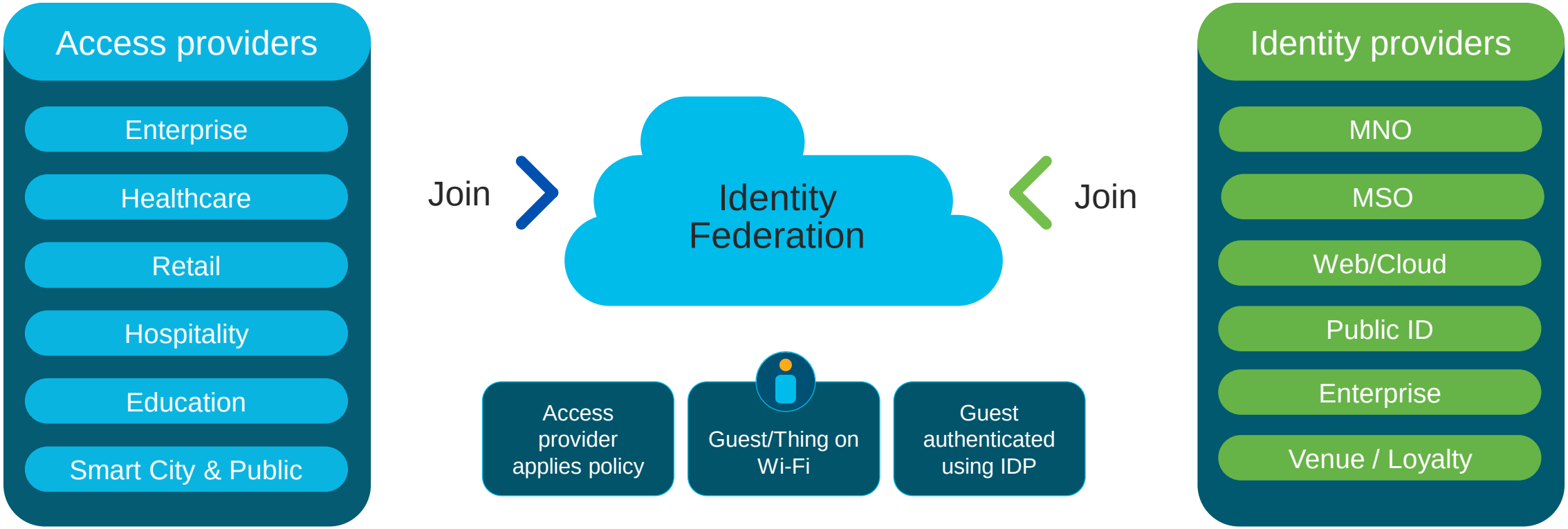
Source: Statista, Oct 2022

Remote Rendering needs capacity & low latency



OpenRoaming: Secure Auto-Connectivity Megatrend

Opening the Wi-Fi Ecosystem to new experiences & business models



OpenRoaming is a consortium of identity & access providers
to enable seamless roaming & onboarding

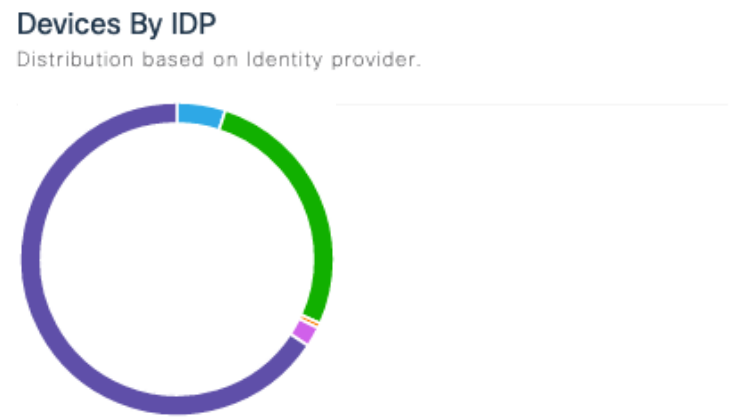
Drives 20% typical attach to over 80% attach – 4X the traffic load!

OpenRoaming: Increased Attach with SLA

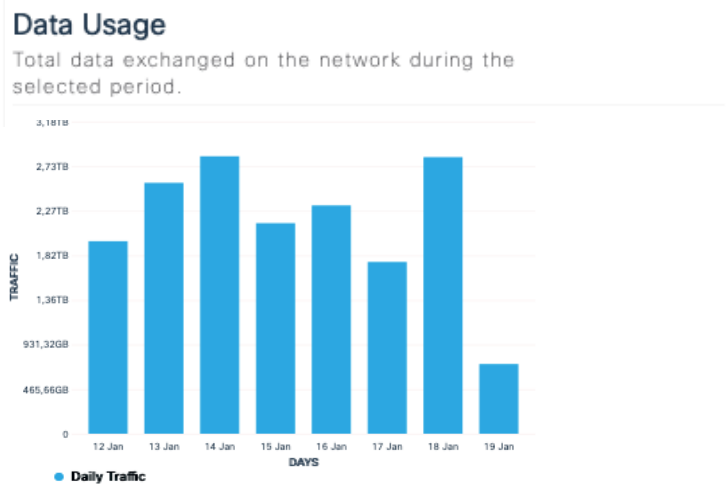
Enables new convergence models between Enterprise and SP (e.g. indoor coverage)

Healthcare Example: Coverage issues solved

SP's and Cloud IDP's



High Usage



Feedback

- Happy visitors and patients
- Some users do not notice they are on Wi-Fi, but they notice good data / voice
- Reduced visitor coverage complaints
- Clinical staff can focus on core tasks instead of getting people connected
- Lower burden on IT staff
- Fast and cost-effective indoor coverage

Why 1200 Mhz?

Channel Width – Solving Consumption Growth

Wider channels at same re-use factor (6-12 APs based on device density)

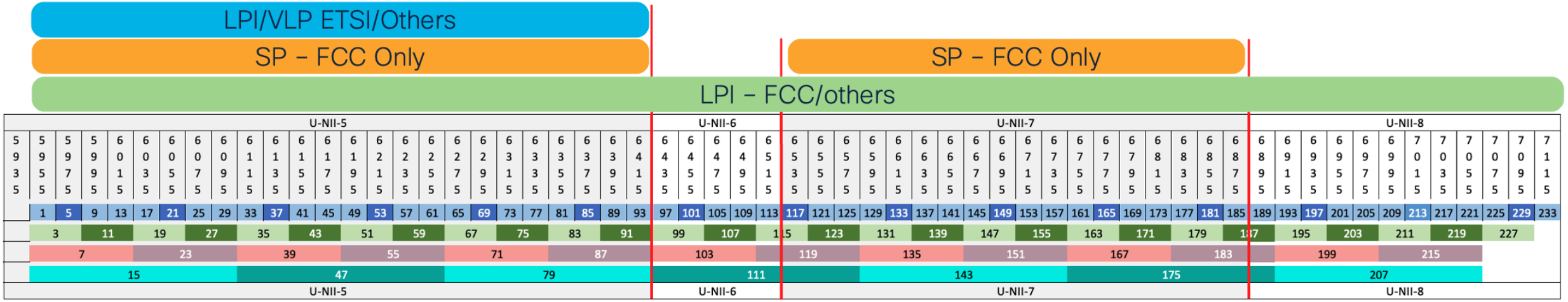
% of customers at different channel widths				
20MHz (13-25ch@5GHz)	40MHz (6-12ch@5GHz)	80MHz (3-5ch@5GHz) (14@6GHz)	160MHz (1-2ch(160) + 1ch(80M) @5GHz) @6GHz)	320 MHz in 6GHz
5GHz Manual				
25%	64%	11%	0.02%	N/A
5GHz Auto				
23%	59%	17%	0.02%	N/A
6GHz Estimate				
5%	25%	60%	10%	0.02%

Anonymous data from >30k configs and >900k 160MHz capable APs across 6 countries

The new 6 GHz band

- Two main proposals being reviewed or accepted by world regulators
  - FCC = 1200 MHz
  - ETSI = 500 MHz

20 MHz Channel
40 MHz Channel
80 MHz Channel
160 MHz Channel
Primary “PSC” channel



20 and 40 MHz channels will continue to be default for 500 MHz countries

2x2 Client 40 MHz 1024 QAM = 574 Mbps

Width	FCC Channels	ETSI Channels
20 MHz	59	24
40 MHz	29	12
80 MHz	14	6
160 MHz	7	3

80 and 160 MHz channels will be the default for 1200 MHz countries

2x2 Client 160 MHz 1024 QAM = 2.4 Gbps

The bridge to possible

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Eric McLaughlin

Vice President & General Manager Wireless Solutions,
Intel Corporation

The Future of Enterprise Wi-Fi

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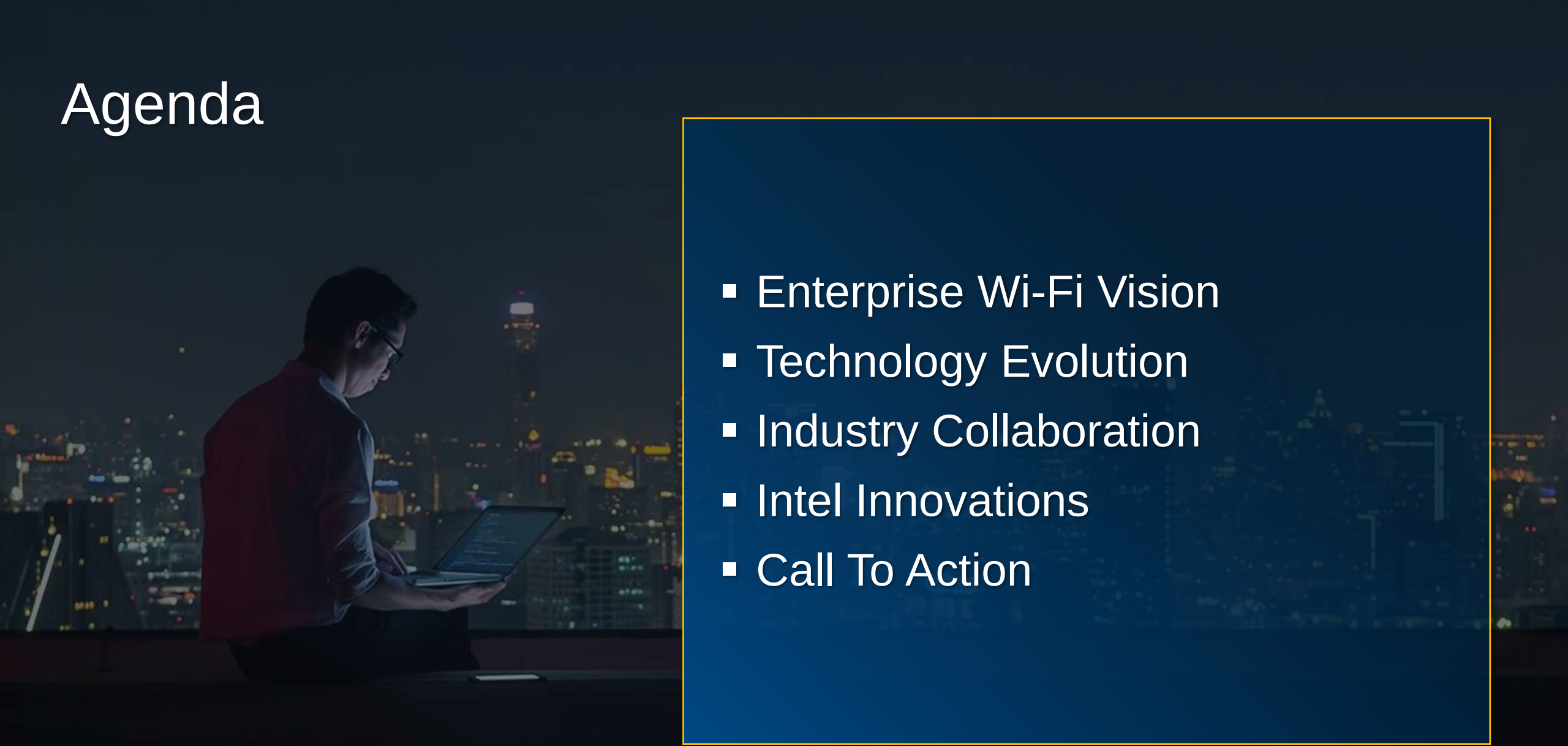
The Future of Enterprise Wi-Fi

Eric A. McLaughlin,
VP & GM Wireless Solutions Group,
Client Computing Group,
Intel Corporation

June 2023

Agenda



- Enterprise Wi-Fi Vision
- Technology Evolution
- Industry Collaboration
- Intel Innovations
- Call To Action

Enterprise Wi-Fi Vision

Hybrid Work

- Nomadic Employees
- Corporate Networks
- Personal Networks
- Public Networks

Many Devices

- Clients / IOT
- BYOD
- Third Party Devices
- New Device Types

Wi-Fi & Private Cellular Networks

- Flexible Options
- Simple/Secure - Access/Operation
- Seamless Switching
- Network Agnostic Services

Advanced Usages

- Video Conferencing
- AR / VR
- Collaboration
- Multi-Device

Location

- Asset Tracking
- Employee Navigation
- Security – Geo Fencing

Spectrum Sharing

- Multiple Wireless Technologies
- Unlicensed / Licensed
- 6 GHz / AFC / P2P
- 60 GHz

E2E QoS, manageability, data analytics, and contextual awareness will help improve user experiences

Technology Evolution

Intelligent Networks + E2E QoS

- Artificial Intelligence
- SW Defined Networks
- Distributed Networks
- Prioritization / Optimization

Manageability

- Network & Client
- On + Off-Premises
- Security / Privacy / Identity

Data Analytics

- Monitoring / Support
- Quality of Service
- Security

Context Aware Experiences

- Proximity / Control
- Location / Health
- Enhanced / Predictive

Client AI

- Massive Distributed Scale
- Low Latency
- More Private / Personalized

Technology advancements will help make the vision a reality

Industry Collaboration Model

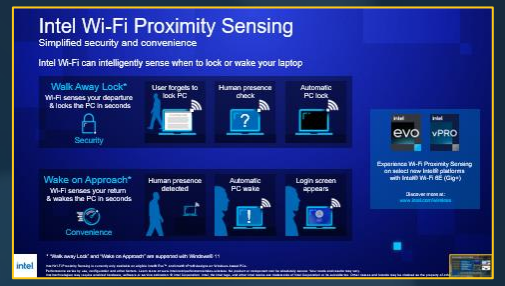
Example: Intel + Cisco

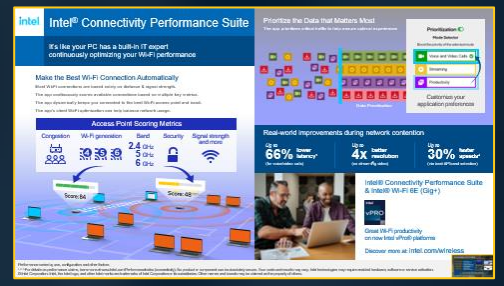
- E2E Performance & QoS
- Seamless / Secure OpenRoaming
- Wi-Fi Based Location
- Intel Connectivity Analytics

Collaboration will help amplify & enable new industry innovations

Intel Innovations for PC Clients

Intel® Wi-Fi Sensing	• Convenience / Security • *Future - Location, Gesture Control*
Intel® Connectivity Performance Suite	• Traffic Prioritization / QoS • Dynamic Connection Optimization • *Future - Historical / Predictive + IT Controls*
Intel® Bluetooth® Improvements	• Audio Quality / Broadcasts / Accessibility • Ecosystem Optimization Program • *Future - Extended BT Range*
Intel® Unison™	• Multi-Device Experiences • Simple, Seamless, Secure • *Future – Device + Use Case Expansion*





The PC is the primary enterprise user's experience hub
for communication, collaboration, productivity, and entertainment

Call to Action

Si / HW / SW / OS Vendors

Carriers

Solution / Service Providers

Network / Infrastructure Vendors

WBA Members… Let's work together with the industry to drive future enterprise Wi-Fi enhancements for this hybrid world.

Thank You!

Notices and Disclaimers

While Wi-Fi 7 is backwards compatible with previous generations, new Wi-Fi 7 features require PCs configured with Intel Wi-Fi 7 solutions, PC OEM enabling, operating system support, and use with appropriate Wi-Fi 7 routers/APs/gateways. 6 GHz Wi-Fi 7 may not be available in all regions.

Performance varies by use, configuration and other factors. For details on performance claims, learn more at www.Intel.com/performance-wireless.

All product plans and roadmaps are subject to change without notice.

Statements in this document that refer to future plans or expectations are forward-looking statements. These statements are based on current expectations and involve many risks and uncertainties that could cause actual results to differ materially from those expressed or implied in such statements. For more information on the factors that could cause actual results to differ materially, see our most recent earnings release and SEC filings at www.intc.com.

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intel

BACKUP

Intel Wi-Fi Proximity Sensing

Simplified security and convenience

Intel Wi-Fi can intelligently sense when to lock or wake your laptop

Walk Away Lock*

Wi-Fi senses your departure & locks the PC in seconds

Security

Wake on Approach*

Wi-Fi senses your return & wakes the PC in seconds

Convenience

intel evo

intel vPRO

Experience Wi-Fi Proximity Sensing on select new Intel® platforms with Intel® Wi-Fi 6E (Gig+)

Discover more at:
www.intel.com/wireless

* “Walk away Lock” and “Wake on Approach” are supported with Windows® 11

Intel® Connectivity Performance Suite

It's like your PC has a built-in IT expert continuously optimizing your Wi-Fi performance

Make the Best Wi-Fi Connection Automatically

Most Wi-Fi connections are based solely on distance & signal strength.

The app continuously scores available connections based on multiple key metrics.

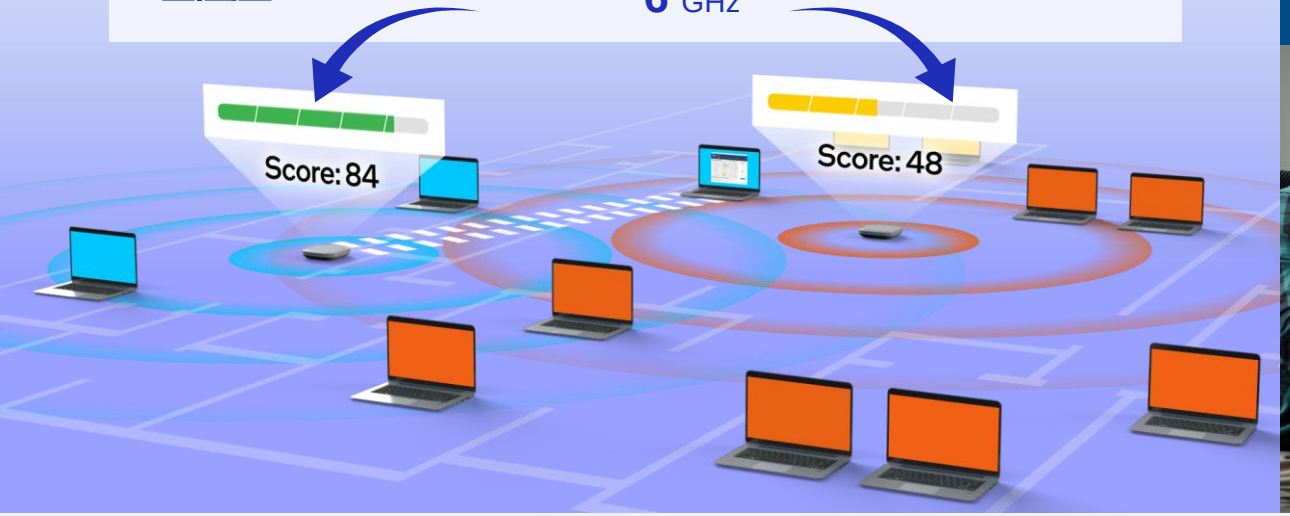
The app dynamically keeps you connected to the best Wi-Fi access point and band.

The app's client Wi-Fi optimization can help balance network usage.

Access Point Scoring Metrics

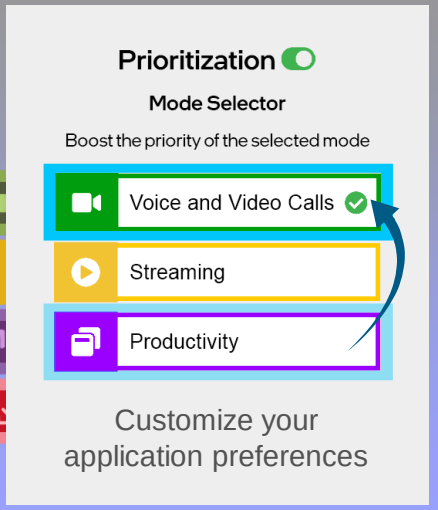
Congestion | Wi-Fi generation | Band | Security | Signal strength and more

2.4 GHz
5 GHz
6 GHz



Prioritize the Data that Matters Most

The app prioritizes critical traffic to help ensure optimal experiences



Customize your application preferences

Real-world improvements during network contention

Up to **66%** **lower latency**[1] (for voice/video calls)

Up to **4x** **better resolution**[2] (on streaming video)

Up to **30%** **faster speeds**[3] (via best AP/band selection)

Intel® Connectivity Performance Suite & Intel® Wi-Fi 6E (Gig+)

intel. vPRO

Great Wi-Fi productivity on new Intel vPro® platforms

Discover more at: intel.com/wireless

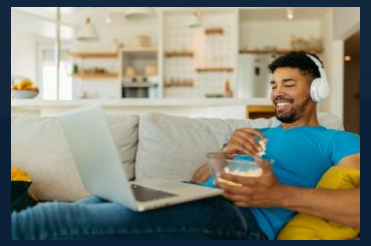
Performance varies by use, configuration and other factors.

[1, 2, 3] For details on performance claims, learn more at www.Intel.com/PerformanceIndex (connectivity). No product or component can be absolutely secure. Your costs and results may vary. Intel technologies may require enabled hardware, software or service activation.

Intel® Bluetooth® LE Audio

Next-Generation Wireless Audio for PCs

Amazing Bluetooth® Audio Experiences



Immersive music, videos, gaming, and VR

True wireless stereo with synchronized multi-stream audio

Enhanced music and speech quality

Higher rate audio sampling

Improved Bluetooth® Accessory Experiences

Enables longer accessory battery life

Up to 50% lower power consumption[1]

Enhanced headset source switching

Support for multiple synchronized groups of streams

Exciting New Auracast™ Capabilities

Broadcast your music to nearby friends or specified speakers

Improved accessibility for hearing aids with laptops and assisted listening services

intel®

1) The Bluetooth® Low Energy Audio specification from the Bluetooth® SIG requires a new LC3 codec which enables improved Bluetooth® audio quality at up to 50% lower bit rates and up to 50% lower Bluetooth® power consumption than Classic Bluetooth® Audio with the legacy SBC codec. Performance varies by use, configuration, and other factors. Your costs and results may vary. Intel technologies may require enabled hardware, software, or service activation. For more information learn more at www.intel.com/performance-wireless. No product or component can be absolutely secure.

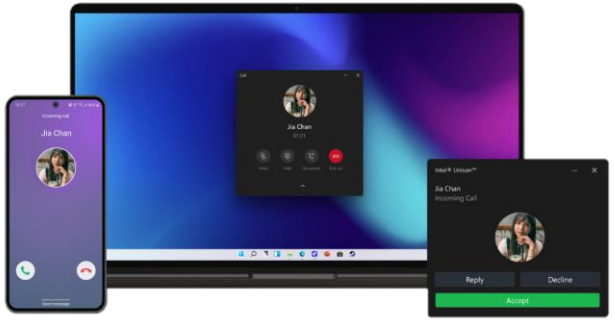
intel. evo

Enjoy new wireless audio experiences with Bluetooth® LE Audio accessories and select Intel® Evo™ laptops with Intel® Wi-Fi 6E (Gig+) and Bluetooth®

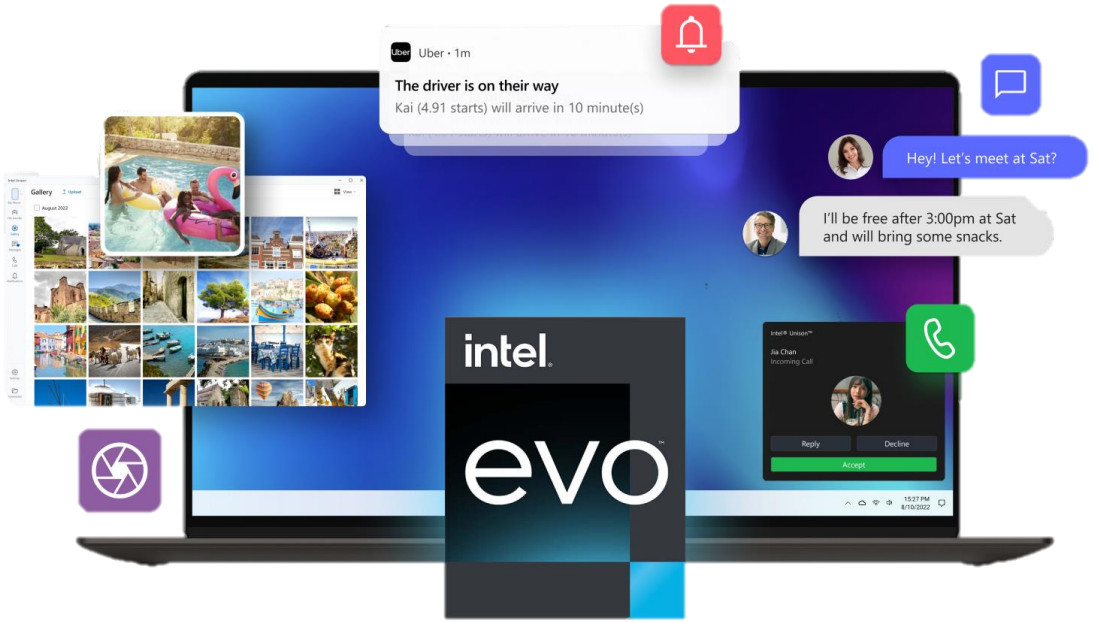
Discover more at intel.com/wireless

Intel® Unison™
Current Features and Capabilities

Phone Calls



+Messages / Notifications



File & Photo Sharing

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20TH ANNIVERSARY | Wireless Global Congress

Bill Marino

Vice President Data Engineering, Boingo Wireless

The Role of AI in 5G & Wi-Fi 6 Network Management

#WGCAMERICAS | #wifirevolution | #lovewifi

The Role of AI in 5G & Wi-Fi 6 Network Management

June 2023

WBA Wireless Global Congress Americas

Bill Marino, Boingo VP Data Engineering

boingo wireless


Boingo simplifies complex wireless challenges to connect people, business and things.

20+ Years of Award-Winning Wireless

LARGEST
DAS Operator
Largest indoor DAS provider in the U.S.

40,500
Small cell nodes

LARGEST
Wi-Fi Operator
Largest operator of airport Wi-Fi networks in the world

1+ MM
Hotspots worldwide

LARGEST
Military Provider
Largest Wi-Fi & Cell Tower provider to US Military bases

2,000+
Buildings

340,000
Beds

FIRST
Commercial DAS Network
to market ('99)

FIRST
Passpoint Network
to market ('14)

FIRST
CBRS Airport Private Network
to market ('18)

FIRST
Wi-Fi 6 Airport Network
to market ('19)

1+ BILLION CUSTOMER REACH/YEAR

boingo wireless


NETWORK
MANAGEMENT
boingo
wireless

Network Congestion

Connected device demand and network congestion is at an all-time high.

>15 billion

Connected IoT devices globally

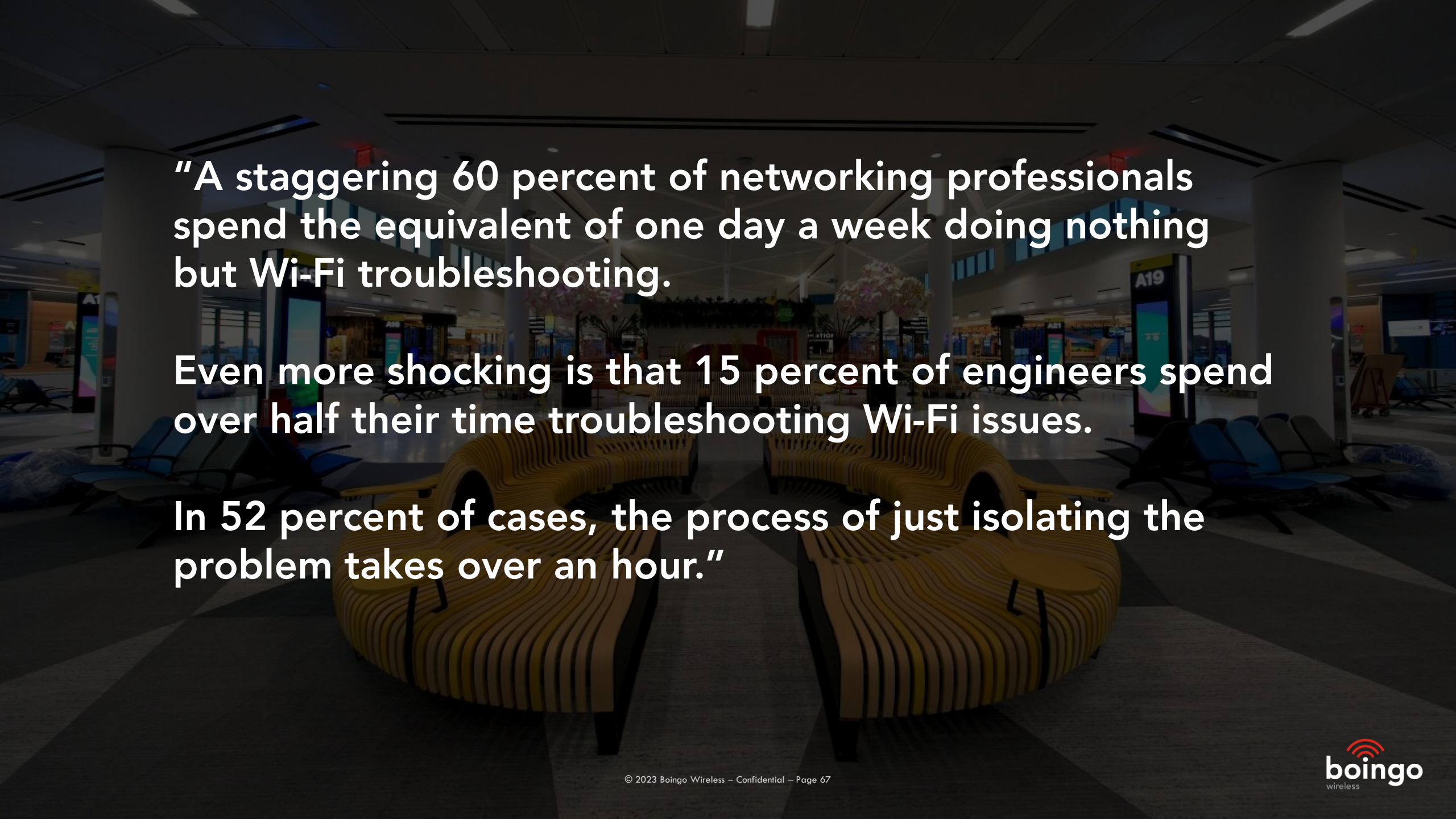
150 exabytes

Internet traffic/month

~60 %

Of all 2023 web traffic is from cell phones

boingo wireless



"A staggering 60 percent of networking professionals spend the equivalent of one day a week doing nothing but Wi-Fi troubleshooting.

Even more shocking is that 15 percent of engineers spend over half their time troubleshooting Wi-Fi issues.

In 52 percent of cases, the process of just isolating the problem takes over an hour."

boingo wireless

ADAPTIVE AI

boingo
wireless

Understanding Quality of Service (QoS)

QoS technology allows the network to automatically prioritize the most important data functions.

- Ensures seamless connectivity for the things that matter most
- Acts as a layer of connectivity insurance for priority items
- Applies only when network demand surpasses a certain threshold
- Addresses bandwidth limitations in dense, congested indoor environments

boingo wireless

DPI in Action – Time is Everything

Deep packet inspection is designed to make sure network access is assigned to the greatest need.

Tag Data

- Immediately identify all download content
- Identifying outliers in behavioral patterns of background software

Assign Behavior

- Automatically categorize each type of content
- Establish priority of apps, streamline content and ensure a smooth onboarding experience

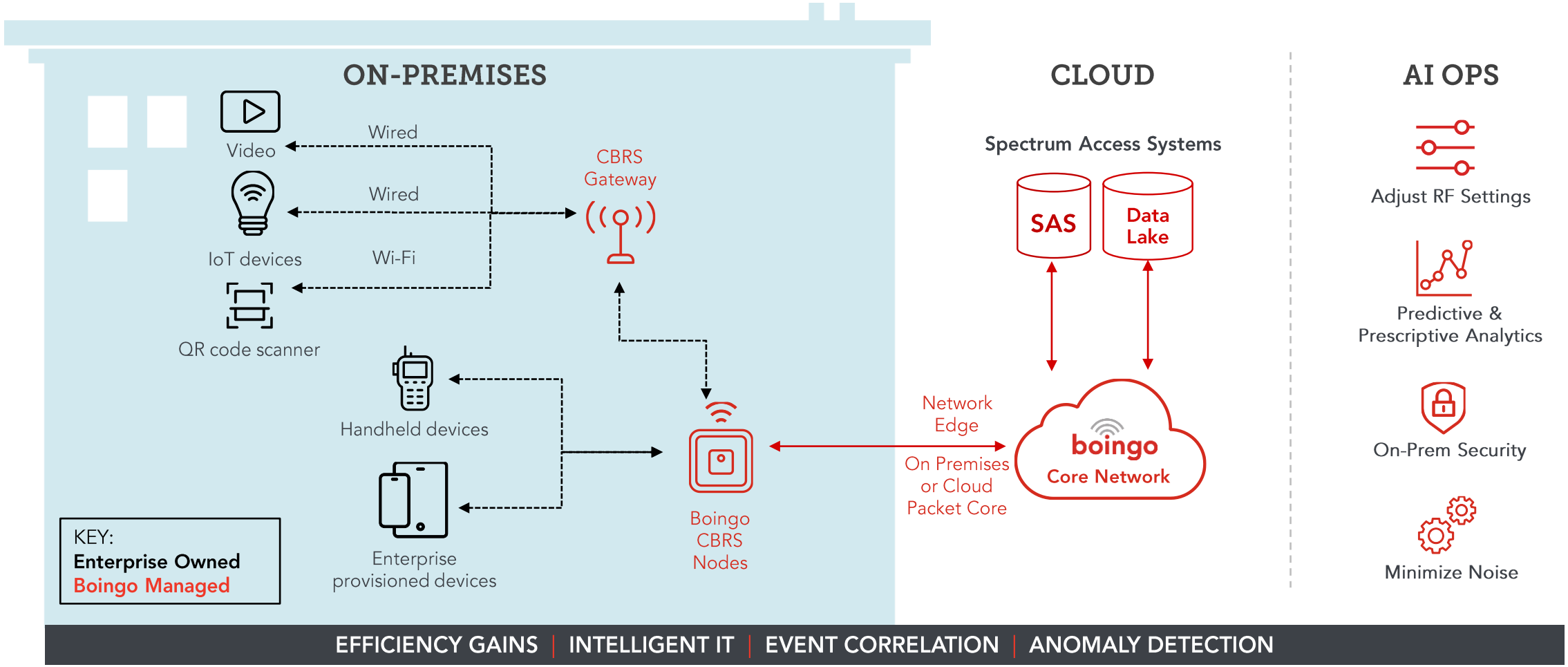
Tech Enabler

- Cache content to pull locally for patch downloads

boingo wireless

AI, 5G, Wi-Fi 6 Architecture

Boingo moves data from the edge in real time to capture data and power AI OPS models.



boingo wireless


EVOLVING
WITH AI
boingo
wireless

Wireless Networks and Adaptive AI

Predicting and forecasting network resources helps anticipate outages, equipment failures and performance degrading.

- **Set Network Parameters** – Fine-tuning of network parameters is essential for capacity expansion
- **Monitor Radio Conditions** – Instantaneous radio conditions should be monitored for better quality of service
- **Eliminate Coverage Holes** – Coverage holes can be eliminated by measuring interference and using inter-site distance data
- **Leverage Predictive Analysis** – Forecasting results can help optimize resources and deliver more reliable service

boingo wireless

Data is Power

It's critical that we leverage data to make IT more effective, proactive and predicative.
The end goal is faster business outcomes and unified tool across all teams.

Speed Up Investigations

Spot trends and pinpoint root causes leveraging metrics and logs

Streamline Monitoring

Visibility to services, apps, physical, virtual, and cloud infrastructure

Analyze System Health

Service insights & event analytics to focus on what's important, not just what's noisy

Act & Increase Productivity

Smart collaboration, orchestration and automation

boingo wireless

Thank You

Let's connect

Bill Marino
Boingo Wireless
Vice President Data Engineering
bmarino@boingo.com

boingo
wireless

20TH ANNIVERSARY | Wireless Global Congress

Panel: Delivering Value to Customers through Next Gen Wi-Fi Networks

Dr. Derek Peterson

CTO, Boingo Wireless.

Rajat Ghai

Vice President - Xfinity Wi-Fi Engineering, Comcast.

J R Wilson

Chairman, Wireless Broadband Alliance; Vice President, Tower Strategy and Roaming, AT&T Services

#WGCAMERICAS | #wifirevolution | #lovewifi

WGC AMERICAS

WI-FI INNOVATION:
FOR OPERATORS, ENTERPRISES, PLACES AND THINGS

COFFEE BREAK & NETWORKING
BE BACK IN 30 MINUTES AT
11.30 AM PST

#WGCAMERICAS | #wifirevolution | #lovewifi

20TH ANNIVERSARY | Wireless Global Congress

Steve Namaseevayum

Vice President of Membership & Industry Alliances.

Session Moderator

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WGC Americas Speakers

Tim Rout
Access Parks

Bart Giordano
Ruckus Networks

Bernard Herscovici
NetExperience

Qasim Cheema
Cox Communications

Qasim Cheema
Cox Communications

Brian Jacks
WiConnect

Phil Morgan
NC-Expert

Joe Martin
Single Digits

Andrea Calcagno
Cloud4Wi

Time	Presentation
11:30 AM (PST)	**Broadband in the Last Frontier** Tim Rout, CEO/Founder, Access Parks.
11:45 AM (PST)	**The State of Enterprise Wi-Fi in 2023** Bart Giordano, President - Networking, Intelligent Cellular & Security, Ruckus Networks.
12:05 PM (PST	**OpenWiFi in Enterprise Networks** Bernard Herscovici, Founder & CEO, NetExperience.
12:15 PM (PST)	**Enterprise Opportunities and Challenges** Qasim Cheema, Lead Wireless Engineer, Cox Communications.
12:25 PM (PST)	**A New Approach to Visitor Marketing** Brian Jacks, CEO, WiConnect.
12:35 PM (PST)	**Delivering the Technology Needs for Large Entertainment Hospitality Groups** Brent Graeser, Director of Telecommunications, Caesers Entertainment, Inc.
12:55 PM (PST)	**Panel: Evolution of Enterprise Wi-Fi** Brian Jacks, CEO, WiConnect; Phil Morgan, CTO, NC-Expert; Joe Martin, VP Product Management, Single Digits; Andrea Calcagno, President, CEO & Co-Founder, Cloud4Wi.
1:30 PM (PST)	**LUNCH & NETWORKING**

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Tim Rout

CEO / Founder, AccessParks.

Broadband In The Last Frontier

#WGCAMERICAS | #wifirevolution | #lovewifi


AccessParks
Broadband in the Last Frontier
Wireless Broadband Alliance
20TH ANNIVERSARY

Problem

Outdoor hospitality operators serving ~1.3B annual visitors want to provide fiber-optic speeds that visitors want, but don’t have the expertise, budget and staff to do so.

AccessParks

Outdoor Hospitality Wi-Fi

48 million camping households

- *Digital natives, Gen-X, Gen-Z, Millennials*
- *45% of camper nights at private parks*
- *58% travel with children*
- *42% report working during trip*

Campers Want Modern Amenities

13,000 Private RV Parks

2,137 State Parks

1.3B Annual Visits

400 National Parks

AccessParks

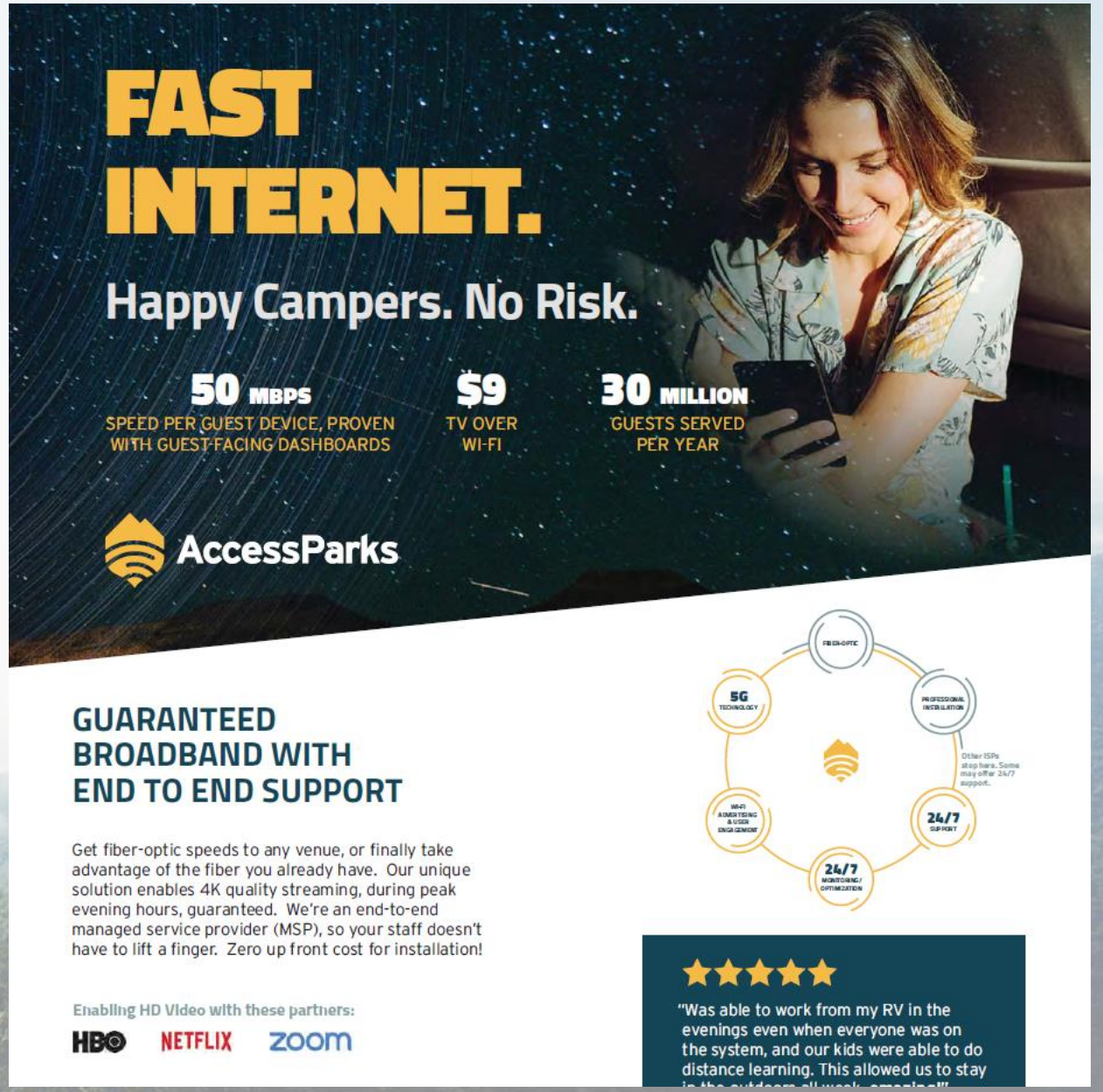
AccessParks Solution

Outdoor, remote location installation in 6-8 weeks.

FCC-defined Broadband of 50 Mbps minimum to every guest during peak times.

Tech stack:

- *Microwave*
- *Fiber GPON*
- *5G mmWave*
- *CBRS LTE + Carrier Offload*
- *Wi-Fi 6 + Passpoint Offload*



AccessParks

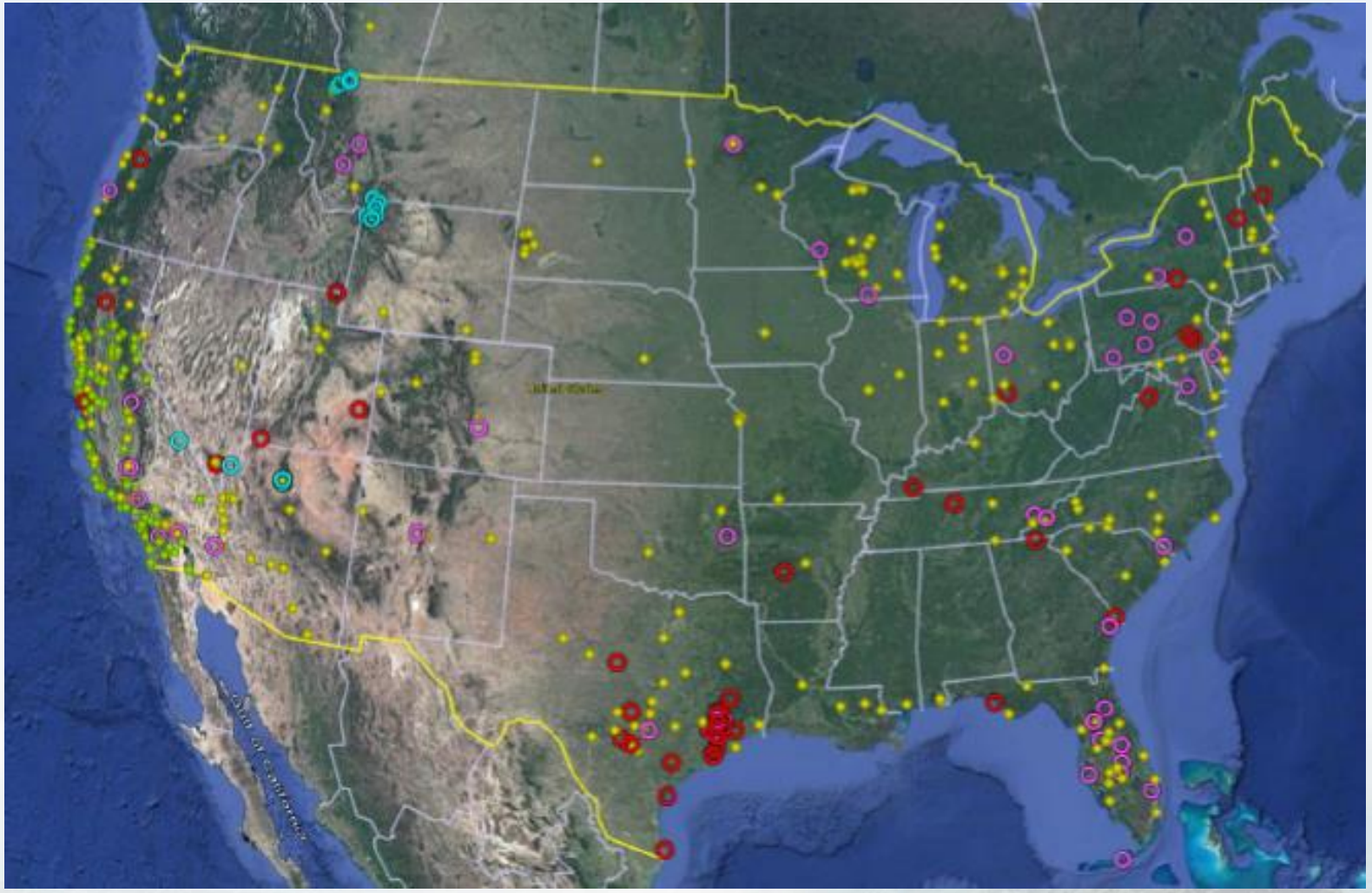
Background

Team with 16+ years experience as end-to-end wireless MSP to remote properties.

- Remote facilities experience:
  - 6 large national parks; Grand Canyon, Yellowstone, etc
  - Private RV parks
  - 50 million acres covered
  - 6,000+ Wi-Fi nodes deployed
- Serving Broadband to over 30 million people annually
- 5G Broadband to any location within 6-12 weeks
- Integrated managed services provider (MSP) for Broadband, NB-IoT, LBS, LTE, SaaS, IP Video, Wi-Fi…
- True FCC-Defined Broadband = 50-250 Mbps to every user device, at peak times
- Partnerships with cellular carriers for neutral-host roaming

AccessParks

Customer Portfolio:



AccessParks

at&t

T-Mobile

COMCAST

CROWN CASTLE

SBA

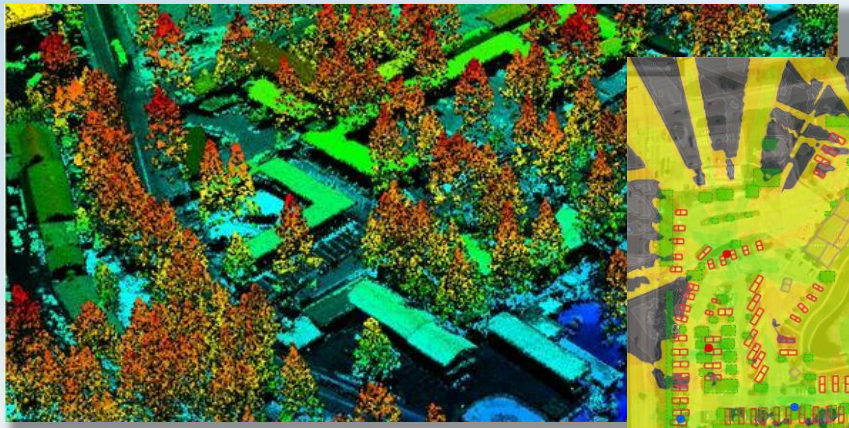
AMERICAN TOWER CORPORATION

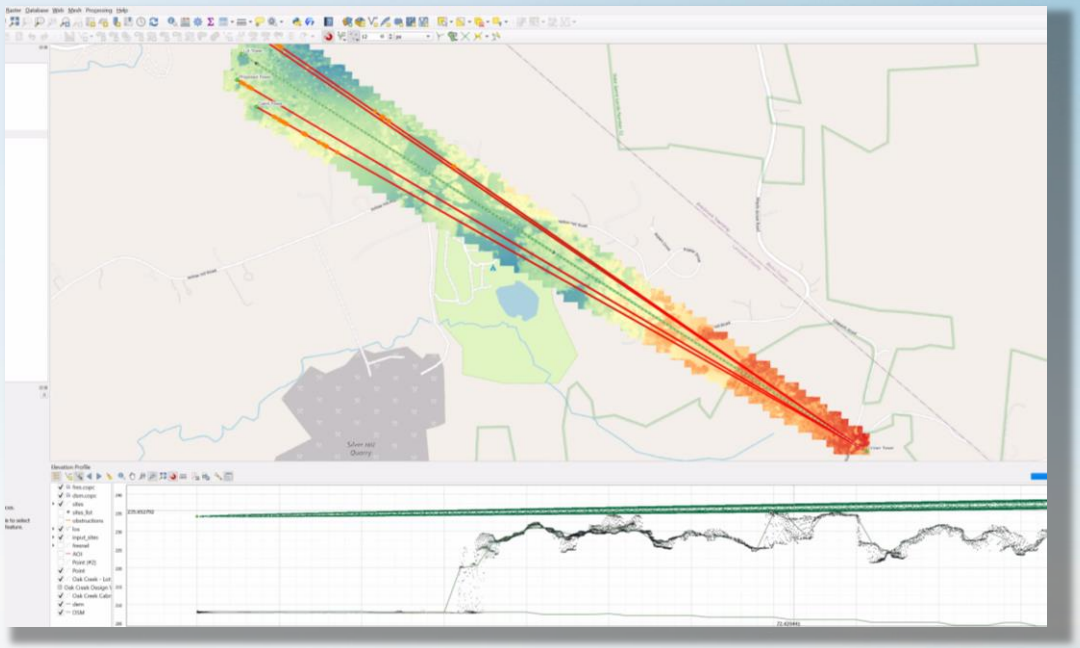
Nationwide Connectivity Network – Outdoor Hospitality

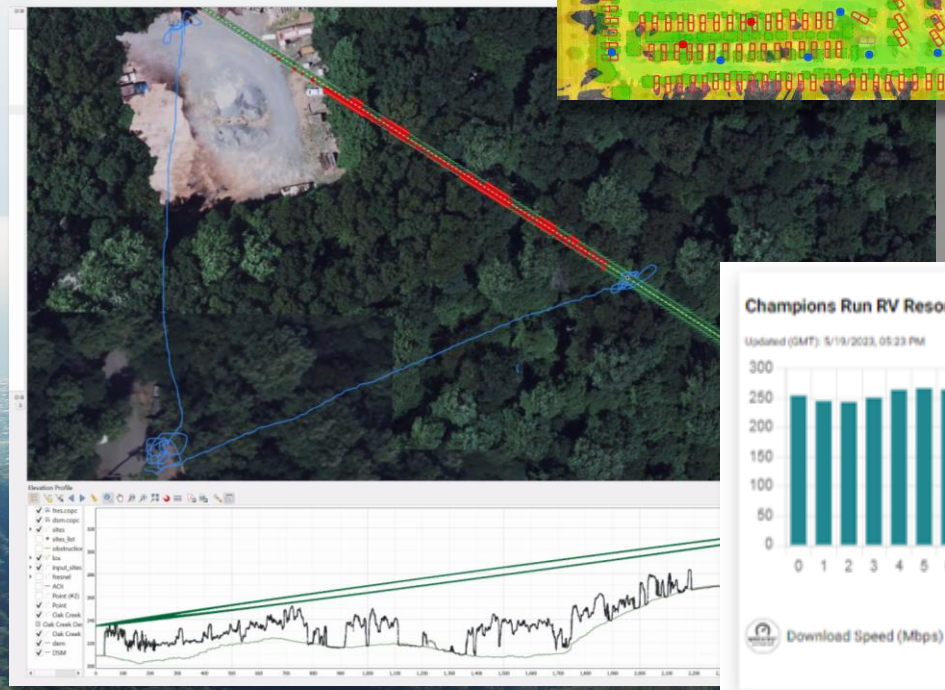
Backhaul

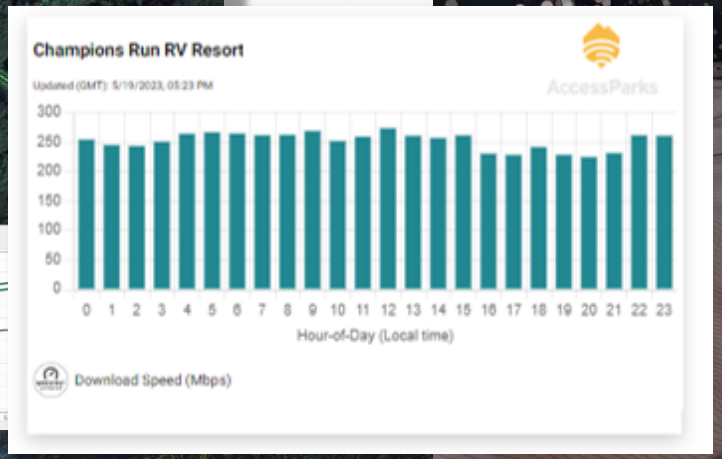
Fiber
+
Microwave
+
CBRS
+
Wi-Fi

Fiber-Microwave-Wi-Fi Design









Backhaul Case Study; Lake Mead National Park

Lake Mead BEFORE

6 million visitors per year with no access to the Internet

5%

Covered area

< 1 Mbps

Internet speeds

Gigabit microwave backhaul to all frontcountry; 250 sq miles

Lake Mead AFTER

AccessParks

Providing internet access for the entire park:

- 8 campgrounds
- 1500 Slip Marina
- 3 RV Parks
- 3 lodges
- All NPS housing

100%

Covered frontcountry area

25-125 Mbps

Customer speeds

- Fiber-Optic Speeds to any Park
- Wi-Fi Providing >50 Mbps Per Device
- 30 Million Annual Users, Growing 14% Month-over-Month

AccessParks

Internet as Great as the Outdoors

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Bart Giordano

President - Networking, Intelligent Cellular & Security,
RUCKUS Networks.

The State of Enterprise Wi-Fi in 2023

#WGCAMERICAS | #wifirevolution | #lovewifi

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Wireless Global Congress
Wireless Broadband Alliance
20th ANNIVERSARY

The State of Enterprise Wi-Fi in 2023

Wireless Global Congress

June 21, 2023

Bart Giordano

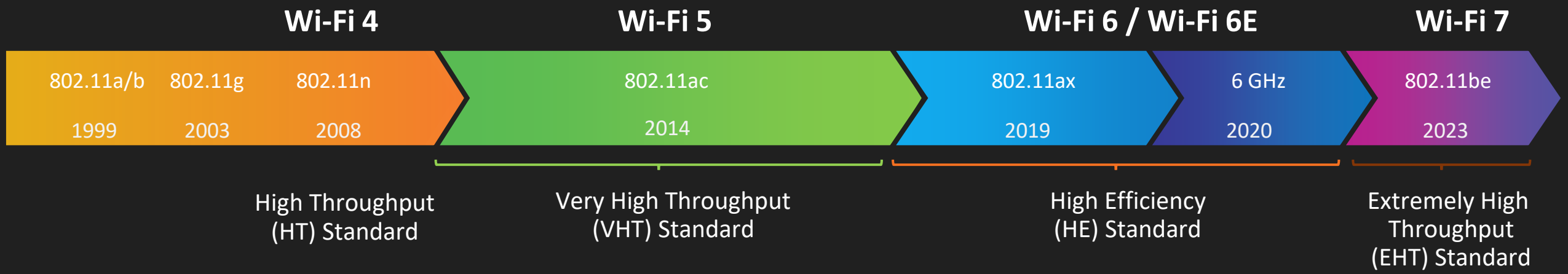
President
Networking, Intelligent Cellular & Security


CAESARS PALACE

The **Next Phase** of Wi-Fi

Peak data rates, aggregate throughput
Under ideal conditions

Network efficiency and capacity
Under real-world conditions
Improve average & worst-case performance



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Predictability

Artificial Intelligence

Convergence

NaaS

AI lets you do more with Wi-Fi

Spot issues before they blow up

ML-driven incident and anomaly detection

Most urgent issues first

AI-driven prioritization

Fix them fast

ML-driven root cause and recommendations

Compare network KPIs before and after a change

Config change analysis

Recommendations on changes to improve performance

AI-recommendations

Reduce power consumption

Sustainable ESG recommandations

AI-Driven Cloud RRM

Greater AP Capacity

Higher client throughput

Lower Airtime Utilization

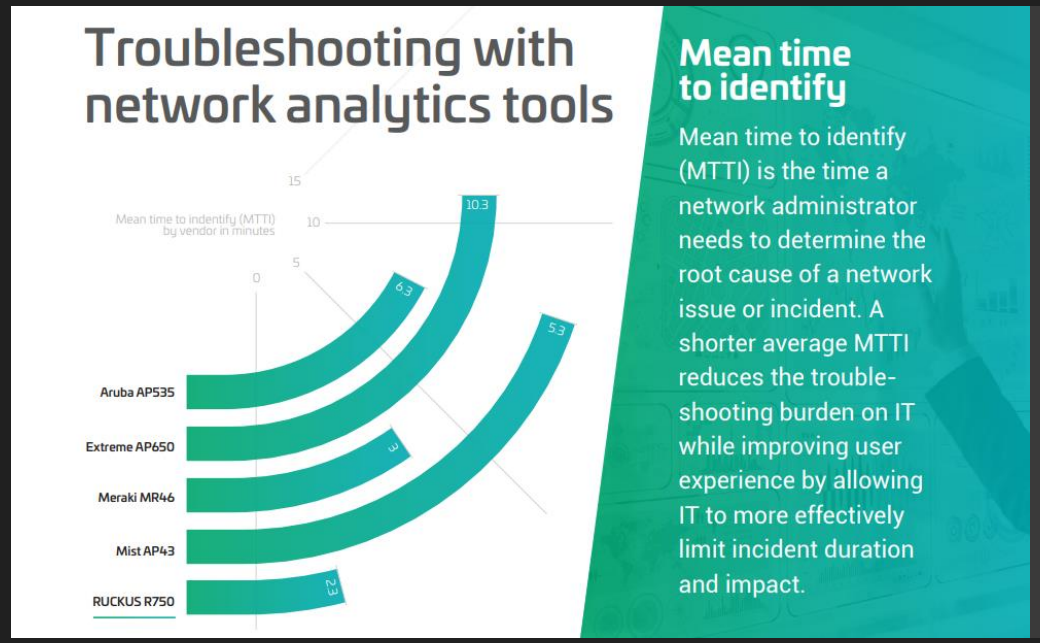
Higher Reliability

Operate APs at **MAX capability**

Proactive, Network Performance Optimization

Dramatic NetOp Improvements with AI

Lowest Mean Time to Identification



- **67%** Reduction in mean time to resolution
- **40%** Reduction in time prioritizing & triaging
- **20%** Fewer helpdesk tickets
- **60%** Savings of SME IT time
- **50%** Reduction in new IT hire training
- **80%** Reduction in customer churn

AI Too is Evolving

2020-2021

Seeds

AI/ML Incidents, Insights, Root cause and Recommendations

- AI/Machine Learning
- Statistical Analysis

2021-2022

Seedling

AI Recommendations, Configuration Analysis, Network Health, Explainable AI, Melissa

- AI/Machine Learning
- Statistical Analysis
- Natural Language Processing (NLP)

2023

Tree

AI-Driven Cloud RRM, Autonomous networking

- AI/Machine Learning
- Statistical Analysis
- Natural Language Processing (NLP)
- Graph AI

2023+

Fruit

AI-Driven Predictions, AI-Driven App QoE, AI Based Purpose-Driven Network Orchestrated from R1

- AI/Machine Learning
- Statistical Analysis
- Natural Language Processing (NLP)
- Graph AI
- Hybrid Federated Machine Learning (HFML)
- Generative AI (integrate LLM)

Predictability

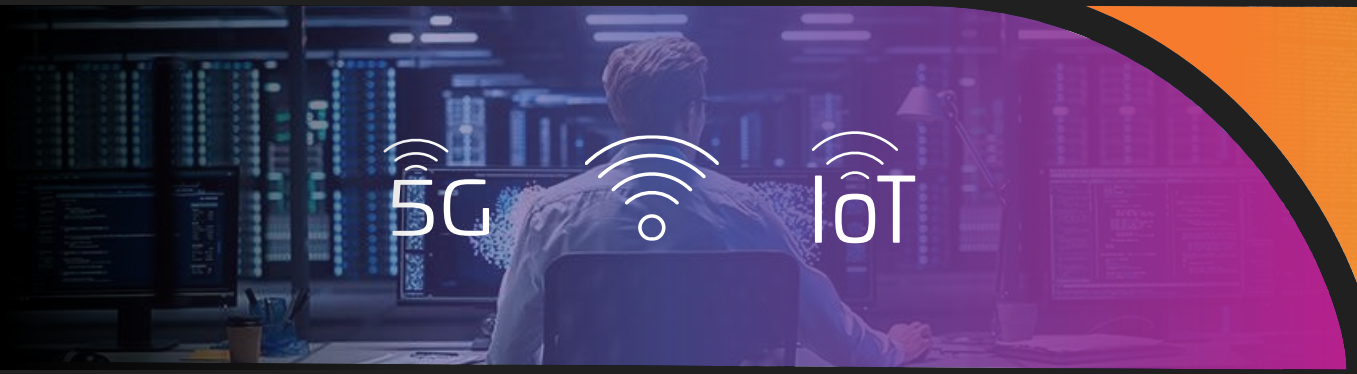
Artificial Intelligence

Convergence

NaaS

Multi-access Public and Private Networks

Network Elements



BeamFlex+ | ChannelFly

App-Aware QoS

Auth

Forwarding

AI-Driven Software

AI Cloud RRM

App AI

Trust AI

Assurance AI

Unified Management

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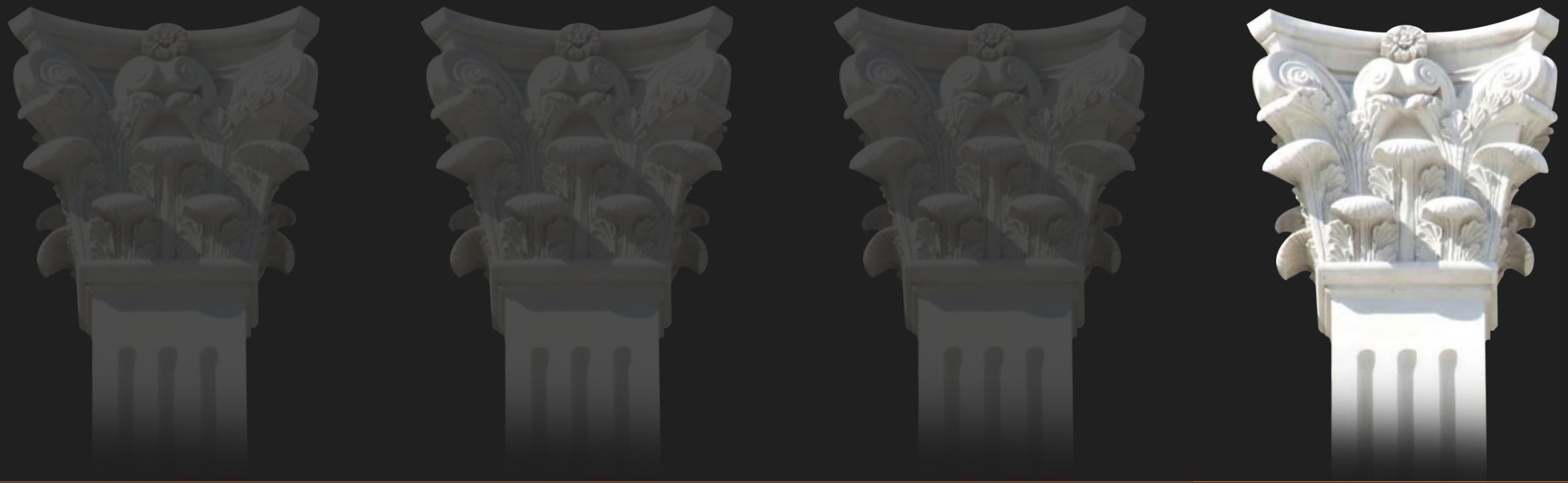
Predictability

Artificial Intelligence

Convergence

NaaS



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RUCKUS AI-Driven Multi-Access Network Platform

RUCKUS Managed Services

- 24/7 Monitoring & Support
- Design and Install
- Onsite Support
- Partner Branding
- Open to non-RUCKUS elements

RUCKUS Infrastructure AS A Service

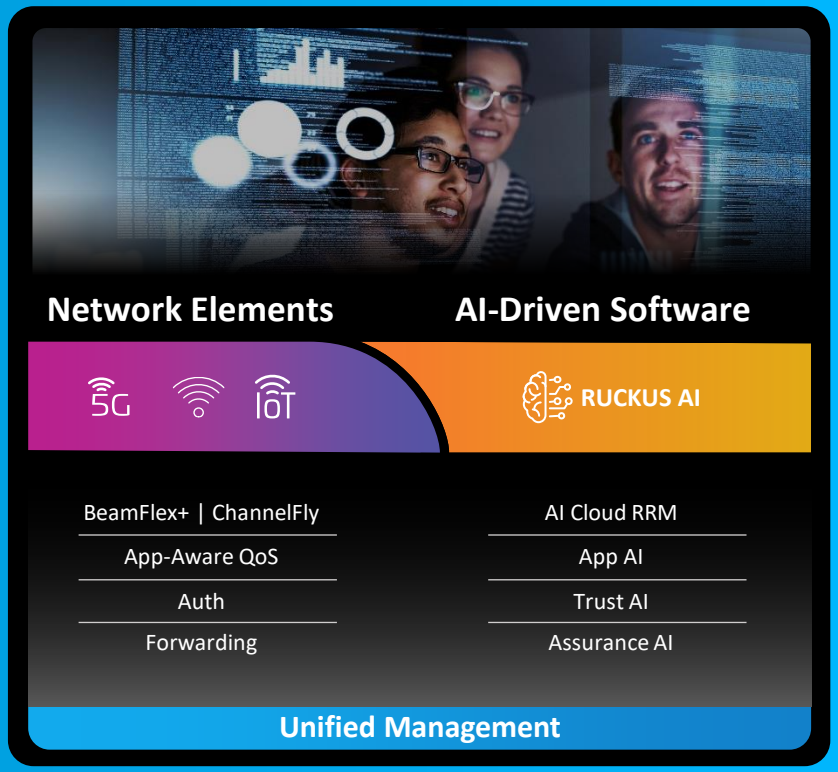
- Subscription payments / CommScope Financial Services
- Open to non-RUCKUS elements

Managed 5G Services Delivered by RUCKUS

- 24/7/365 T1 & NOC
- Trouble ID & Resolution
- P4G/5G Core

Converged Network Platform

- Unified management
- Unified Security & policy
- Unified IT Integration



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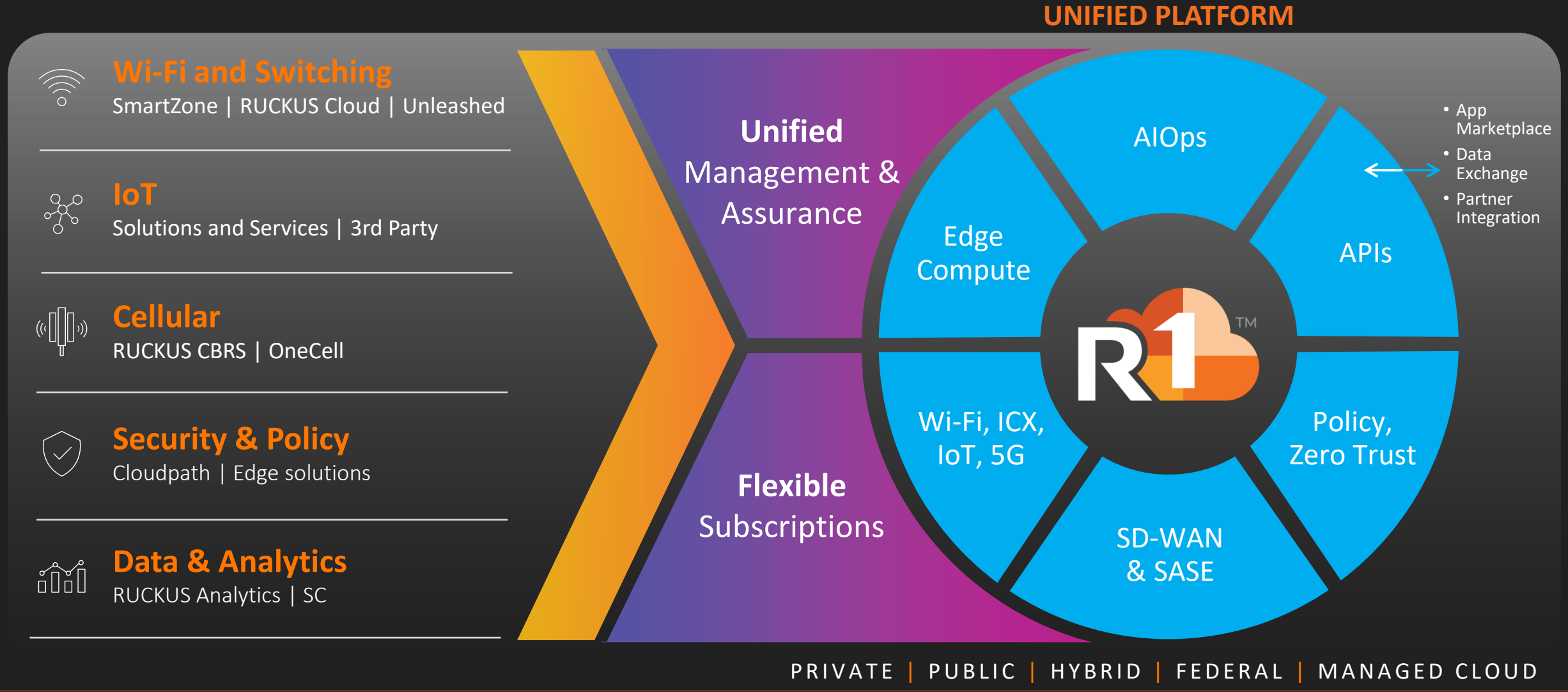
RUCKUS One™

AI-driven, Converged Network Assurance and Business Intelligence Platform



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ENTERPRISE NETWORKS

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Thank you

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Bernard Herscovici

Founder & CEO, NetExperience

Enterprise Meets OpenWiFi

#WGCAMERICAS | #wifirevolution | #lovewifi

ENTERPRISE MEETS OPENWIFI

NetExperience

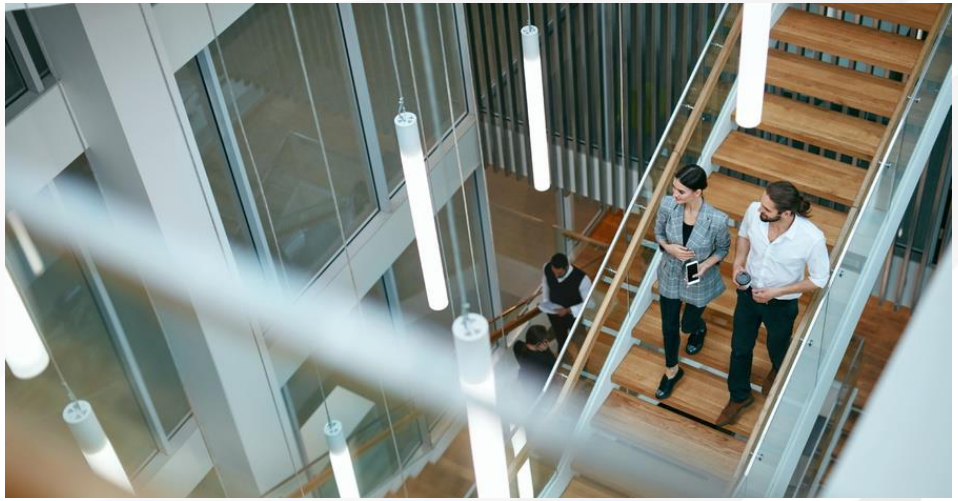
Bernard Herscovici
CEO

June 21, 2023

Deck Presentation

www.netexperience.com

About Our Company



A Brief Story About The Company

- Software company, founded in 2019 by WiFi experts
- Focused on OpenWiFi technology and its adoption
- Contributor to OpenWiFi open source
- Commercial platform for OpenWiFi in service now

NetExperience

Deck Presentation

What is OpenWiFi?

- Telecom Infra Project
- WiFi Providers
- Disaggregated Networks
- Opensource foundation
- Ecosystem

Unique Combination of Features

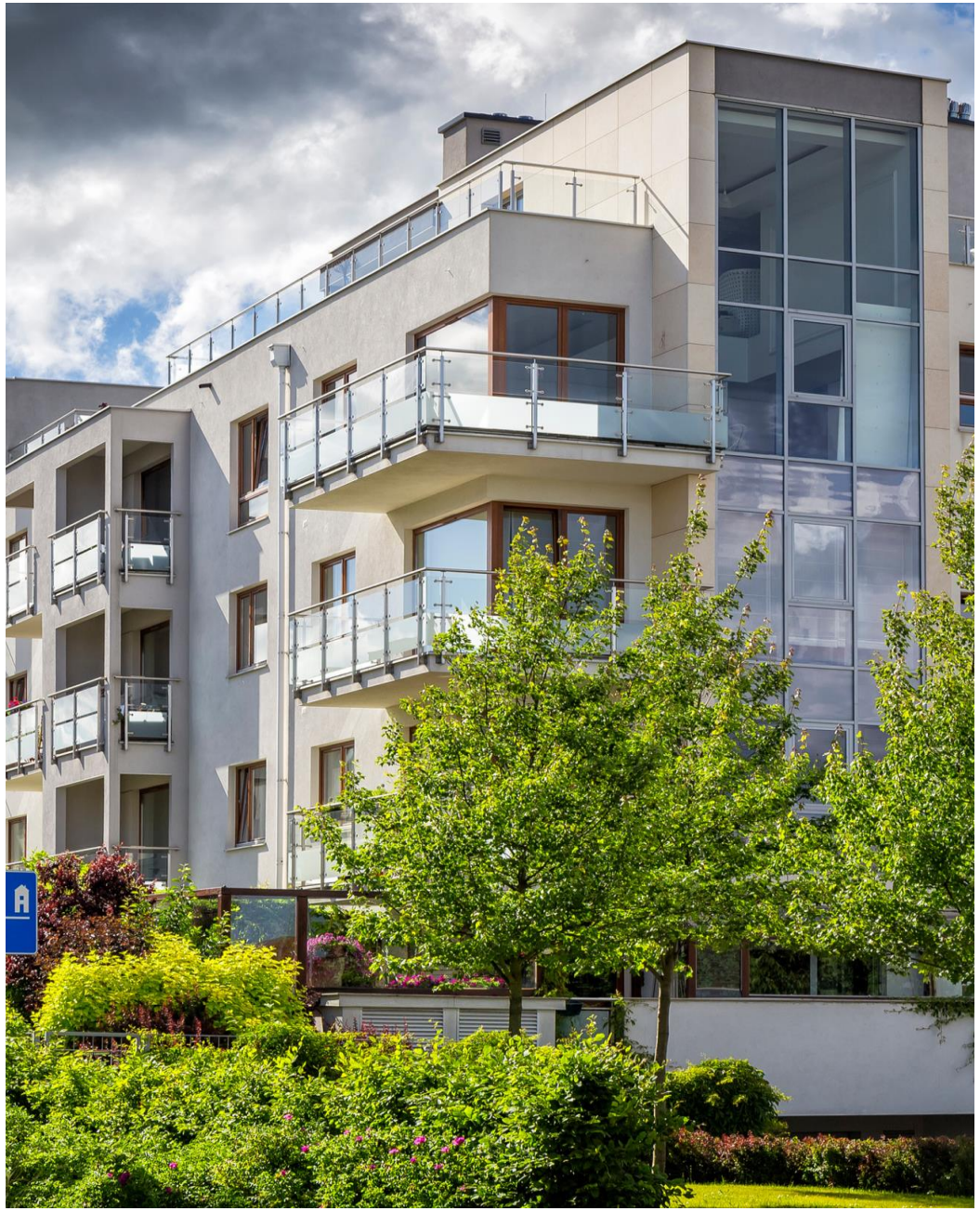
- Multiple HW vendors
- Multiple use cases
- Disruptive TCO
- Access Points and Switches
- Integrates WiFi Controller
- Workflow/Network Management
- OpenRoaming and Passpoint
- Community driven

NetExperience

Deck Presentation

Early Adopters

- Managed providers
- Multifamily homes
- Student Residences
- Hospitality



NetExperience
Deck Presentation

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Qasim Cheema

Lead Wireless Engineer, Cox Communications.

Enterprise Opportunities and Challenges

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Enterprise Opportunities and Challenges

June 21, 2023

Presented by:

Qasim Cheema

WIFI Engineering – Cox Engineering

COX ENTERPRISES

Privately Held & Family-Owned

Founded in 1898 by Ohio Governor James M Cox
120+ Years of Innovation & Technology Leadership

COX

Largest privately held telecom company in the U.S.

COX BUSINESS

COX MEDIA

COX AUTOMOTIVE™

World leader in vehicle remarketing services and software for automotive dealers and global consumers

KELLEY BLUE BOOK OFFICIAL GUIDE

Autotrader

Dealertrack

Manheim

COX ENTERPRISES | NEW VENTURES

Cleantech | Healthcare | Esports

BRIGHT FARMS

iorahealth

SIERRA ENERGY

CARBON LIGHTHOUSE

ATLANTA REIGN

Cox Prosight℠

Cox Edge

ATLANTA FAZE

Cox Private Networks

COX

DEPTH IN ALL VERTICALS-HOSPITALITY INDUSTRY

Stay Connected, WIFI , Connected Rooms, ITV and Free to Guest

COX BUSINESS

BLUEPRINTRF NETWORK INTELLIGENCE

Industry Experience 11 Years

HN Hospitality Network

Industry Experience 40 Years

Who We Service

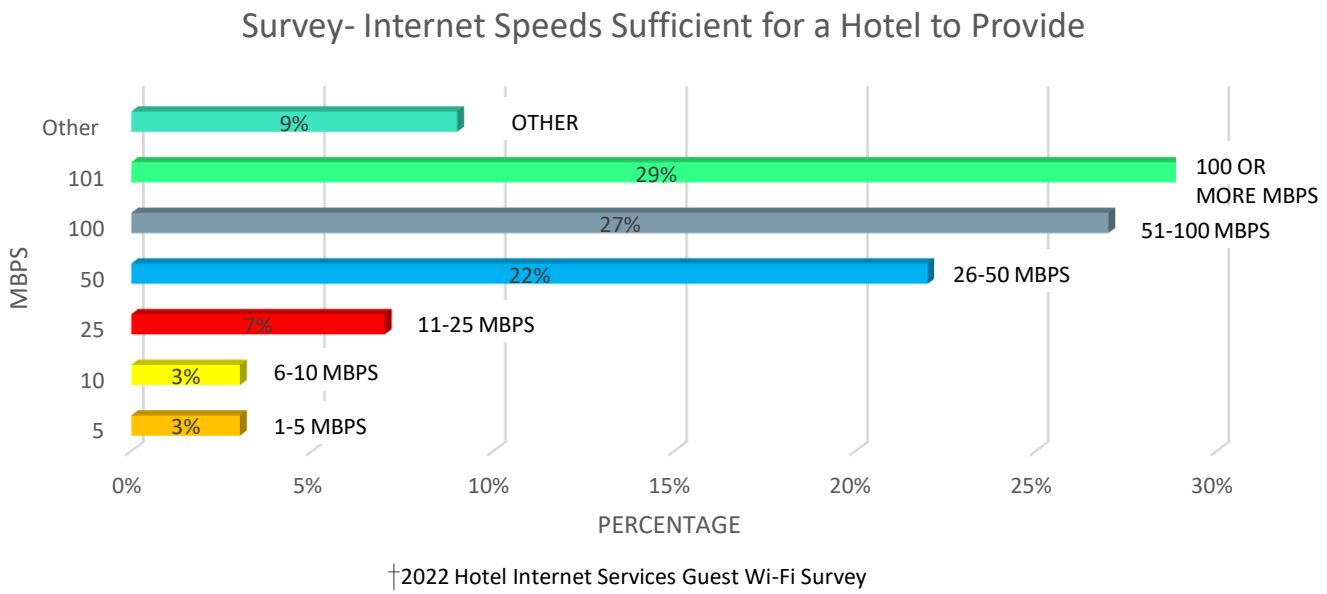
- Luxury & Full-Service Hotels
- Convention Centers
- Stadiums & Arenas
- Large Public Venues

Our Solutions

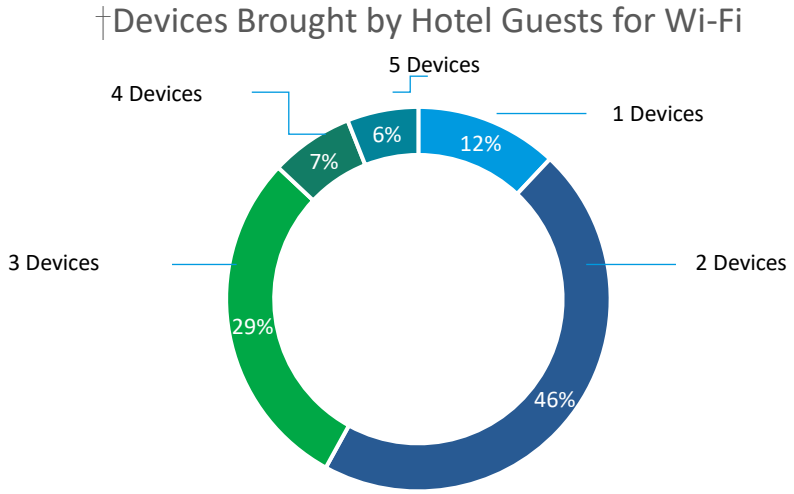
- Guest Room Entertainment
- Free to Guest Video Services
- Advanced Convention Services
- IPC Voice
- Managed Wi-Fi
- Internet Circuits
- Digital Signage
- NOC as a Service

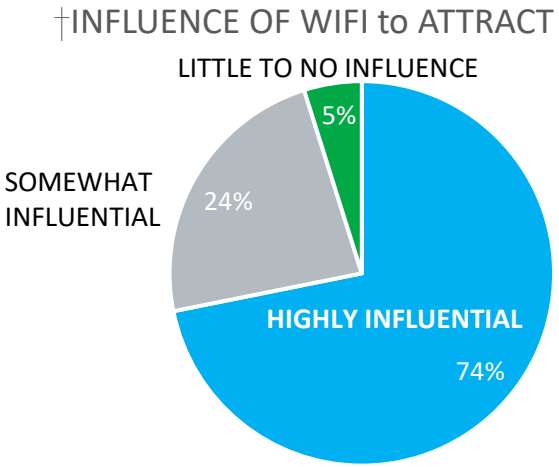
Learn More Here:

IMPACT OF WI-FI ON THE HOSPITALITY INDUSTRY



†2022 Hotel Internet Services Guest Wi-Fi Survey





- Hospitality Wi-Fi is no longer an amenity but a utility.
- Hospitality Wi-Fi tops any other service and utility when comes to guest booking Hotel choice.
- Hospitality Wi-Fi for Back of the house is equally important as Front of the house and guest facing Wi-Fi

WIFI OPPORTUNITIES-HOSPITALITY INDUSTRY

Managed WIFI - Hotels and gaming Industry, *LPVs (Large Public Venues)

Tiered Bandwidth – Rev share

IoT (Internet of Things) – Hotel Smart rooms.

Convention Services

Marketing & Advertising

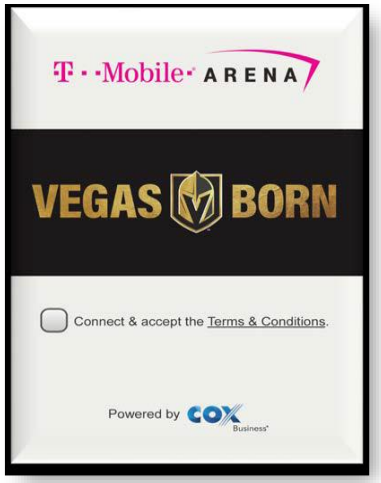
Location Based Services – Guest Engagement

Carrier offloading

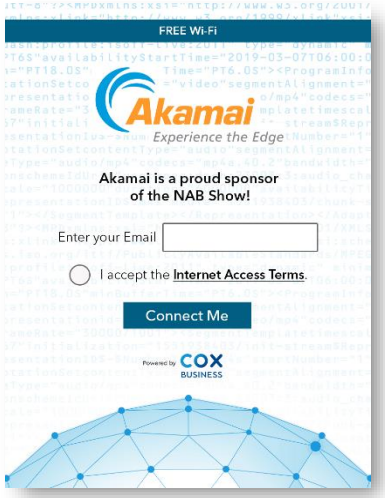
PROVIDER EXPERIENCE :COX CUSTOMERS

~3,000 Hotels ~750,000 Rooms

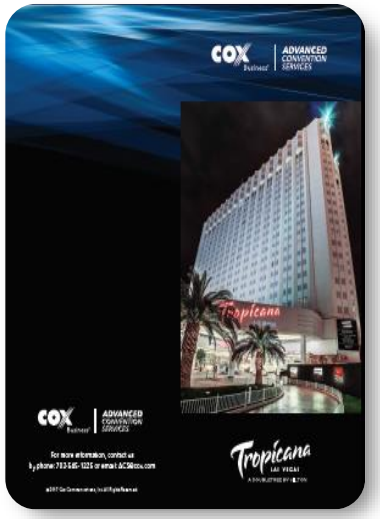
REVENUE GENERATING OPPORTUNITIES



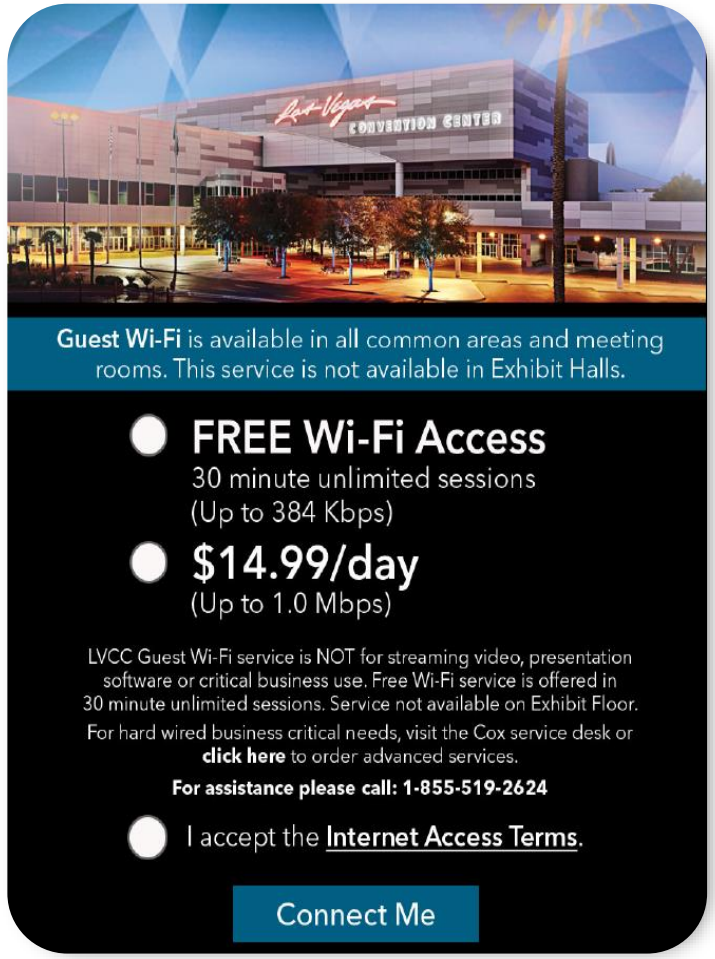
Splash Page -Advertising



Convention Services /Portal



Marketing & Advertising



Tiered Bandwidth – Rev share

WIFI CHALLENGES-HOSPITALITY INDUSTRY

Managed WIFI - Physical Obstructions and Interferences,
LPVs Mounting & infrastructure Restrictions

Product life Cycle - EOSS / EOL

Other Challenges:

Questions ???


COX
Bringing us closer

20TH ANNIVERSARY | Wireless Global Congress

Brian Jacks

CEO, WiConnect

A New Approach to Visitor Marketing

#WGCAMERICAS | #wifirevolution | #lovewifi

A New Approach to Visitor Marketing

WiCONNECT

Brian D. Jacks
CEO

Mall owners control advertising on Digital Screens.

What about mobile digital screens?

Digital programmatic advertising is a $679 billion industry projected to reach $2.7T by 2028.

Source: Statista

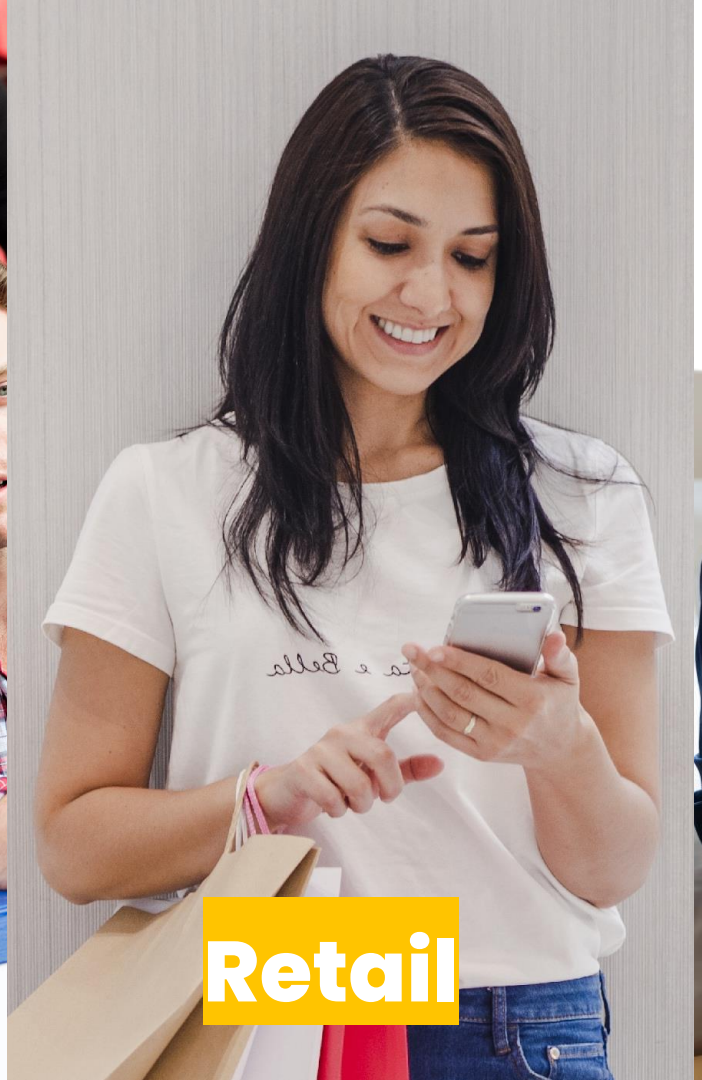

Advertisers are paying media companies to reach visitors on your Wi-Fi network.
WiCONNECT


Is your marketing team also spending money to reach this audience?
Leverage the power of your Wi-Fi network.
WiCONNECT

What if a mall owner could gain access to mobile ads?

- ✓ Event messaging
- ✓ Brand promotion
- ✓ Incentivize Mall App downloads
- ✓ Send surveys
- ✓ Sell this advertising inventory to tenants for revenue generation


Stadiums


Retail


Hospitality

Retargeting

Continued engagement


reach
Turn your Wi-Fi network into a powerful marketing tool with WiConnect Reach
WiCONNECT

How reach works

On network ad inventory

WiConnect Ad Platform

Bids won

Followed by off network retargeting

Vancouver Airport

Unique visitors reached in one day

2.5K

Impressions

15K

Renaissance Hotel

- ✓ Reached up to 178 devices/day
- ✓ Reached up to 138 device/day via Retargeting
- ✓ 300+ websites/4,975 impressions (mail.yahoo, travelerdreams, dailyfitness, smartnews, flipboard, apnews, forbes, cnn, foxnews, weather)
- ✓ 50+ apps, 1,937 impressions (iFunny-cool memes, Smartnews, CBS Sports, PodcastAddict, Woodoku, Spider solitaire, Speedtest)

WiConnect offers a unique combination of expertise

We are Networking + Advertising Experts

Mobile, Broadband and Wi-Fi Networking

+

Adtech & Advertising Revenue Generation

WiCONNECT

www.WiConnect.com

WiConnect creates winning connections for everyone

Advertisers

Media & LiveReach

Unique ad inventory for targeted audience engagement

MSPs

Captivate

Captive portal extensions optimized for targeted messaging and advertising

Venues

Reach & Splash

Branded, fully customizable post-auth landing pages

Ad Platforms

Match

Patented tech for overcoming cookie deprecation

WiCONNECT

Interested in powering up new possibilities with Wi-Fi?

Come talk to us! We'll help you get the most from your Wi-Fi network.

www.WiConnect.com

WiCONNECT

Thank you!

Brian D. Jacks
CEO

bjacks@WiConnect.com
+1-914-262-7276
WiConnect.com

Renaissance Hotel

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Brent Graeser

Senior. Director I.T. Telecom / Wireless,
Caesers Entertainment, Inc.

Delivering the Technology Needs for Large Entertainment Hospitality Groups

#WGCAMERICAS | #wifirevolution | #lovewifi

Delivering the Technology Needs for Large Entertainment Hospitality Groups

Brent Graeser
Sr. Director I.T.
Telecom / Wireless
Caesars Entertainment




Wireless connectivity has become as important as running water or electricity.

Wireless Needs for Business Operations

- Digital Workplace
- Digital Customer Experience
- Data Analytics
- MNO Coverage
- Roaming / Mobility
- Security – PCI/PII
- Latency
- Location / Life Safety
- Disparate Networks
- Prioritization
- Outdoor Coverage for Large Spaces
- Ease of deployment / Reconfiguration

Wireless Needs for Customers/Guests

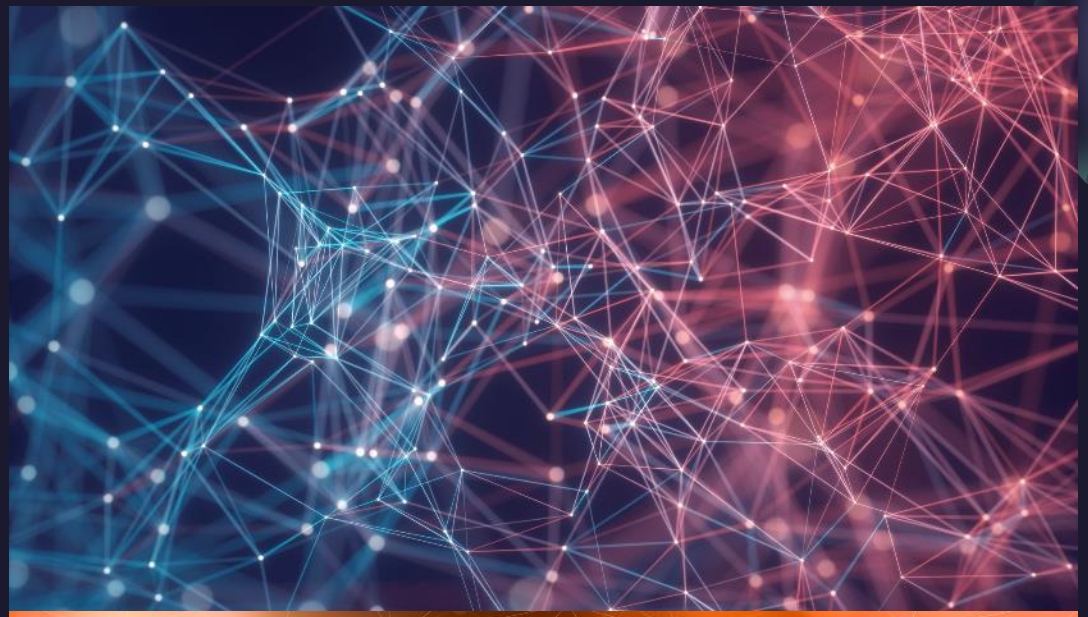
- Easy!!
- Neutral MNO Coverage
- Coverage Areas
- Roaming / Mobility
- Location Intelligence
- Modern, High-Tech Amenities

Thank You

Brent Graeser

bgraeser@caesars.com

www.caesars.com



20TH ANNIVERSARY | Wireless Global Congress

Panel: Evolution of Enterprise Wi-Fi

Brian Jacks

CEO, WiConnect..

Phil Morgan

CTO, NC Expert

Joe Martin

Vice President Product Management, Single Digits.

Andrea Calcagno

President, CEO & Co-Founder, Cloud4Wi

#WGCAMERICAS | #wifirevolution | #lovewifi

For More Information on Cloud4Wi

CLOUD4WI

Request a Demo

Service Providers

Cloud4Wi for service providers

Enhance your WiFi strategy with Cloud4Wi's next-gen carrier-class WiFi service management platform. Unleash the power of Passpoint-based functionalities and achieve remarkable outcomes for your WiFi strategy.

Request a Demo

20TH ANNIVERSARY | Wireless Global Congress

WGC AMERICAS

WI-FI INNOVATION:
FOR OPERATORS, ENTERPRISES, PLACES AND THINGS

LUNCH & NETWORKING
BE BACK IN 60 MINUTES AT
2.30 PM PST

#WGCAMERICAS | #wifirevolution | #lovewifi

20TH ANNIVERSARY | Wireless Global Congress

Steve Andrews

Board Member, Wireless Broadband Alliance

Session Moderator

#WGCAMERICAS | #wifirevolution | #lovewifi

20TH ANNIVERSARY | Wireless Global Congress

WGC Americas Speakers

Kyle Korner
Comcast

Zac Freeman
Newracom

Guharajan Sivakumar
Aprecomm

Joseph Valencia
Origin Wireless

Tim Colleran
LEVL

Oz Yildirim
Airties

Maria Cuevas
BT Group

Time	Presentation
2:30 PM (PST)	**Delivering the In-Home Wi-Fi Experience: Challenges and Opportunities** Kyle Korner, Director X-Finity Products, Comcast.
2:45 PM (PST)	**Wi-Fi HaLow's Impact on the Future of IoT** Zac Freeman, VP of Marketing & Sales, Newracom
2:55 PM (PST)	**Measuring and Delivering Experience to Millions of Homes** Guharajan Sivakumar, CTO, Aprecomm
3:05 PM (PST)	**WiFi Sensing: Enabling Advanced Home Intelligence** Joseph Valencia, Chief Product Officer, Origin Wireless
3:25 PM (PST)	**Panel: 20 Years of Broadband - What Next** Tim Colleran, VP Sales, Bus. Development, and Product Marketing, LEVL; Oz Yildirim, EVP & GM Americas Business Unit, Airties; Maria Cuevas, Networks Research Director, BT Group; Kyle Korner, Director - XFinity Products, Comcast.
4:00 PM (PST)	**COFFEE & NETWORKING**

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Kyle Korner

Director X-Finity Products, Comcast.

Deliver the In-Home Wi-Fi Experience: Challenges and Opportunities

DELIVER THE IN-HOME WIFI EXPERIENCE: CHALLENGES AND OPPORTUNITIES

June 21, 2023

COMCAST

AREAS OF EVOLUTION

WI-FI

Shift away from basic Wi-Fi to Mesh Wi-Fi and software-defined networking

TELEMETRY

Move from simple feedback about a network, to real-time advanced telemetry

END-TO-END

DOCSIS was viewed as the last-mile, now an App-enabled experience with status of the network

COMCAST

image:Flaticon.com

CHALLENGES

INTEROPERABILITY

How to achieve

- Best experience for latest tech
- Ensure support of legacy devices
- Wi-Fi experience during transition to newer standards

ACTIONABLE INSIGHTS

Leveraging telemetry

- Identify the biggest buckets to solve
- How to best utilize a point-in-time measurement
- Context matters / Audience

IN-HOME WI-FI EXPERIENCE

Understanding

- When to take action
- What is the experience
- What is expected by the customer

COMCAST

OPPORTUNITIES

1

WI-FI EXPERIENCE EVOLVES WITH CUSTOMER

Better identify where customers are at and meet them

2

RIGHT DATA, RIGHT PLACE

The best decisions are made with good data

3

RE-VISIT EXPERIENCE FOR CURRENT TECH

What could be changed and measured, or can it be used to solve a different problem

4

NEW TECHNOLOGY

Finding the best use for the respective technology advancements and create more efficient use of the Wi-Fi spectrum

COMCAST


COMCAST

20TH ANNIVERSARY | Wireless Global Congress

Zac Freeman

Vice President of Marketing & Sales, Newracom

Wi-Fi HaLow Impact on the Future of IoT

#WGCAMERICAS | #wifirevolution | #lovewifi

NEWRACOM

Wi-Fi HaLow

Impact on the Future of IoT

Y. Zachary Freeman
Vice President, Marketing

NEWRACOM

Founded In

2014 - Core technology root from Korean national research institute (ETRI)

Locations

Irvine. CA, U.S
Seoul, S. Korea
Taipei, Taiwan

Our Mission

To enable our customers to connect the unconnected through disruptive wireless technology.

Our Vision

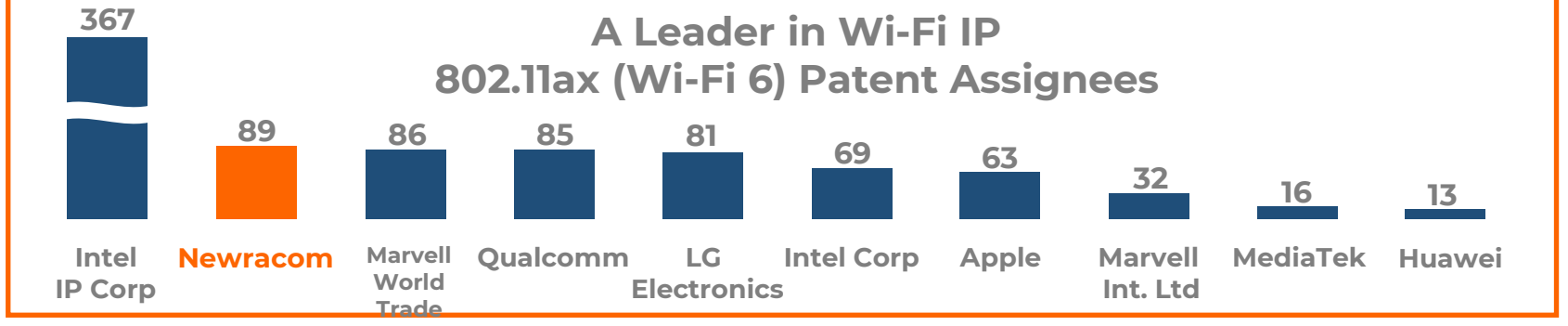
To provide the tools to enable wireless computing to the benefit of the physical world.

Our Credentials

- *Over 200 patents in wireless connectivity*
- *Renown Talent - 80% Masters and Ph.D*
- *World's first Wi-Fi HaLow SoC (NRC7394)*
- *World's 4th contributor of Wi-Fi 6 standards*
- *"Best Wi-Fi IOT Product" Wi-Fi Now 2019*
- *"Best Wi-Fi IOT Startup" Wi-Fi Now 2021*

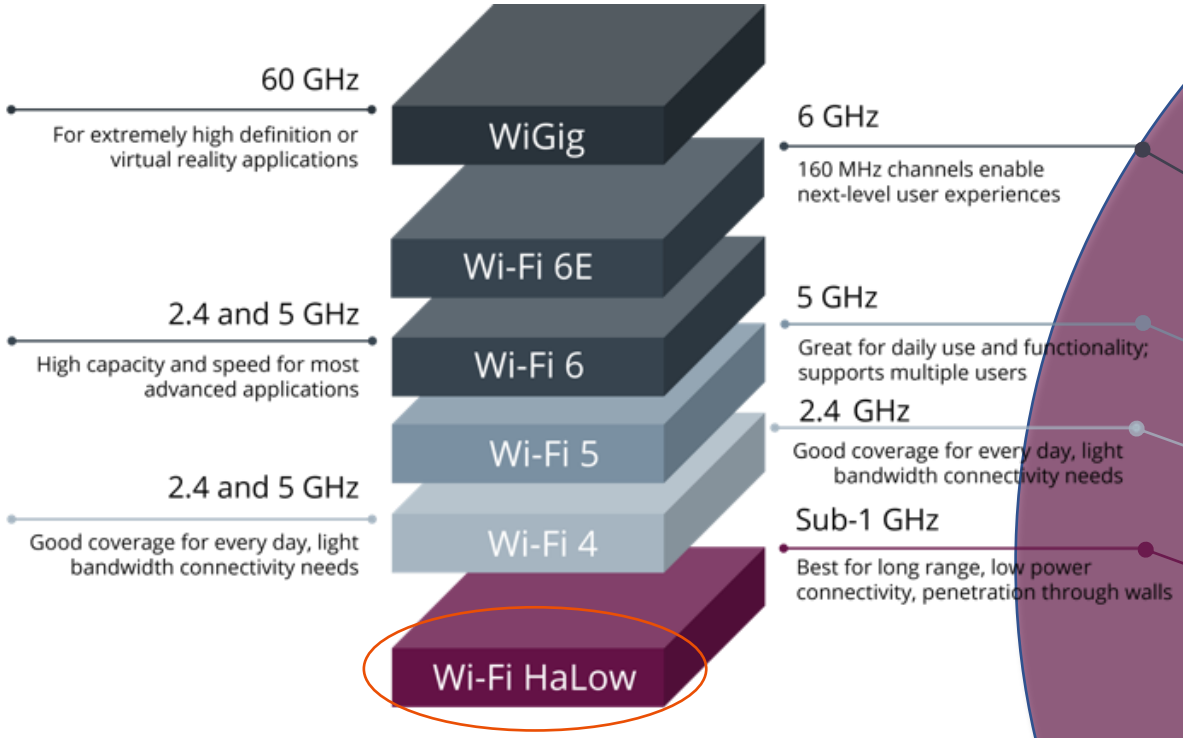
Our Products

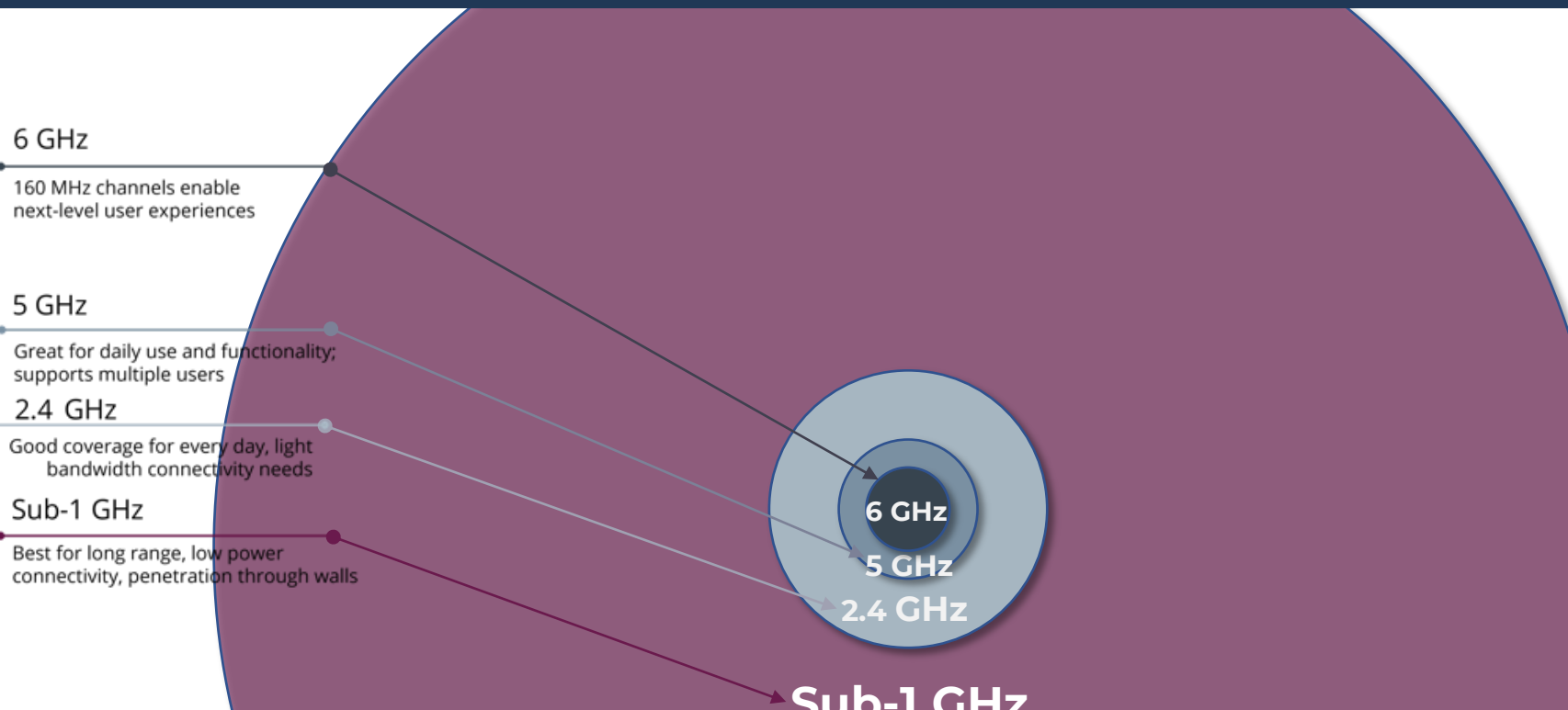
- ***World's first long range & low power Wi-Fi HaLow SoC*** *(NRC7292)*
- ***Long range & low power Wi-Fi HaLow SoC for TVWS & Global*** *(NRC4792)*
- ***Lowest power consumption and lowest cost Wi-Fi 4 SoC*** *(NRC6191)*
- ***World's smallest and lowest power HaLow SoC*** *(NRC7394)*




ECO MODE
SEWERAGE
FIRE EXTINGUISHING
WATER SUPPLY
PASS CONTROL
INTERNET
HEATING
SECURITY
PAYMENTS
LIGHTING
ELECTRICITY
GENERATOR
CONDITIONING
SOLAR
Wi-Fi HaLow™
IEEE 802.11ah
SUPERIOR RANGE
1.5km coverage
ENERGY EFFICIENT
Multi-year battery operations
HIGH DATA RATE
Up to 15Mbps
WPA3 SECURITY
HIGH CAPACITY
8000 STA per AP
FLEXIBLE & EASY
IP Based
Wi-Fi Connectivity. Designed for IoT.

Low Power, Long Range and Superior Material Penetration.





Wi-Fi CERTIFIED HaLow™ for IoT

Features	Benefits
Sub-1 GHz spectrum operation	Long range: approximately 1 km
Narrow band OFDM channels	Penetration through walls and other obstacles
Several device power saving modes	Supports coin cell battery devices for months or years
Native IP support	No need for proprietary hubs or gateways
Latest Wi-Fi® security	

Source: Wi-Fi Alliance®

Low Power, Long Range and Superior Material Penetration.

Wi-Fi CERTIFIED HaLow™ for IoT

Features

- Sub-1 GHz spectrum operation
- Narrow band OFDM channels
- Several device power saving modes
- Native IP support
- Latest Wi-Fi® security

Benefits

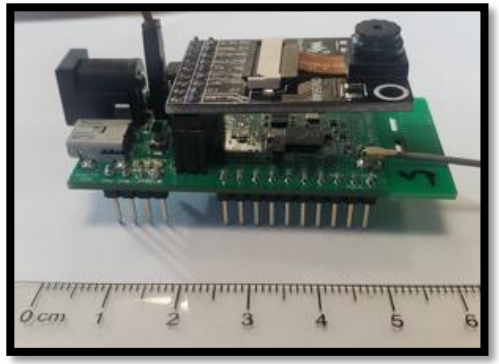
- Long range: approximately 1 km
- Penetration through walls and other obstacles
- Supports coin cell battery devices for months or years
- No need for proprietary hubs or gateways

Source: Wi-Fi Alliance®

Demonstrating Wi-Fi HaLow capabilities in the real world.

Long Range - from AP to STA: 1790 m

- 1 MHz wide channel: 1.25 Mb/s TCP
- 4 MHz wide channel: 3.4 Mb/s TCP



Low Power – Multi Year battery Life
Enhanced Power Save Modes

High Client Count – over 1,000 devices connected to 1 AP

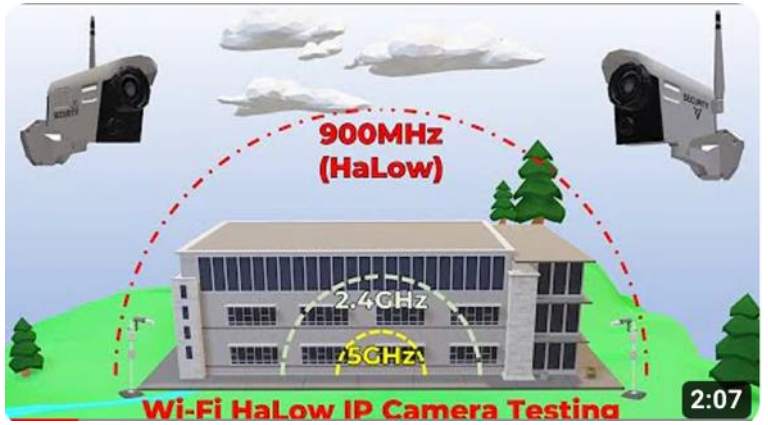
Strong material penetration
and large indoor coverage

Demonstrating Wi-Fi HaLow capabilities on YouTube.

1000+ Device Mixed Network Demo

Long Range Video Transmission Over HaLow

Large Indoor Coverage for Sensor Applications / Asset Tracking



2.4GHz vs 900MHz IP Camera Indoor testing

https://www.youtube.com/@newracominc.6582

Smart Home

- Security & Access
- Yard & Pool
- Low Power Sensors
- Outdoor Lighting

Multi Dwelling Units

- Reduced Infrastructure
- Security & Access
- Material Penetration
- Sensing & Safety

Commercial Buildings

- Security & Access
- Sensing & Safety
- Overlay Networks
- Parking & EV Charging
- Lighting

Smart Cities

- Vision Sensing
- Air Quality
- Green Energy
- Lighting
- OpenRoaming for IoT

Smart Retail

- Digital Signage
- Smart carts
- Produce Monitoring
- Parking & EV Charging

Industrial & Agricultural

- Low Power Sensors
- High Capacity Network
- Automation
- Safety
- Robotics

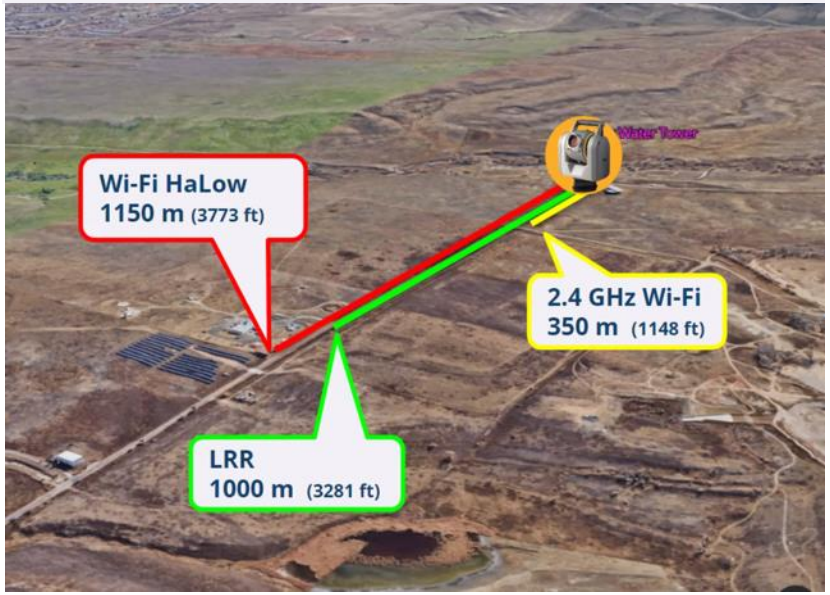
Application Examples

Introducing Trimble SX12 with Wi-Fi HaLow Radio Technology

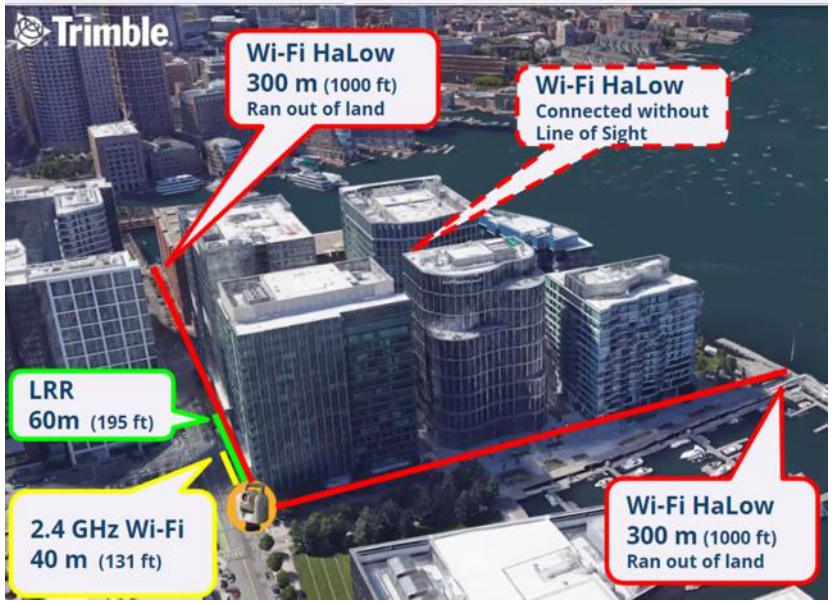
April 18, 2023

A new model of the Trimble® SX12 total station is available, now equipped with Wi-Fi HaLow™ radio technology. Wi-Fi Halow provides a more reliable and robust connection—up to 14 times higher bandwidth than long-range radio. It makes it easy to complete data-heavy tasks like scanning transfers or video streaming.

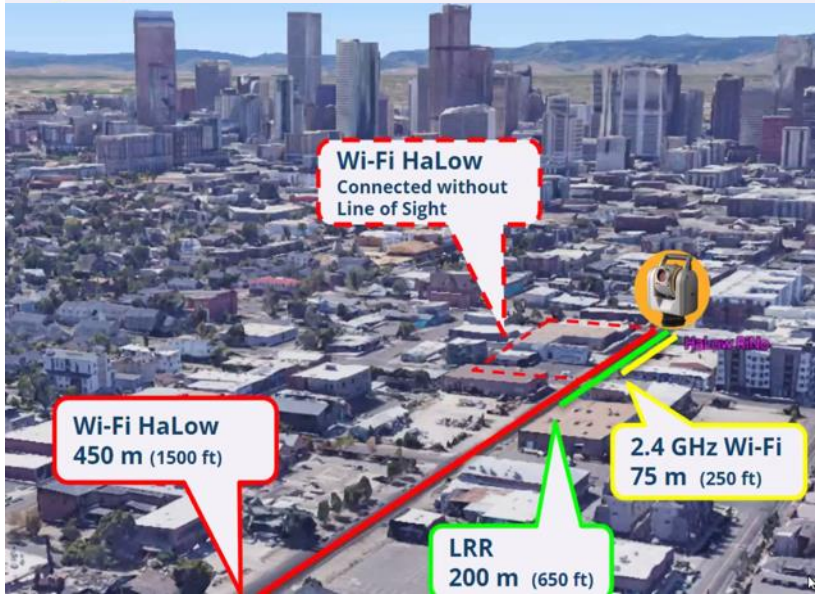
Real-World side-by-side Range Tests: Open Field



Real-World side-by-side Range Tests: Downtown Boston



Real-World side-by-side Range Tests: Denver RiNo District



https://geospatialresources.trimble.com/blog/introducing-trimble-sx12-with-wi-fi-halow-radio-technology

ASKEY

Smart City

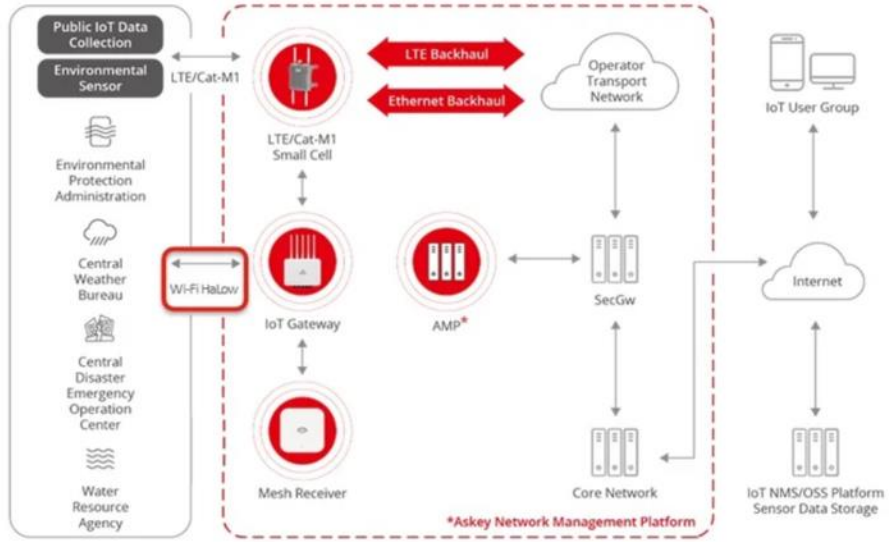
Keep The Passengers in The Loop

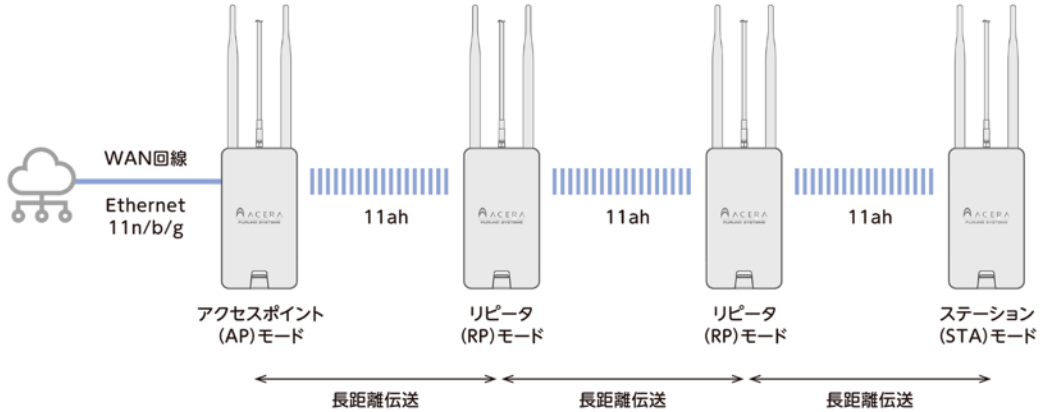
Askey provides over 70% Smart Bus Stops with Wi-Fi Hotspot and solar energy in Taipei.

Keep the city environment hospitable and informative.

New standard 11ah using 920MHz band. Contribute to solving social issues

Civil IoT Network Solution





Applications and Adoption – Japan's AHPC

Over 130 Member Companies

Regular member (communication carrier)

ITEC Hankyu Hanshin Co., Ltd.
NTT Access Service Systems Laboratories
NTT DOCOMO, INC.
NTT Broadband Platform Corporation
Catch Network Co., Ltd.
KDDI Corporation
SoftBank Corp.
NIPPON TELEGRAPH AND TELEPHONE WEST CORPORATION
Nippon Telegraph and Telephone East Corporation
Meek Co., Ltd.
USEN NETWORKS Co., Ltd.
Rakuten Mobile, Inc.
Wire and Wireless Co., Ltd.
Wireless Gate Co., Ltd.

Regular members (equipment manufacturers, Siers, etc.)

Azure Wave Technologies, Inc.
IO DATA DEVICE CO., LTD.
Aisin Co., Ltd.
Idea Co., Ltd.
Island Six Co., Ltd.
Askey Japan Co., Ltd.
Azbil Corporation
Upside limited liability company
Aviacomm Inc.
Applet Co., Ltd.
Amiya Co., Ltd.
ARTERIA Networks
Arrow Electronics Japan
Umbersoll Japan Co., Ltd.
Ishibashi Co., Ltd.
ITOCHU Techno-Solutions Corporation
Internet Initiative Japan Inc.
HC Networks Co., Ltd.
Eight Sense Co., Ltd.
Exeo Group Co., Ltd.
SCSK Corporation
NEC Networks & System Integration Corporation
NTT Advanced Technology Corporation
NTT DATA Customer Service Corporation
FXC Co., Ltd.
LTE-X Inc.
ELECOM CO., LTD.
Kaga Electronics Co., Ltd.
Kanematsu Communications Co., Ltd.
DEGLO Co., Ltd.
Kawasaki Heavy Industries, Ltd.
Limited Liability Company
Zenrin Datacom Co., Ltd.
Toyo Technica Co., Ltd.
TOA Corporation
Toenec Co., Ltd.
Nakayo Co., Ltd.
Nissin Dentsu Giken Co., Ltd.
Nissei Co., Ltd.
Nissei Electric Co., Ltd.
Nippon Antenna Co., Ltd.
Nippon Sheet Glass Co., Ltd.
Nippon Comsys Co., Ltd.
Japan System Development Co., Ltd.
Nippon Electric Works Co., Ltd.
Hewlett-Packard Japan LLC
Nippon Ryton Co., Ltd.
Net One Partners Co., Ltd.
Persol R&D Co., Ltd.
Bios Co., Ltd.
Buffalo Co., Ltd.
Panasonic Connect Co., Ltd.
Parallel Networks LLC
PZP Co., Ltd.
Beat Craft Co., Ltd.
Bmap Co., Ltd.
PicoCELA Inc.
Hitachi, Ltd.
VR Techno Center Co., Ltd.
Field Brain Co., Ltd.
Fujita Solution Partners Co., Ltd.
Fujitsu Limited
Fujitsu Client Computing Limited
Fujitsu Laboratories Ltd.
Kyowa Dengyo Co., Ltd.
Core Co., Ltd.
GOKE JAPAN Co., Ltd.
Cornes Technology Co., Ltd.
Contec Co., Ltd.
Silex Technology Co., Ltd.
Sakusa Co., Ltd.
Cisco Systems GK
Information Systems Research Institute Co., Ltd.
Staff Co., Ltd.
Smart Logic Co., Ltd.
ThroughTek Co., Ltd. (TUTK)
Secom Co., Ltd.
Seven to Five Co., Ltd.
Sense Things Japan Co., Ltd.
Century Systems Co., Ltd.
Taixin Semiconductor Co., Ltd.
Takebishi Co., Ltd.
Chuo Denshi Co., Ltd.
D-Link Japan Co., Ltd.
Tetra Aviation Co., Ltd.
Plat Home Co., Ltd.
Furuno Systems Co., Ltd.
Furuno Electric Co., Ltd.
Boyd Router Systems Co., Ltd.
Microwave Factory Co., Ltd.
Micro Summit Co., Ltd.
Maspro Denko Co., Ltd.
Mitsubishi Electric Corporation
Information Technology R&D Center
Mirait One Co., Ltd.
Murata Manufacturing Co., Ltd.
Meisei Communication Co., Ltd.
Mega Chips Co., Ltd.
Morse Micro
Mobile Techno Co., Ltd.
Ubiquos Japan Office
Yokogawa Electric Corporation
Riken Keiki Co., Ltd.
Root Webs Co., Ltd.
Ranger Systems Co., Ltd.

Regular members (academic organizations)

Industrial Technology Research Institute
Kanagawa Institute of Technology
National University Corporation Tokyo University of Marine Science and Technology
University of Tokyo
University of Hyogo Graduate School
Japan Advanced Institute of Science and Technology
Muroran Institute of Technology

Regular members (Others)

Tokyu Construction Co., Ltd.
Rick Telecom Co., Ltd.

special member

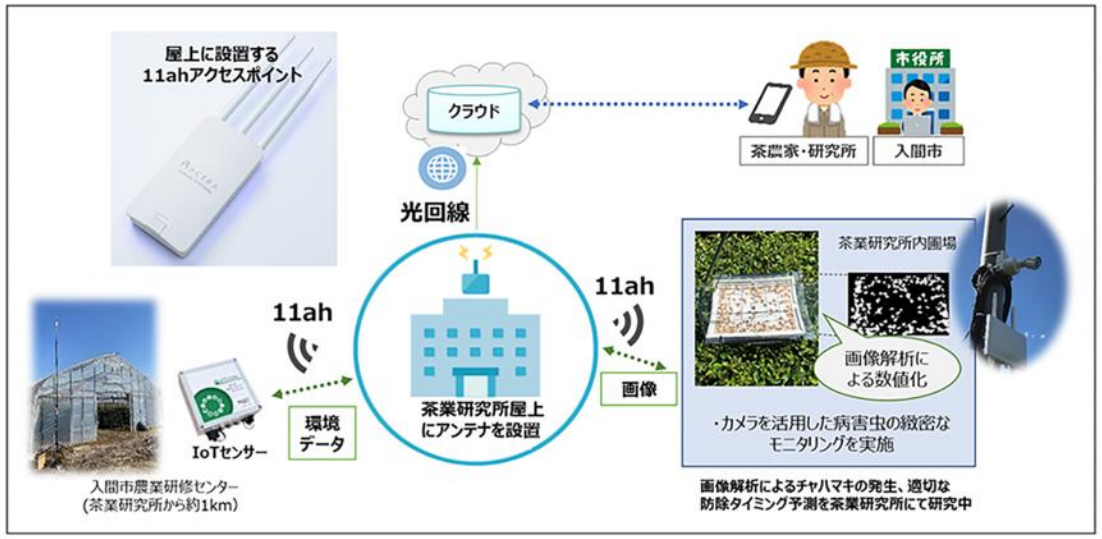
NPO Update Success Academy
Kanagawa Prefectural Fisheries Technology Center Sagami Bay Proving Ground
Kochi Prefecture
National Neighborhood Association Activity Support Net
Nagano Economic Research Institute
General Incorporated Association Wireless LAN Business Promotion Liaison Committee
Mobile Computing Promotion Consortium (MCPC)

Demonstration experiment of agricultural DX for tea leaf cultivation using the new Wi-Fi standard "IEEE 802.11ah" started

2023.03.23

- An 11ah access point was installed on the roof of the Saitama Prefecture Tea Industry Research Institute, and IoT sensors and cameras installed on the Saitama Prefecture Tea Industry Research Institute and farm fields in Iruma City acquired useful data for tea leaf production (main acquisition data)
  , temperature and humidity, solar radiation, soil moisture, soil EC (electrical conductivity), wind speed and direction
  , images (still images and videos), etc.
- Sharing the information required by tea farmers from the acquired data using LINE of the Saitama Prefectural Tea Industry Research Institute
- Selecting devices that are considered useful for promoting agricultural DX in tea leaf cultivation, and verifying their control and operation at 11ah

(Demonstration test image)



(actual installed equipment)

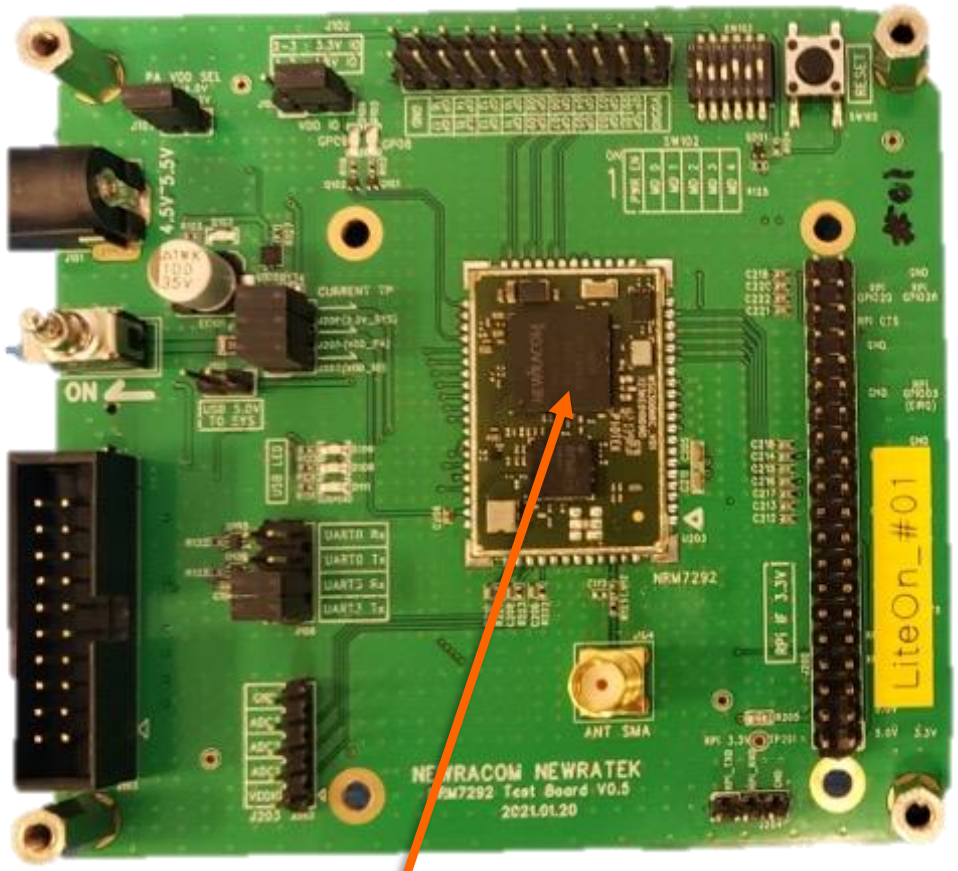
11ah antenna installed on the roof of the Tea Research Institute

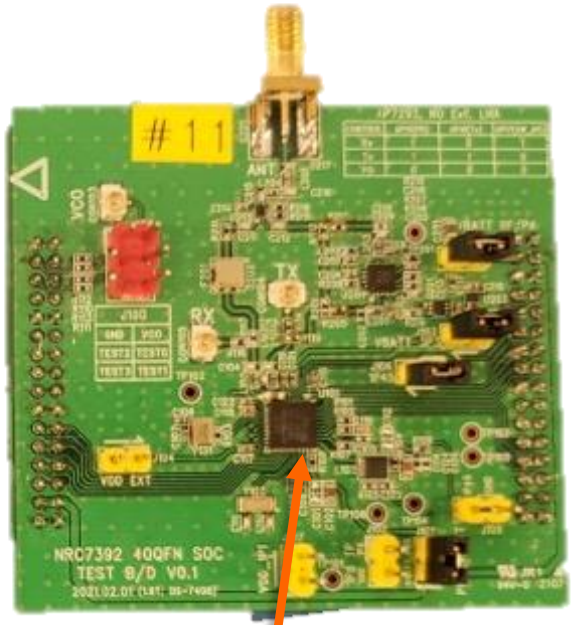
A camera installed in the field of the tea industry research institute

Sensors installed at the Iruma City Agricultural Training Center

https://www.ntt-agritechnology.com/news/20230323.html

Newracom introduces next generation HaLow SoC – **NRC7394**





NRC7292 (1st Gen)

- External FEM (23dBm)
- Support for 1000 clients with security
- 10x10mm + FEM

NRC7394 (2nd Gen)

- Integrated FEM (15dBm)
- Support for 8000 clients with security
- 6x6 mm


Thank
You
NEWRACOM
505 Technology Dr. Suite #100, Irvine, CA 92618 U.S.
+1-949-390-7111
www.newracom.com

20TH ANNIVERSARY | Wireless Global Congress

Guharajan Sivakumar

CTO, Aprecomm

Meeting in “QoE for Million Homes

#WGCAMERICAS | #wifirevolution | #lovewifi

Microsoft Teams

Meeting in "QoE for Million Homes"

2023-06-20 14:24 UTC

Recorded by
guharajan sivakumar

Organized by
guharajan sivakumar

Channel
QoE for Million Homes

20TH ANNIVERSARY | Wireless Global Congress

Joseph Valencia

Chief Product Officer, Origin Wireless

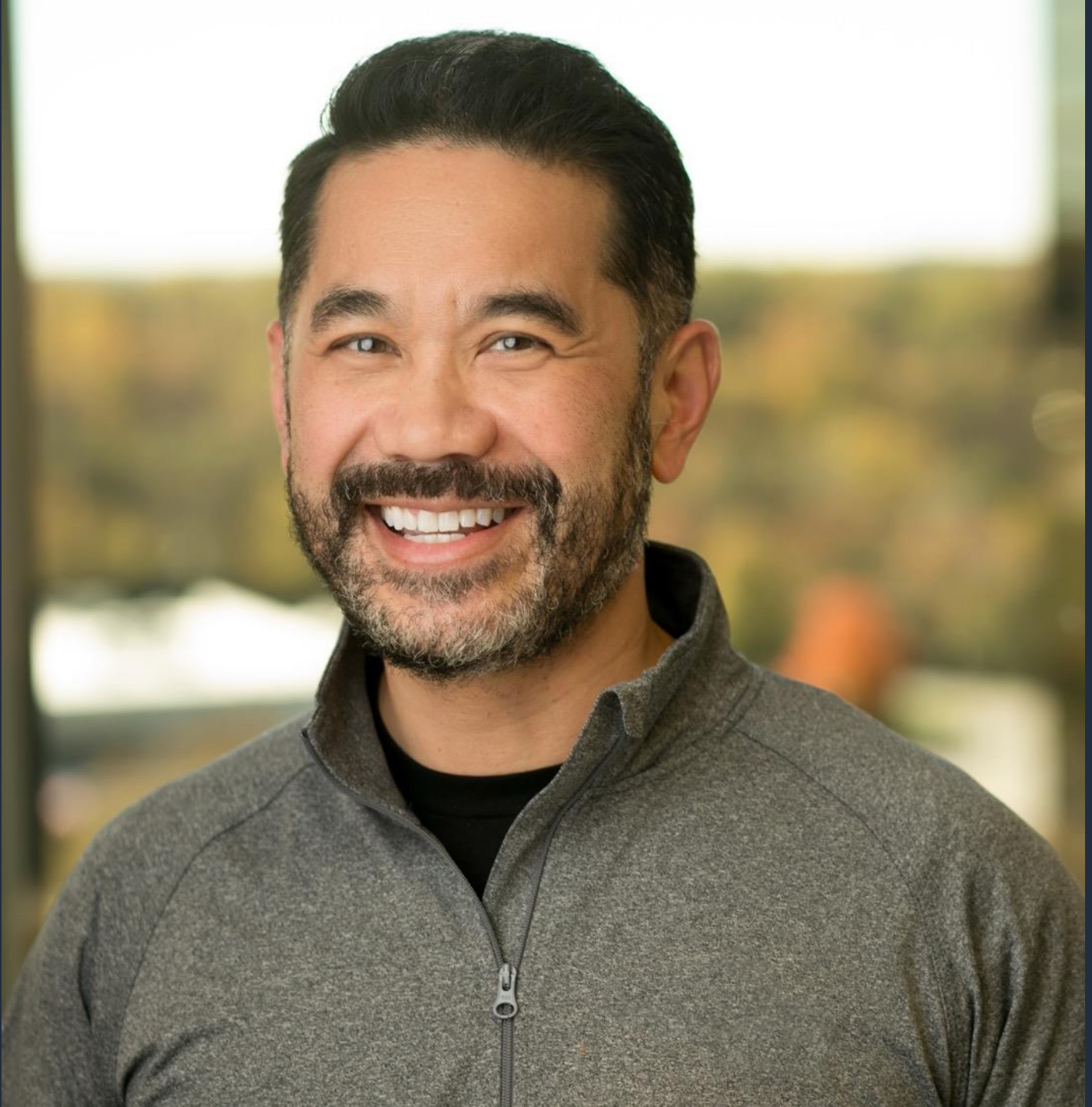
WiFi Sensing: Enabling Advanced Home Intelligence

#WGCAMERICAS | #wifirevolution | #lovewifi

ORIGIN™

WiFi Sensing: Enabling Advanced Home Intelligence

June 21, 2023



Joseph Valencia

Chief Product Officer

20+ years technology & telecom

- Product Management
- Business Development
- Strategy
- Innovation

verizon Microsoft

T-Mobile hp

ORIGIN™

About Origin

The pioneers of WiFi Sensing

The fastest growing WiFi Sensing company in the world

Most robust roadmap in the industry

50+ patents granted & 130+ filed

---

verizon

ALARM.COM

verisure

Deutsche Telekom

muRata INNOVATOR IN ELECTRONICS

LINKSYS

ALOE CARE HEALTH

ORIGIN™

The Smart Home Challenge

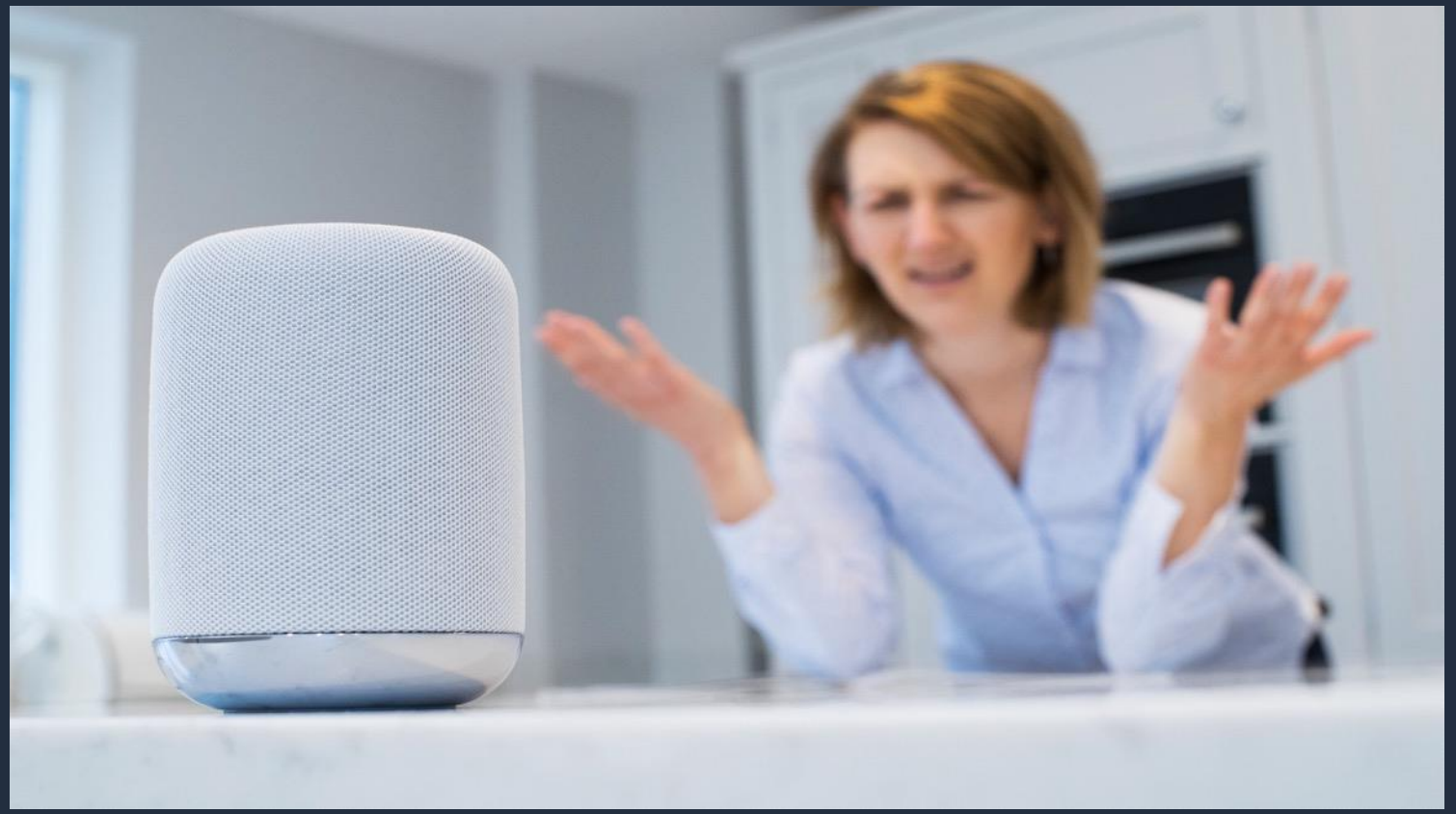
ORIGIN™

What we were promised

ORIGIN™

But instead of this. . .

We got this



ORIGIN™

The WiFi Advantage

ORIGIN™


Non-line-of-sight
Continuous Context
Privacy
Ubiquitous

Unlocking Home Intelligence

ORIGIN™


Topologies
Sensing Agent
Edge vs. Cloud

WiFi Sensing knows...

ORIGIN™


WiFi Sensing knows...
Security

Security

Challenge	Solution
False Alarms	Motion classification
Coverage	1:1 with WiFi
HW cost	Flexible integration options
Hard to setup	Plug and play

Outcome

- Improved end user satisfaction
- Reduced operational costs
- New offers enabled

ORIGIN™


WiFi Sensing knows...
Aging
ORIGIN™

Aging

Challenge	Solution
Acceptance	Transparent integration options
Privacy	Camera-less
Coverage	1:1 with WiFi
Injury	Fall detection

Outcome

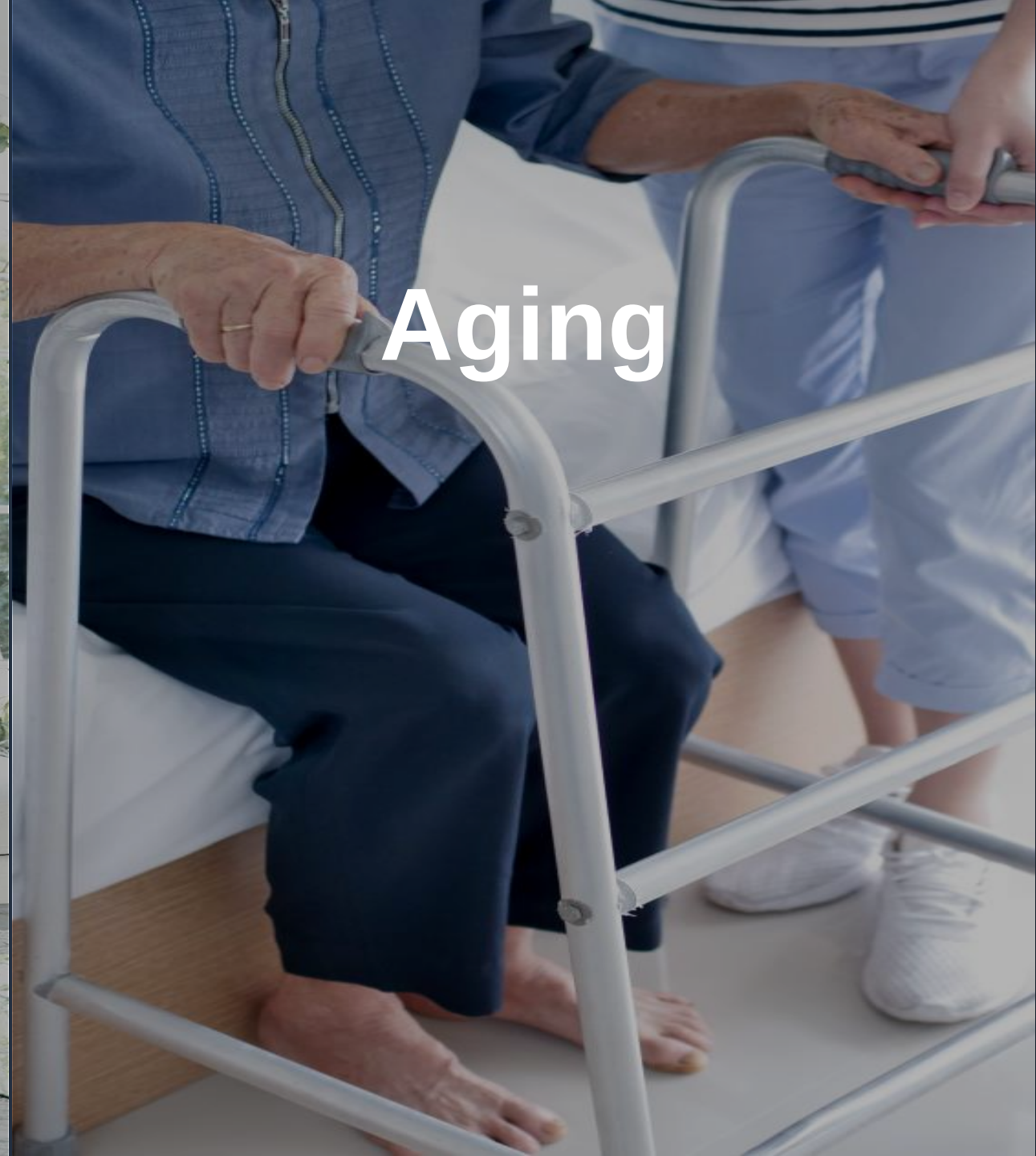
- Increased adoption
- Augmented performance
- Improved insights

ORIGIN™

WiFi Sensing knows...

ORIGIN™


Security


Aging

Thank You

ORIGIN™

WiFi can do more.

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Panel: 20 Years of Broadband – What Next

Tim Colleran

VP Sales, Business. Development, and Product Marketing, LEVL.

Oz Yildirim

EVP & GM Americas Business Unit, Airties.

Maria Cuevas

Networks Research Director, BT Group.

Kyle Korner

Director - XFinity Products, Comcast.

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WGC AMERICAS

WI-FI INNOVATION:
FOR OPERATORS, ENTERPRISES, PLACES AND THINGS

COFFEE BREAK & NETWORKING
BE BACK IN 30 MINUTES AT
4.30 PM PST

#WGCAMERICAS | #wifirevolution | #lovewifi

20TH ANNIVERSARY | Wireless Global Congress

Bruno Tomás

CTO, Wireless Broadband Alliance

Session Moderator

#WGCAMERICAS | #wifirevolution | #lovewifi

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WGC Americas Speakers

Norisuke Hirai
Tokyo Metropolitan Government.

Ike Elliott
Kyrio

Trevor Miranda
Cambium Networks

Bruno Cendón Martin
Meta

Malcolm Smith
Cisco

Howard Buzick
TIP OpenWiFi

Jack Raynor
TIP OpenWiFi.

Huw Rees
NetExperience

Dr. Derek Peterson
Boingo Wireless

Jon Buck
Mobilitie

Time	Presentation
4:30 PM (PST)	**Implementation of OpenRoaming on TOKYO FREE Wi-Fi** Norisuke Hirai, Director for Digital Shift Promotion, Tokyo Metropolitan Government.
4:45 PM (PST)	**Wi-Fi and Cellular Convergence** Ike Elliott, CEO, Kyrio.
5:05 PM (PST)	**Managing the Wi-Fi Experience From Access to WAN** Trevor Miranda, Chief Architect - Network Infrastructure, Cambium Networks.
5:15 PM (PST)	**Extended Reality in the Congested Enterprise** Bruno Cendón Martin, Senior Director of Engineering, META and Malcolm Smith, CTO Advisor, Wireless Cisco..
5:35 PM (PST)	**OpenWiFi: Enhancing the Wi-Fi Experience** Howard Buzick, TIP OpenWiFi.
5:45 PM (PST)	**Panel: Delivering the Best Wi-Fi Experience** Jack Raynor, Co-Chair Open Converged Wireless Project Group, TIP OpenWIfi; Huw Rees, VP, Product Development, NetExperience; Dr. Derek Peterson, CTO, Boingo Wireless; Jon Buck, Senior Director, Technical Operations & Architecture, Mobilitie
6:30 PM (PST)	**DRINKS & NETWORKING RECEPTION**

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Norisuke Hirai

Director for Digital Shift Promotion, Tokyo Metropolitan Government.

Implementation of OpenRoaming on TOKYO FREE Wi-Fi

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Implementation of OpenRoaming on TOKYO FREE Wi-Fi

Norisuke Hirai

Director for Digital Shift Promotion,

TOKYO METROPOLITAN GOVERNMENT (TMG)

Implementation of OpenRoaming on TOKYO FREE Wi-Fi

- TMG chooses to implement OpenRoaming on its Wi-Fi!
- Why TMG chooses OpenRoaming?
- Good OpenRoaming POC in TOKYO Marathon 2023

TMG chooses to implement OpenRoaming!

TMG Launched OpenRoaming Wi-Fi Service

On March 31, 2023, TMG launched as a new Wi-Fi service that solves the problems of existing Wi-Fi.

TMG Press Release

My TOKYO Individuals Business Language Search by Keywc ログイン メニュー

First Municipality to Launch Wi-Fi Using OpenRoaming

March 29, 2023 Tokyo Metropolitan Government

お気に入り

The Tokyo Metropolitan Government will be the first municipality to establish a public Wi-Fi infrastructure that supports OpenRoaming, and will launch services at four locations.

The TMG, in collaboration with KDDI Corporation and Wire and Wireless Co., Ltd. have decided to develop a new Wi-Fi infrastructure using OpenRoaming [1], an international Wi-Fi connection infrastructure that is being introduced in Europe, the United States, and Japan, and to launch services.
OpenRoaming is characterized by a high level of security and convenience, and can automatically connect to OpenRoaming-compatible Wi-Fi spots in Japan and overseas with a single setup.
As a first step, the service will be launched at the four facilities listed below, and will be expanded to approximately 600 tourist facilities and other TMG-owned facilities in fiscal 2023, in order to provide a secure and seamless communication environment in the midst of the expected increase in the number of foreign arrivals and departures.
The TOKYO Data Highway Strategy Promotion Council, comprised of experts and others, will continue to study the spread of OpenRoaming-compatible Wi-Fi services throughout Tokyo, including private facilities, so that Tokyo residents can enjoy the benefits of the digital society in safety and comfort.

https://www.my.metro.tokyo.lg.jp/w/000-20230329-00012614

The Article on WBA website

WIRELESS BROADBAND ALLIANCE 20th ANNIVERSARY ABOUT US WHAT WE DO MEMBERSHIP EVENTS & AWARDS NEWSROOM RESOURCES CENTRE MEMBER LOGIN

KDDI and Wire & Wireless announce a public Wi-Fi infrastructure supporting OpenRoaming

Achieves an internationally standardized secure Wi-Fi connection environment for local residents and domestic and international travelers

KDDI Corporation (Headquarters: Chiyoda-ku, Tokyo; President: Makoto Takahashi; hereafter KDDI) and Wire & Wireless Co., Ltd. (Headquarters: Chuo-ku, Tokyo; President: Tomoki Mukaiyoshi; hereafter Wi2) have developed a free Wi-Fi network platform (hereafter the platform) that supports OpenRoaming, an international wireless LAN roaming infrastructure promoted by the Wireless Broadband Alliance (WBA)(Note 1), and will provide it to municipalities starting in April 2023. Additionally, both companies have been contracted by the Tokyo Metropolitan Government to develop and operate the "TOKYO FREE Wi-Fi" (https://wi-fi.metro.tokyo.lg.jp/) service environment using OpenRoaming, which will begin operation on March 31, 2023. This platform is a foundational system for providing free Wi-Fi and achieves a highly secure and convenient, free Wi-Fi environment.

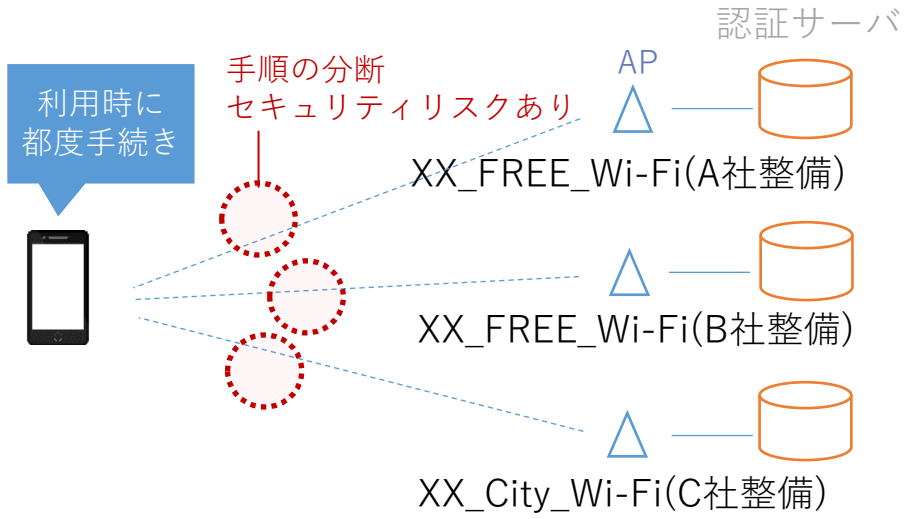
Image of OpenRoaming Utilization in Tokyo

https://wballiance.com/kddi-and-wire-wireless-announce-a-public-wi-fi-infrastructure-supporting-openroaming/

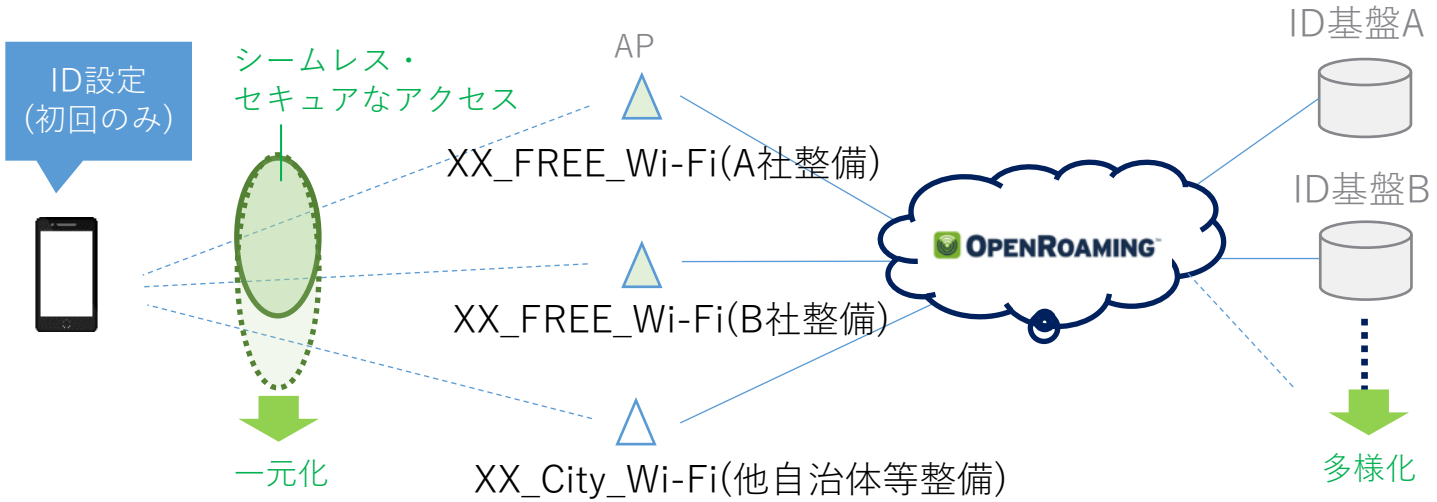
Features of OpenRoaming

Significantly improved "convenience" and "security" that have been issues with existing free Wi-Fi

Existing Free Wi-Fi



New Free Wi-Fi with OpenRoaming



Convenience：
Identity verification is required on the Web for each network and each use.
Procedures are complicated.

Security：
Vulnerable to wiretapping and false base stations

Convenience：
Automatic connection is possible by confirming the identity in advance and setting the ID on PCs or Smart Phones
Connect to networks around the world that support OpenRoaming with a single ID

Security：
Wireless encryption with keys for each user and certificates to prevent fake AP connections

ID-distribution mechanism of TOKYO FREE Wi-Fi

Expand awareness and usage opportunities through collaboration with online and offline media

Area sign

Implementation by Web application

https://wi-fi.metro.tokyo.lg.jp/

Multiple Language

Link with disaster prevention apps (planned for the future)

LINE(TMG Official)

Add a menu to existing apps and direct them to OpenRoaming

OpenRoaming can be used without installing additional apps

- **Can be used with LINE IDs, which are widely used in Japan**

Deployment Plan of OpenRoaming

By April 2023, 26 locations

(ex. Nishi-Shinjuku Smart Pole, TMG office, travel information center etc.)

By March 2024, about <u>600 locations</u>

(ex. Metropolitan High schools, metropolitan facilities etc.)

西新宿スマートポール*一部除く cityroam eduroam

都庁第二本庁舎3階 Wi-Fi6 eduroam

東京観光情報センター（バスタ新宿） Wi-Fi6E eduroam

新宿都税事務所（本館4F、本館6F） Wi-Fi6 eduroam

東京都立大久保病院（3F外来待合エリア）*実証実験中 Wi-Fi6 eduroam

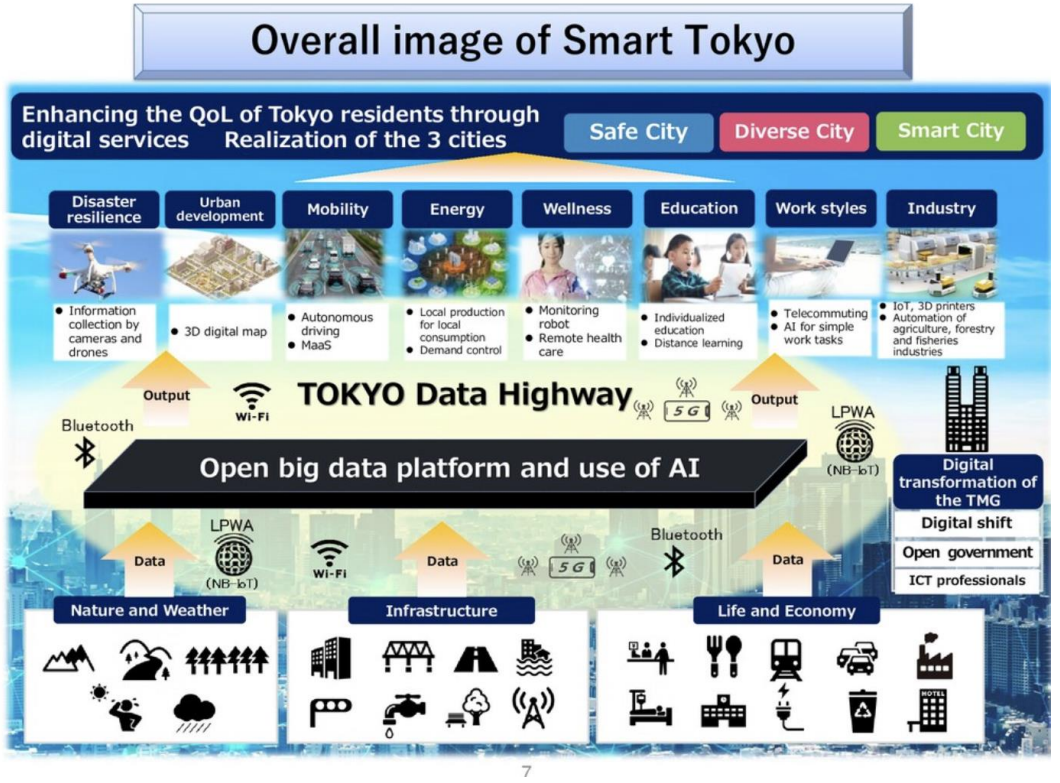
We are planning to encourage other municipalities and private companies to implement OpenRoaming.

(ご参考) https://www.metro.tokyo.lg.jp/tosei/hodohappyo/press/2023/01/27/documents/29_04.pdf → P.118「つながる東京」Wi-Fiアクセスポイントの整備

Why TMG chooses OpenRoaming?

TOKYO Data Highway Strategy

- Announced In 2020.
- Realizing a “Connected Tokyo” for anyone, anytime, anywhere with Mobile Broadband such as 5G and Wi-Fi.
- an infrastructure for enhancing the QoL of Tokyo residents and travelers through the digital services.



Why TMG choose OpenRoaming?

Lessons learnt from 3 good case studies

LinkNYC	eduroam	Cityroam
Passpoint Deployment Leads to Secure and Seamless Wi-Fi Experience	**Many Students and staff of academic around the world eduroam IDs are potential customers**	**Easily connect to OpenRoaming in Japan. Widely available to the residents and travelers.**

1. TMG, one of the world's largest cities should contribute to the spread of secure and seamless Wi-Fi with Passpoint.
2. TMG should contribute to the realization of a globally "connected Tokyo," by providing Wi-Fi connected to international wireless LAN roaming infrastructure such as eduroam and OpenRoaming/Cityroam

TMG chooses to implement OpenRoaming on TOKYO FREE Wi-Fi.

Good OpenRoaming POC in TOKYO Marathon 2023

OpenRoaming Wi-Fi POC on TOKYO Marathon 2023

- **Provided Free Wi-Fi for runners from overseas on TOKYO Marathon 2023.**
- **Prepare for two connect method by QR code and OpenRoaming.**
- **Announced ONLY QR Code method to connect Free Wi-Fi.**

Wi-Fi connection method and number of connections

← Registration Period → TOKYO Marathon

Connect Method	Mar-2	Mar-3	Mar-4	Mar-5	Total
QR Code	566	509	278	2,183	2,594
OpenRoaming	698	787	160	643	1,425
Total	1,264	1,296	438	2,826	4,019

We have found that **half or more of people are connected via OpenRoaming**, except on marathon day, even though we have NEVER announced OpenRoaming method to connect Free Wi-Fi.

Summary

- TMG chooses to implement OpenRoaming on its Wi-Fi!
- By March 2024, will launch about 600 APs (already 26 APs)

Why OpenRaoming? Because I believe:

- TMG, one of the world's largest cities should contribute to the spread of secure and seamless Wi-Fi with Passpoint.
- TMG should contribute to the realization of a globally "connected Tokyo," by providing Wi-Fi connected to international wireless LAN roaming infrastructure such as eduroam and OpenRoaming/Cityroam

Thank you!!

Let us all work together with TOKYO to promote OpenRoaming!

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Ike Elliott

President & CEO, Kyrio

A Vision for Wi-Fi and Mobile Convergence

#WGCAMERICAS | #wifirevolution | #lovewifi

CableLabs®

KYRIO® | SCTE®

A Vision for Wi-Fi and Mobile Convergence

WGC, Las Vegas
June 2023

Ike Elliott, President and CEO, Kyrio
ike@kyrio.com

kyrio.com

776

500M

- The CableLabs family of companies holds 776 granted patents
- Over 500 million people use these technologies every day

https://www.cablelabs.com/resources/patents

Trust Experience.
Trust Kyrio.

CableLabs®

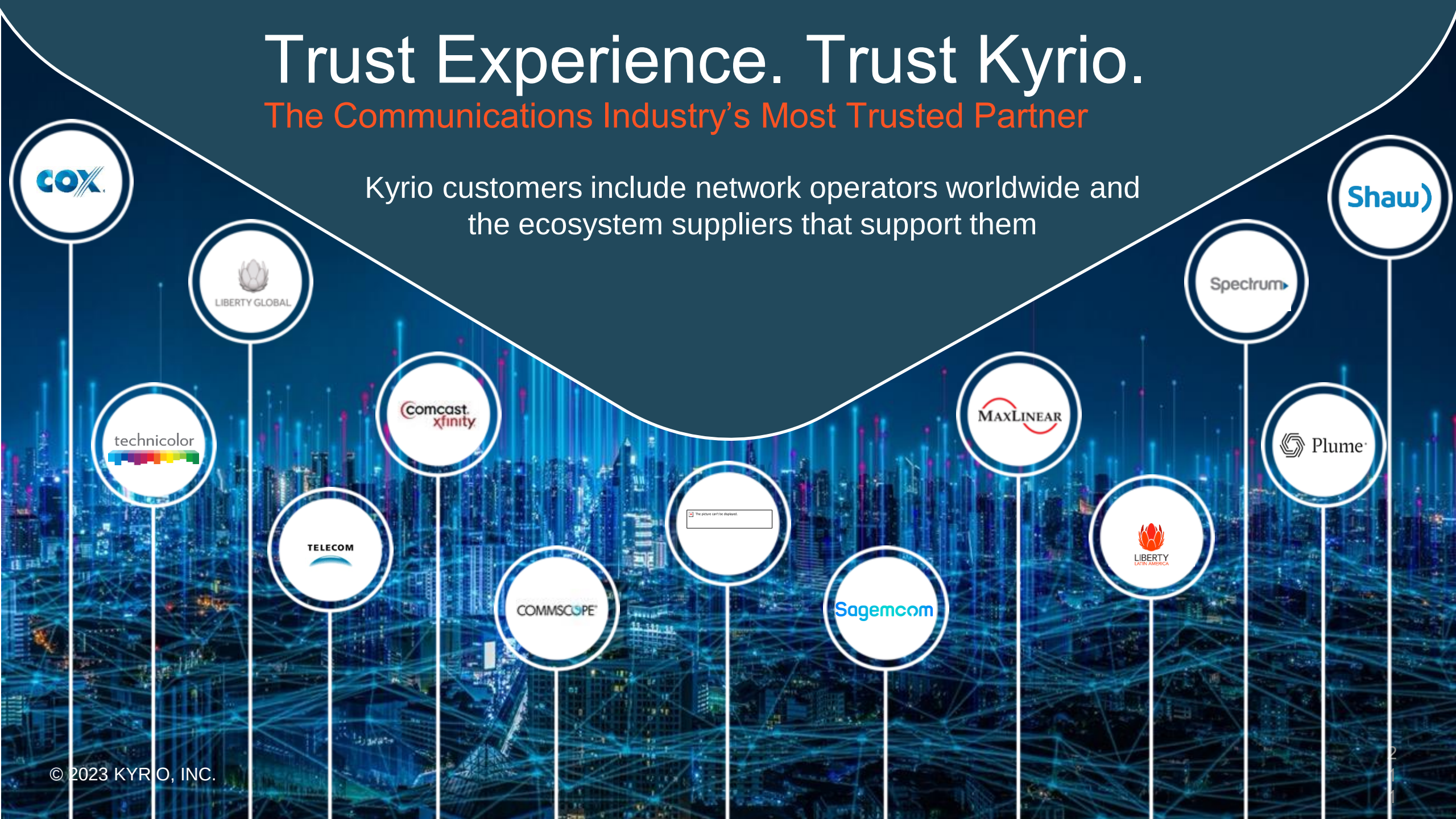
KYRIO® | SCTE®

As a wholly-owned subsidiary of CableLabs, Kyrio was created to serve all network operators and their suppliers

Trust Experience. Trust Kyrio.

The Communications Industry's Most Trusted Partner

Kyrio customers include network operators worldwide and the ecosystem suppliers that support them



Innovation

GAP

Commercial Scale

“Any sufficiently advanced technology is indistinguishable from magic.”

- Arthur C. Clarke, “Profiles of the Future: An Inquiry into the Limits of the Possible”, 1962

Hide the how.

Internet experiences do not yet hide enough of the how.

Example #1

Network Performance Management

Trust Experience.
Trust Kyrio.

Example #2

Reliability of Connection

Our wireless Internet experiences do not yet hide the how

Now is the time to make it magical

What If?

- What if we used software, AI, and the cloud to make networks that anticipate user needs?
- What if we opened up the interfaces to let everyone innovate?

Objectives

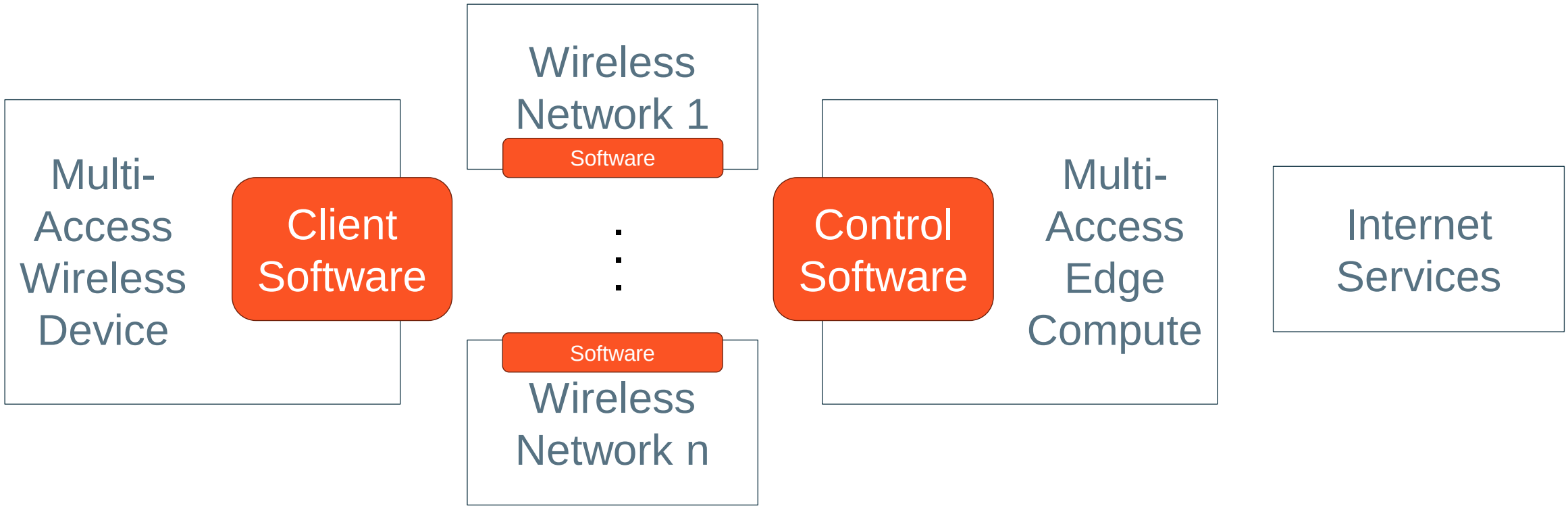
- Achieve real time understanding of network connectivity and performance
    - At each user multi-access wireless device
    - On each available network
- Create an open framework for acting on that information to do what the user would have wanted, without their intervention
- …And minimize any hardware or operating system dependencies

The Toolkit for the Mission

- The cloud
- Open CPE operating systems
- Artificial intelligence
- Multi-stakeholder communities
- Modern software practices
- New innovations

Trust Experience.
Trust Kyrio.

A Generalized Framework for a Solution



Example use cases

Example #1

Making Sticky Wi-Fi a Thing of the past

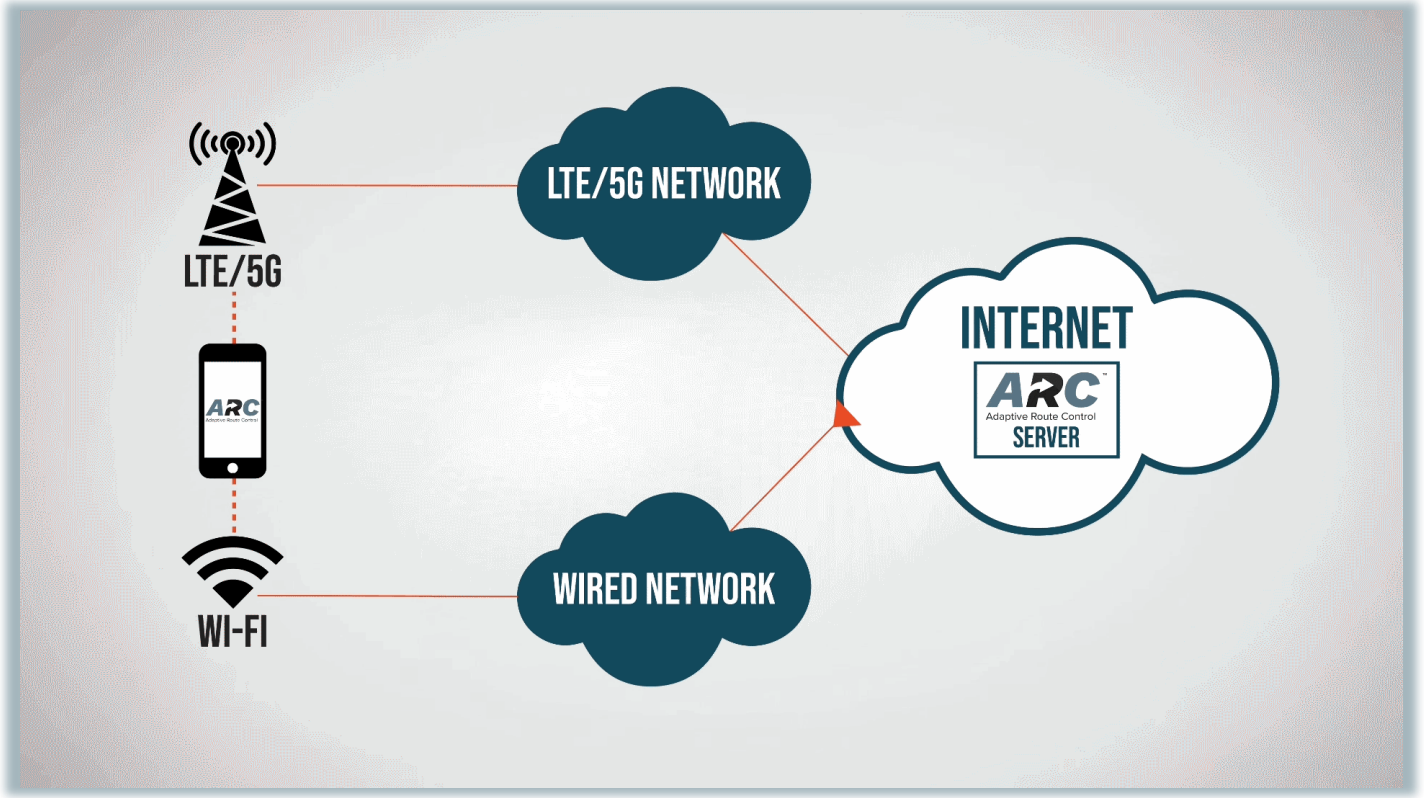
Trust Experience.
Trust Kyrio.

Adaptive Route Control (ARC) Mobile

ARC™
Adaptive Route Control
Mobile

Seamless Application Access

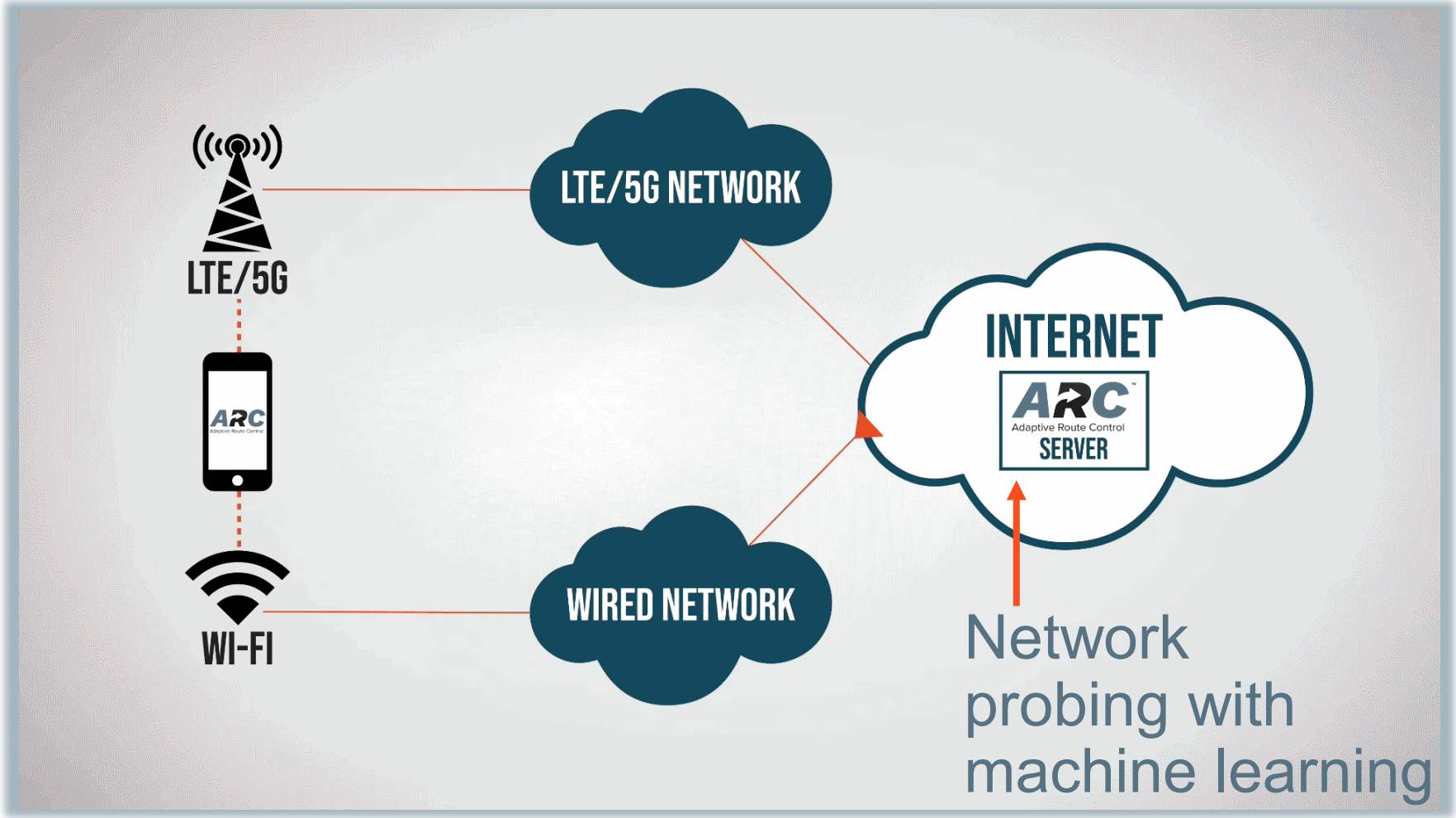
Steering across RAN transitions



Adaptive Route Control (ARC) Mobile Network Awareness

KYRIO

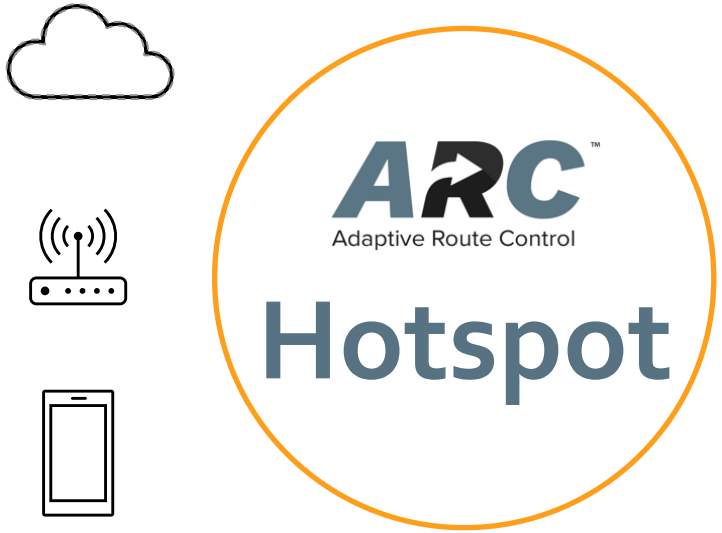
- ARC Server gathers network performance stats:
  - Light Active
  - Passive
- AI/ML predicts near future performance

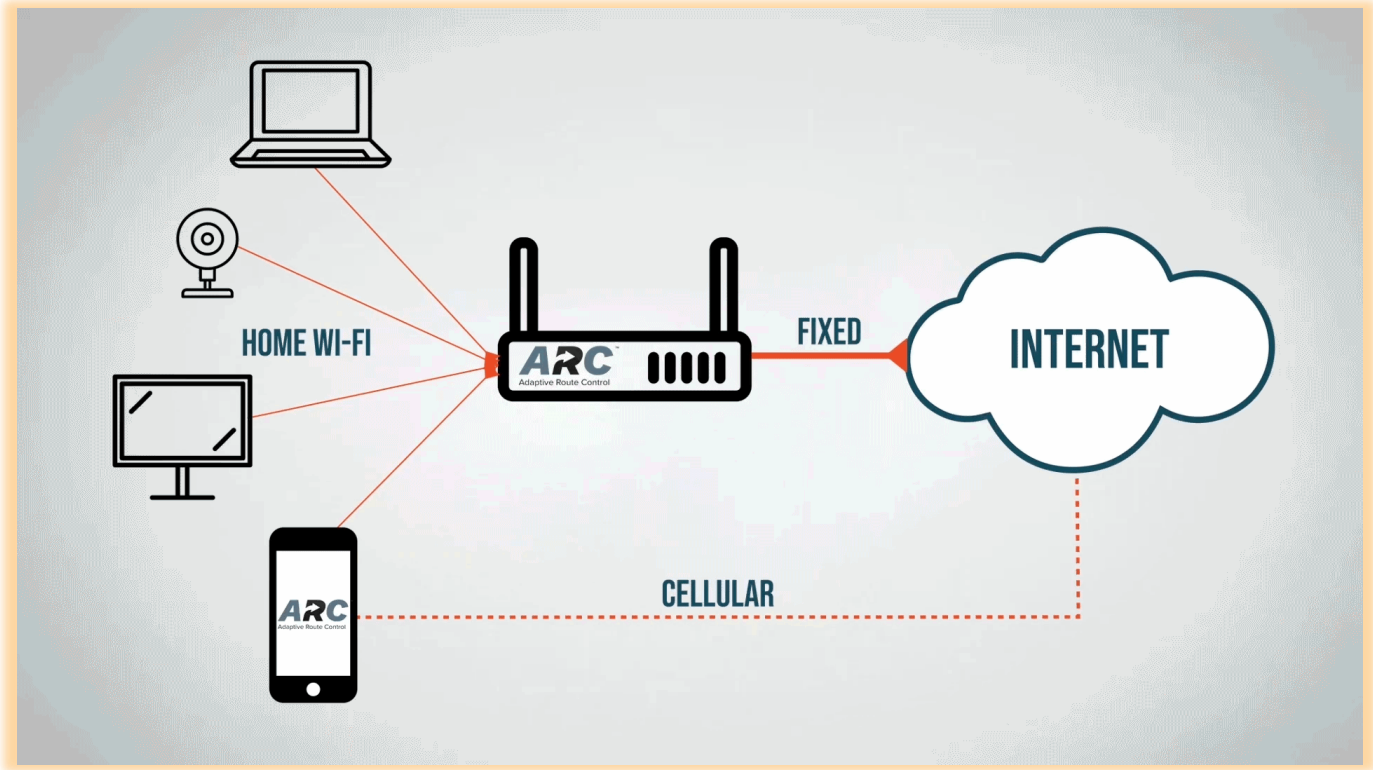


Example #2

Automatically Using Available Networks

The ARC Hotspot





Seamless Application Access

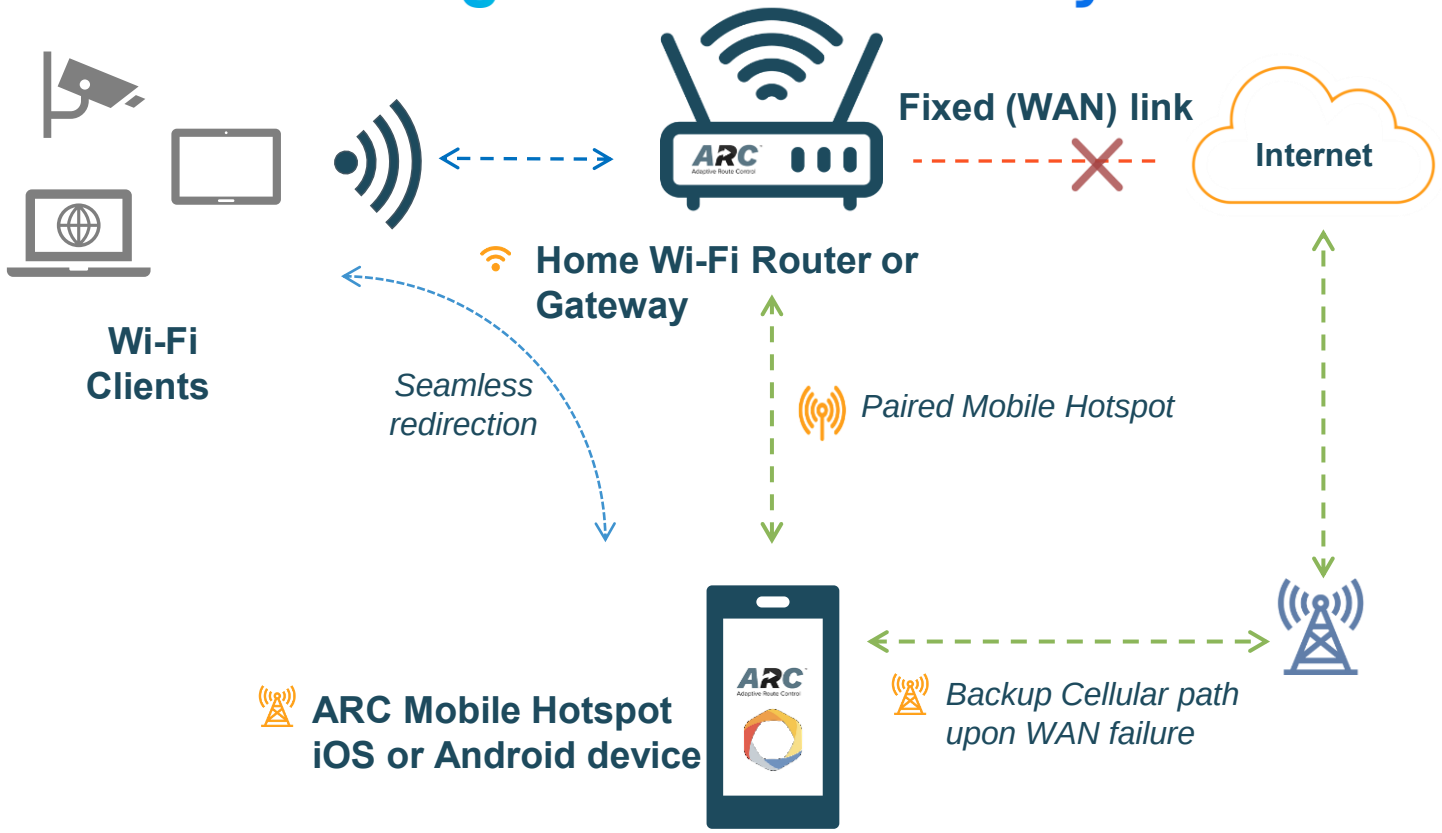
Handles WAN disruption steering to LTE/5G

Adaptive Route Control (ARC) Hotspot Integration with Gateways and Routers

KYRIO

Software working with:

Sagemcom and Linksys



You are invited to collaborate

- Want to integrate? We want to talk with you!
- Want to help us define APIs? We want to talk with you!
- Meet us at our table in the lunch room, or reach out at ike@kyrio.com

Thank You

Ike Elliott
President & CEO, Kyrio
ike@kyrio.com

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Trevor Miranda

Enterprise Chief Architect, Cambium Networks.

Managing the Wi-Fi Experience From Access to WAN

#WGCAMERICAS | #wifirevolution | #lovewifi

Cambium Networks™

Managing the Wi-Fi Experience from Access to WAN

Trevor Miranda

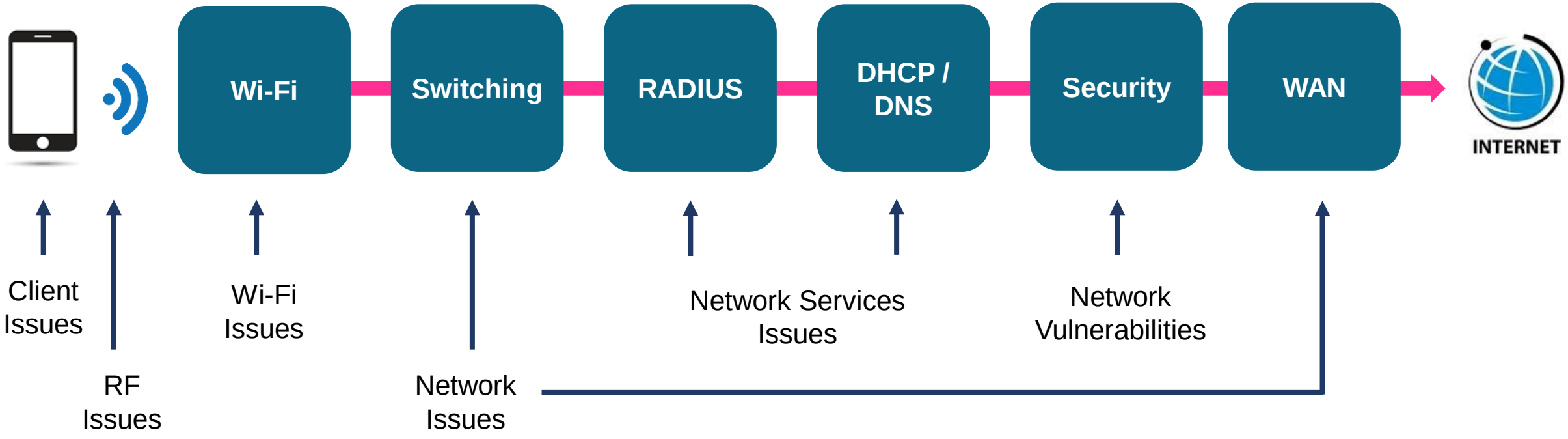
Enterprise Chief Architect
Cambium Networks


Disconnected from Wireless
Connection dropped
Bad roam
Cannot Connect
Blind spots
Not good for gaming
Webpage doesn't load
Low Latency
Bad Wi-Fi!
Connection hangs
My Zoom Call dropped
Poor Voice quality
Slow performance
Slow Downloads
Netflix is buffering
How to Deliver a Hassle-Free Network?

Wi-Fi Is the Internet!

Cambium Networks™

Many Factors Impact Wi-Fi Experience

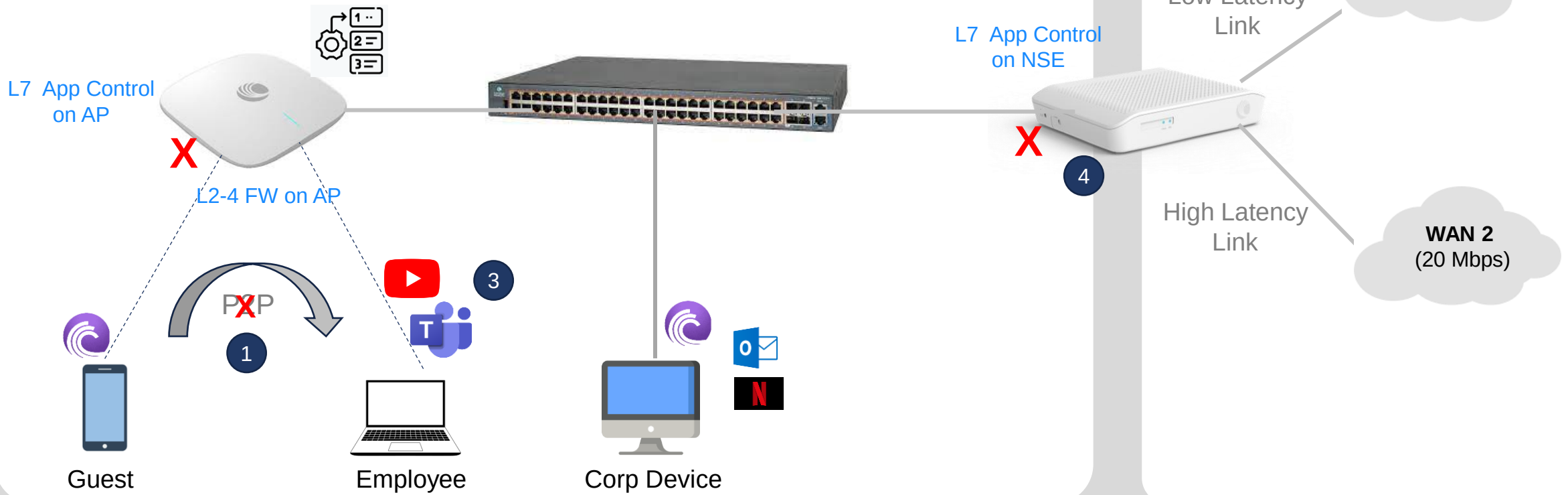


Clients Needs: Predictable Performance
Enterprise IT, MSP Needs: Simple Experiences to Manage Complexity & Cost

ONE Network – End-to-end Application Control

Cambium Networks™

1. Block peer-to-peer (P2P) traffic
2. Block BitTorrent
3. Prioritize Application
4. Optimize WAN Utilization



Building Blocks To Deliver Hassle Free Wi-Fi

Cambium Networks™

Integrated Network

1+1=3

Cloud Management

Improve Efficiency

Automation

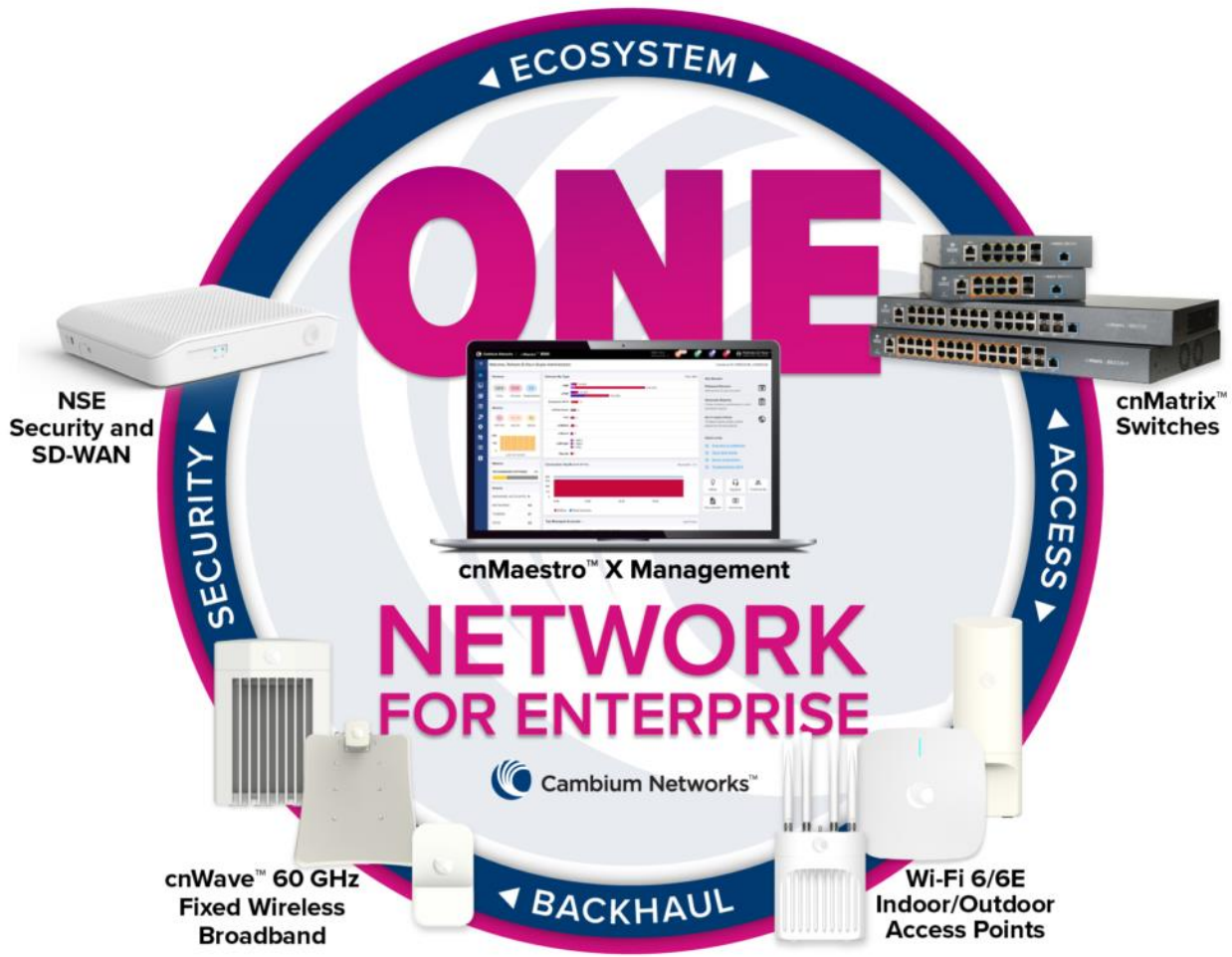
Reduce Errors

Network Assurance

AIOps

Right Sized Economics

ONE Network to deliver Hassle Free Wi-Fi



ONE Network

- Wi-Fi, switching, security and backhaul in a single managed solution

Superior Performance

- Application optimized
- High density, long range

Simple to Operate

- Cloud managed
- Integrated automation

Economical

- Less equipment
- Lower TCO

20TH ANNIVERSARY | Wireless Global Congress

Bruno Cendón Martin

Senior Director of Engineering, Meta.

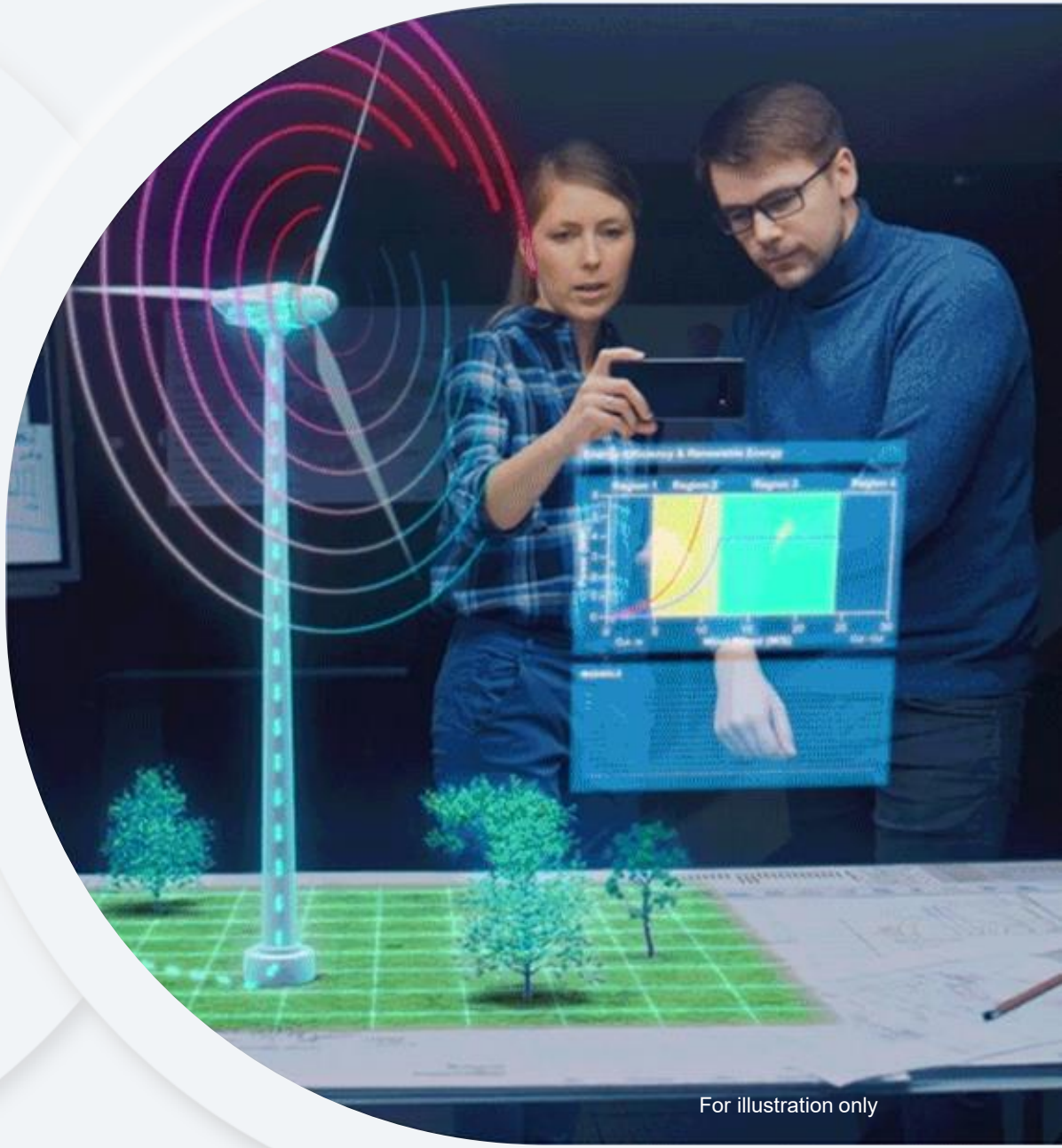
Malcolm Smith

CTO Advisor, Wireless, Cisco.

Extended Reality in the Congested Enterprise

#WGCAMERICAS | #wifirevolution | #lovewifi

WGC Americas 2023



For illustration only

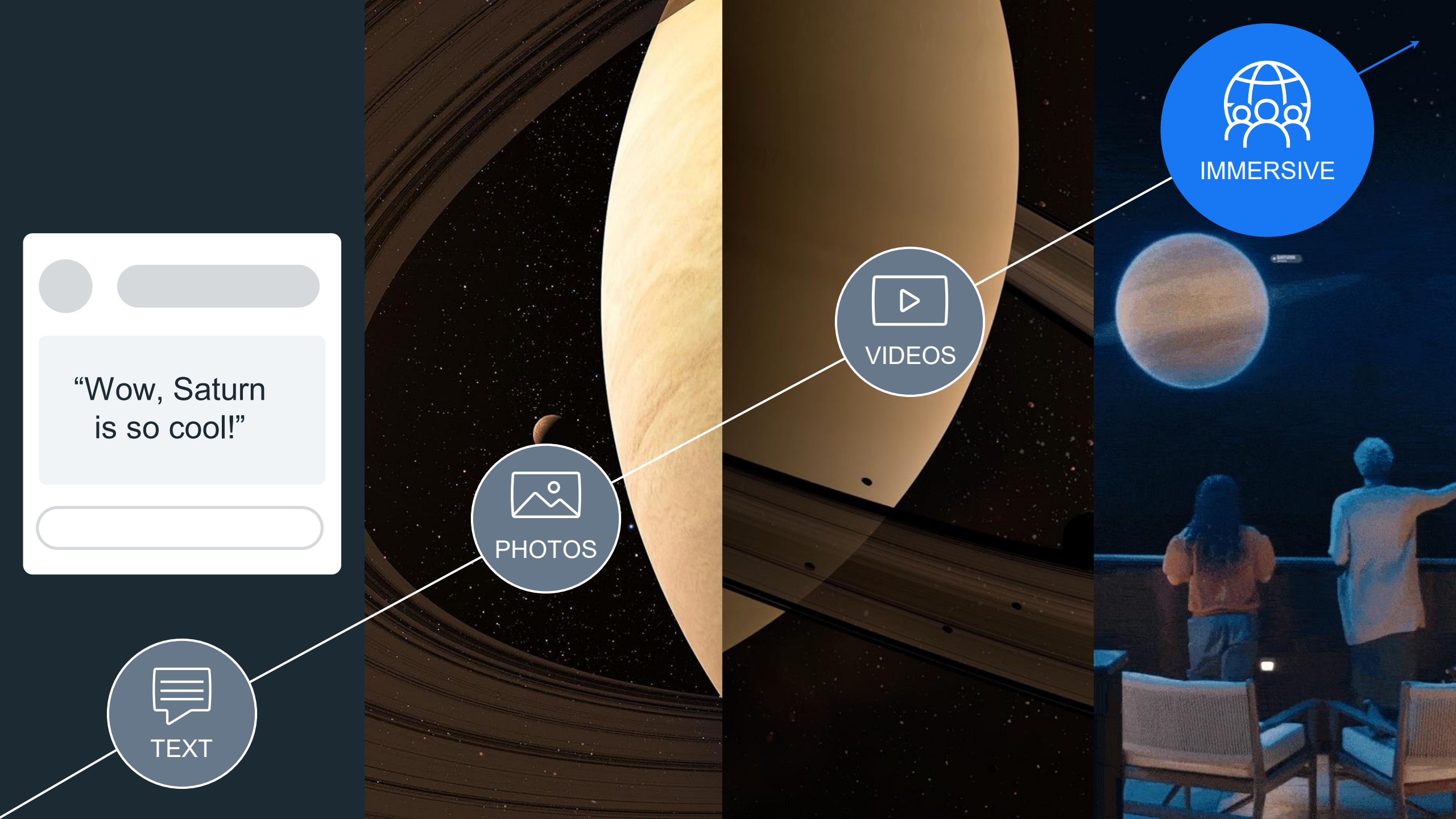
REALITY LABS

Meta

BRUNO CENDON MARTIN

SR. DIRECTOR, WIRELESS TECHNOLOGIES REALITY LABS
AT META

Meta


“Wow, Saturn is so cool!”
TEXT
PHOTOS
VIDEOS
IMMERSIVE

What does Wi-Fi have to do with this?

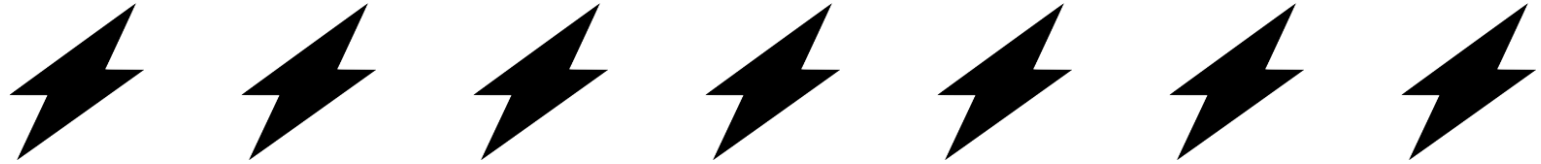
Better Connectivity is key to build Connections Across worlds

XR Wireless Challenges

LATENCY

AR and VR devices need to operate at speeds acceptable for the human brain

POWER



The extreme integration required, brings unseen thermal limitations in consumer devices

QoS/QoE

Without proper bidirectional classification of traffic, all transmissions will be best effort

…but we have challenges with our Wi-Fi infra!

Households are seeing a non-stop increase in # of devices!

Average of ~20 devices per household

They see increasing number of contending networks!

Average of ~30 contending networks per household

And we are very data hungry!

~650 GB/month!

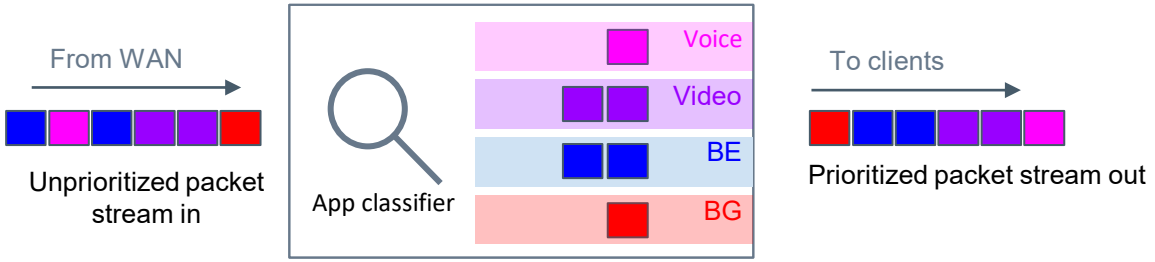
We suffer from lower and lower QoS & hence, QoE!

- Higher latency ⟹ Congestion & interference
- Lower throughput for each user & application ⟹ Worse experience and power
- Lower QoE/QoS for real time and immersive applications ⟹ Bread and butter of AR/VR!

How to solve the problem for XR

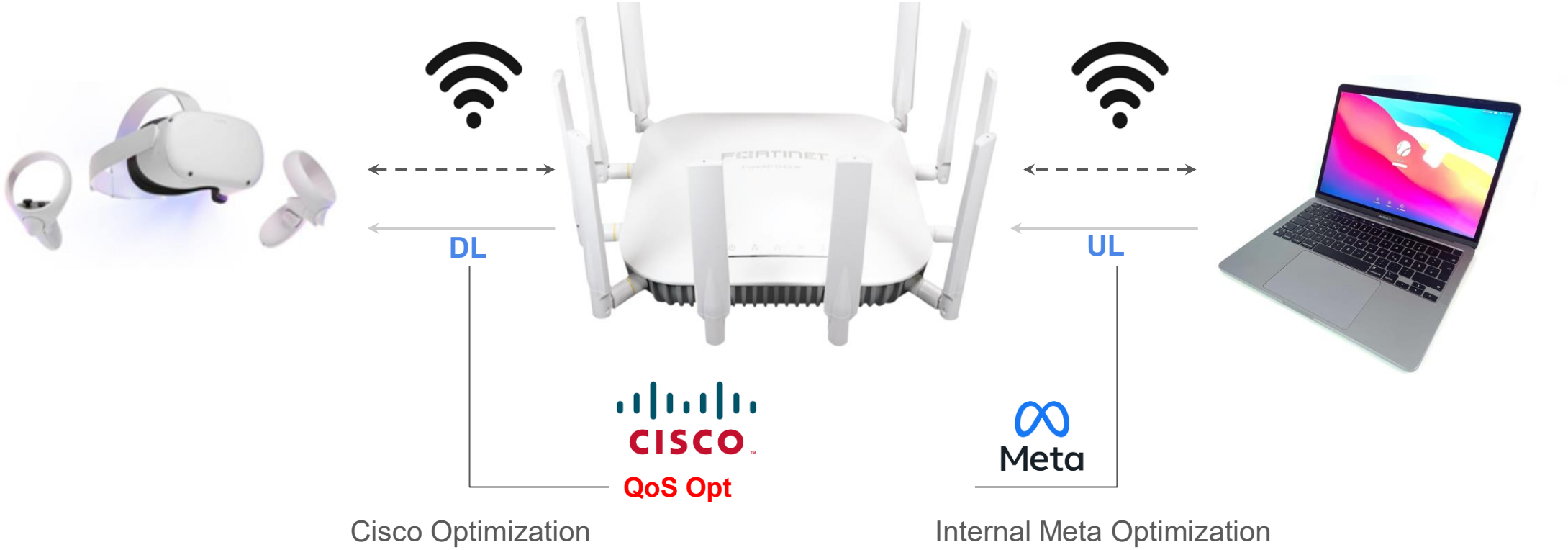
- We need proper bidirectional QoS classification. Best effort **isn’t enough**!
- Wi-Fi WMM QoS has been part of Wi-Fi Cert since 802.11n/Wi-Fi 4
- But most downstream traffic is either not classified at all, or not classified accurately
- Differentiated QoS brings improved latency, hence better QoE

Current feature focus



- **Downlink QoS policy** - In AP
  - Setting up desired downlink traffic QoS policy based on device reported traffic classifiers (IP address, port, domain name, etc) for all low latency applications
- **Uplink QoS tagging** - In VR device and AP
  - UL traffic prioritization (DSCP marking) by device. AP to maintain & honor the packet prioritization

Test setup - Optimizing Remote Desktop



What we still need to do

- **XR Aware Smart Scheduling -** In VR device and AP
  - Smart UL scheduling. The device provides App level info (application frame rate, burst size, etc) to the AP aiding in efficient UL resource assignment - QoS Management R3
- **Power Saving Optimization**
  - Custom and fine tune wake and sleep duty cycle (bursty traffic) using features such as TWT for VR / AR applications
- **SAWF / Other Features**
  - Band Steering Optimization/Mobility Management , Link & Network Monitoring/Notification
- **Wi-Fi 7 Optimization**

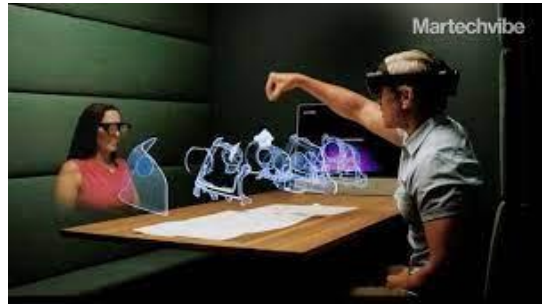
The Enterprise Metaverse

AR “HUD” / assistant

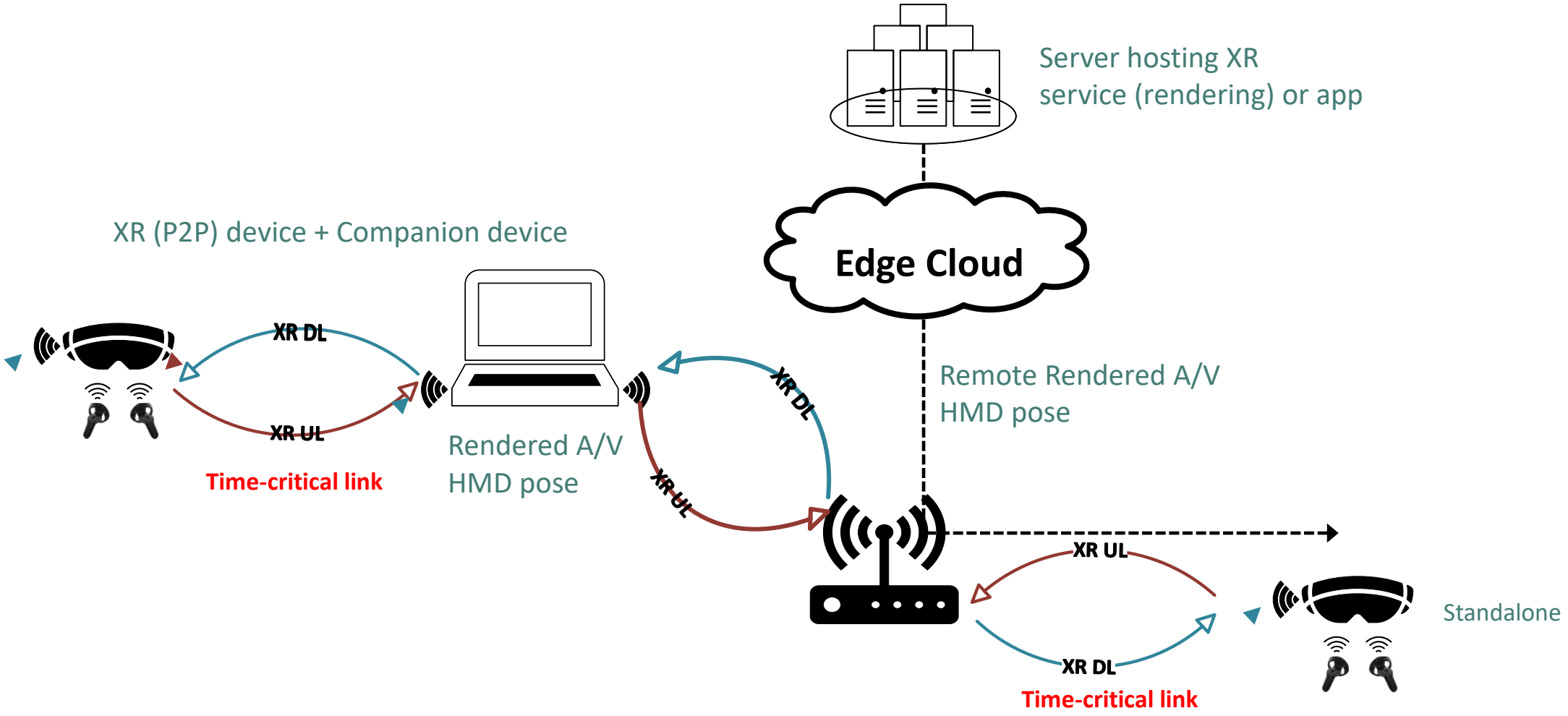
AR operations / productivity

Immersive VR training, operations, and collaboration

Immersive MR collaboration/training



Common Enterprise XR architectures



XR Remote rendering requires management of ALL Wi-Fi links

AR/VR/XR is real

…and business relevant

Traffic Stream	KPI Description	Spec
Pose/IMU/CTRL button presses (UL) (HMD → PC)	Throughput	~2Mbps
	Latency	P90 < 2ms P99.9 < 6ms
Mic Audio (UL) (HMD → PC)	Throughput	< 1Mbps
	Latency	P90 < 10ms P99.9 < 15ms
Haptics (DL) (PC → HMD)	Latency	P90 < 10ms P99.9 < 15ms
Audio (DL) (PC → HMD)	Throughput	~2Mbps
	Latency	P90 < 10ms P99.9 < 15ms
Video (DL)	Throughput	100-200 Mbps
	Latency	P75 < 5ms P99.9 < 50ms

Target

Remote rendering improves the user experience and lower battery consumption

Education: Educators predict a bright future for immersive VET (Virtual Environment Technology)

Inherently a high-density client and **congested** environment

Low latency and high-capacity KEY for XR success

ZERO LATENCY

Region : Global • Industry: Entertainment

cisco

Creating immersive, free roam virtual reality experiences for all players with Wi-Fi 6E

"We have confidence in the reliability of Cisco Wireless, without its 6E capabilities, we wouldn't be able to provide truly rich, immersive VR experiences for our customers."

Scott Vandonkelaar, Co-founder & Chief Technology Officer

Challenges

Tech heavy backpacks for players were taking away from immersive VR experiences.

Needed reliable, secure connection to continue and expand operations.

Solutions

Cisco Wireless Wi-Fi 6E access points

Cisco Meraki switches

Cisco Meraki security & SD-WAN

Cisco Meraki dashboard

Cisco Meraki Mobile Device Management

Results

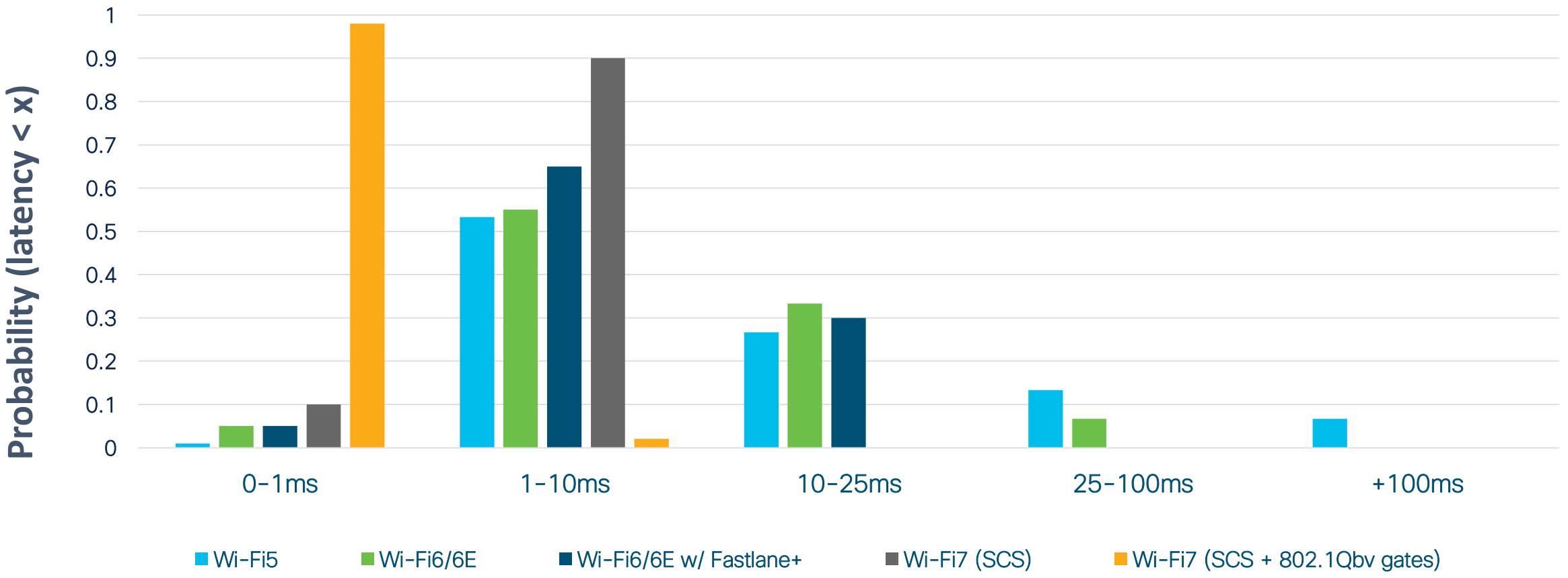
Wi-Fi 6E enables **real-time remote rendering.**

Eliminates the need for on-player compute.

Reduces latency and eliminates interference with wider channels and improved throughput.

Delivers a better gaming experience.

E-QOS: Wi-Fi 7 SCS enables determinism for XR/IOT



Latency performance bounded in congested scenarios.

Source: https://mentor.ieee.org/802.11/dcn/22/11-22-0634-00-00be-802-11be-enhancements-for-tsn-time-aware-scheduling-and-network-management-conside

Wi-Fi 6E / 7 has KEY support for XR

- Broad, cell–wide support of mGig **speed** (up to 160/320MHz channels)
- Efficient interference (e.g., **DFS, AFC**) avoidance (puncturing)
- SLA/SCS-based **KPI** delivery (**bounded** latency, jitter) in uplink & downlink
- Link aggregation & **reliability** (multi-link-operation/MLO)
- Optimum channel **utilization** (multi resource unit/MRU flexibility)

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Howard Buzick

Business Development, TIP OpenWiFi.

Open WiFi Open for Business

#WGCAMERICAS | #wifirevolution | #lovewifi

TELECOM INFRA PROJECT

OpenWiFi

Open WiFi
Open for Business

NON-PROFIT FOUNDATION

FOUNDED 2016

1,000+ members

COLLABORATIVE ECO-SYSTEM APPROACH

Founding Members

Vodafone

Intel

Meta

Telefónica

Deutsche Telekom

British Telecom

FOCUSED ON REAL WORLD SOLUTIONS

TIP OpenWiFi

300

Participating Organizations

Diverse Open Source Membership

SERVICE PROVIDERS

TECHNOLOGY PARTNERS

SYSTEM INTEGRATORS

CONNECTIVITY STAKEHOLDERS

Participants

1050

New Participants ’22

350

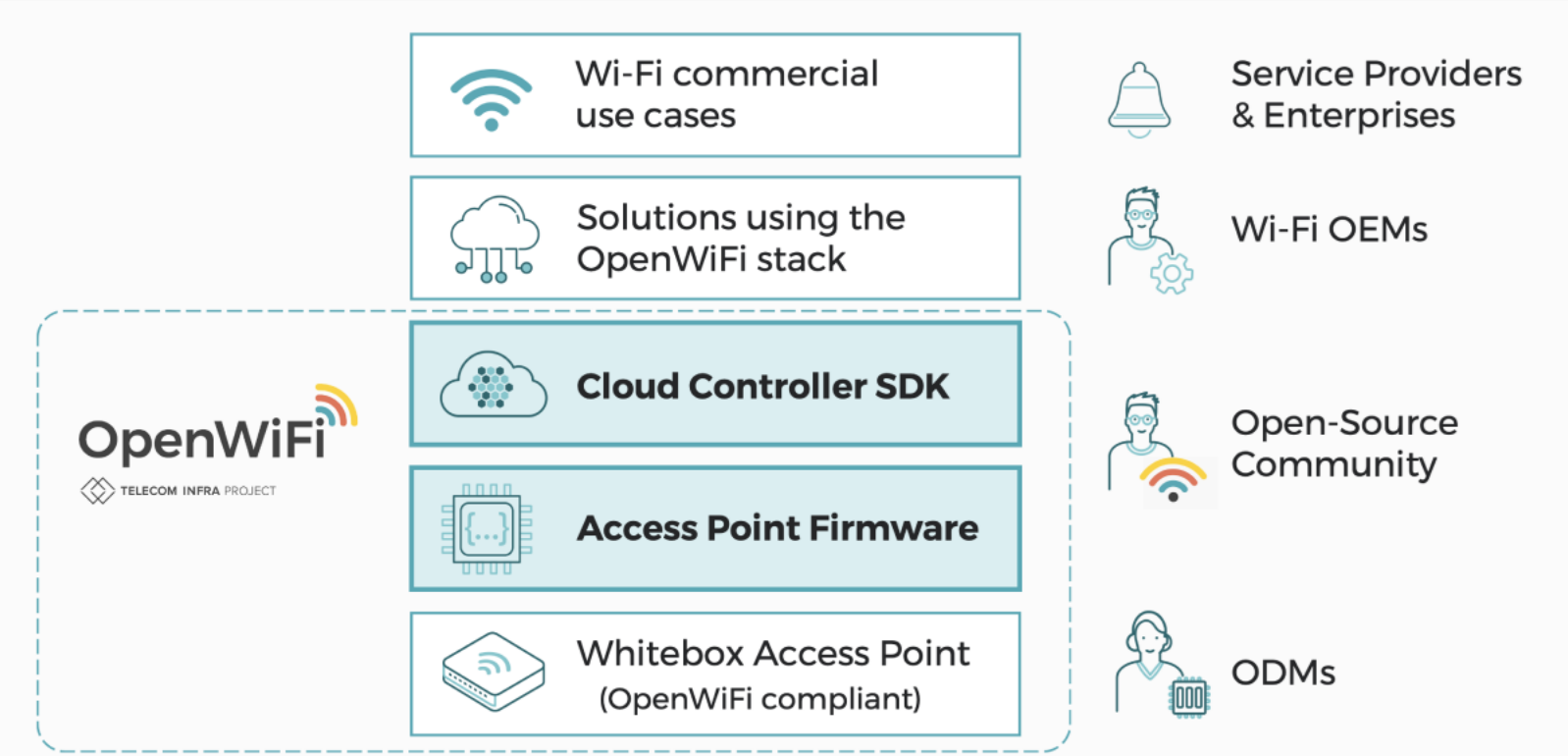
FOCUSED ON OPERATOR DEPLOYMENTS

TIP OpenWiFi

Over 300 Companies in a Growing Ecosystem

TIP OpenWiFi

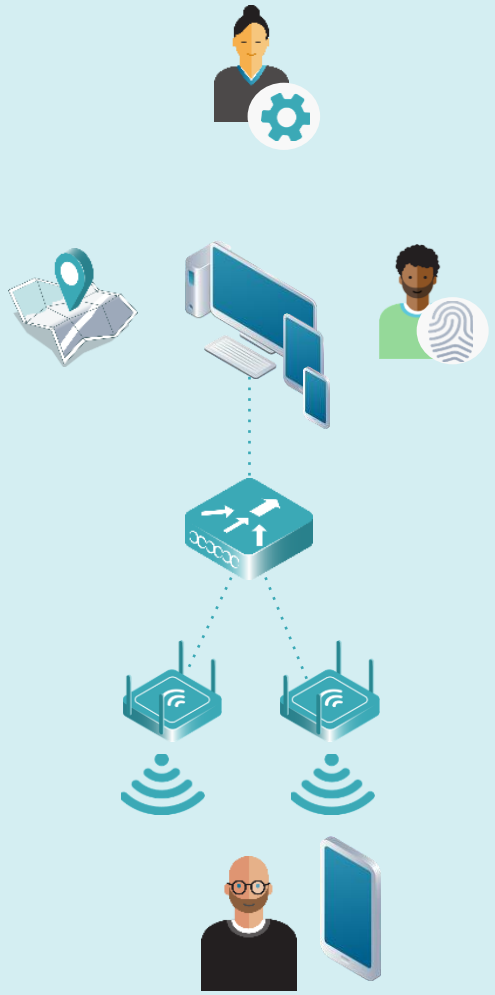
What is TIP OpenWiFi?



OpenWiFi is a community-developed, disaggregated Wi-Fi software system, offered as free open-source software, that includes both a **cloud SDK** and an **Enterprise-grade Service Provider Access Point (AP) firmware**, designed and validated to work seamlessly together.

TIP OpenWiFi

Service Provider Inputs on Lock-In

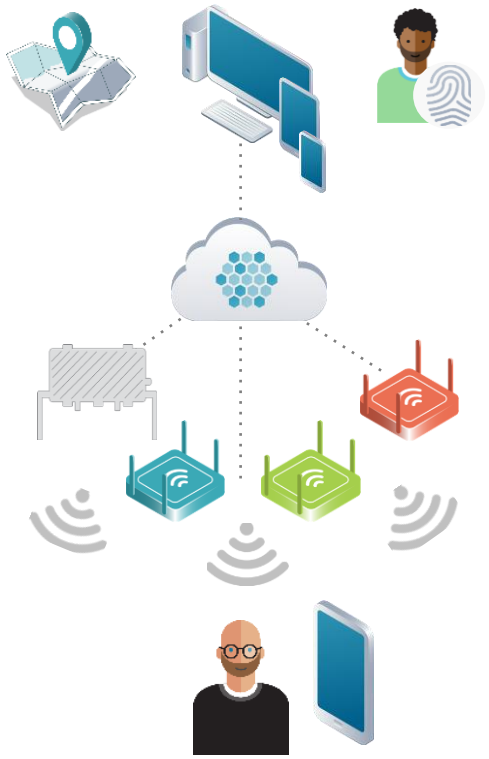


Typical Wi-Fi Vendor lockup

- Proprietary APIs
- Closed implementation
- Proprietary interface
- Vendor HW only
- Standard air interface certified by Wi-Fi Alliance

OpenWiFi

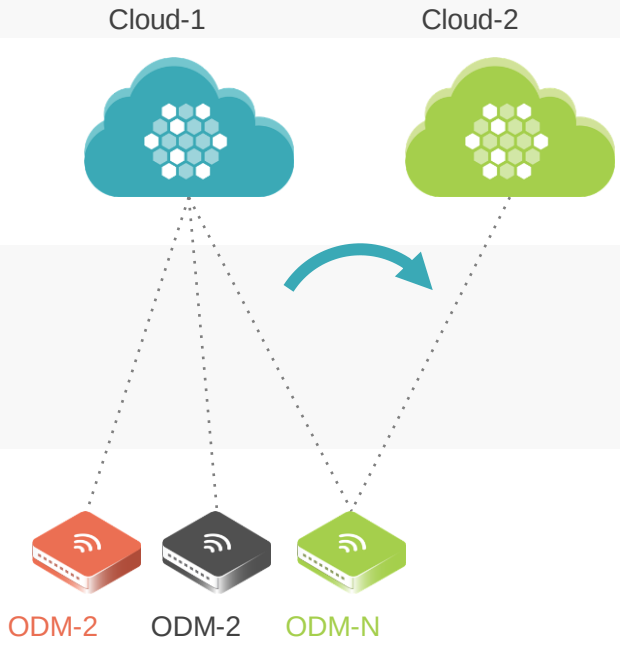
TELECOM INFRA PROJECT



- Industry Seamless Offload
  OpenRoaming – Every Device
- Open APIs
  Integrate once, works cross vendor
- Open-source core, choice in controller
- Contribute, secure, examine
- Interoperable interface
- Choice of HW
- Standard air interface certified by Wi-Fi Alliance

TIP OpenWiFi

Choice of Cloud & Choice of Device



Choice in Cloud:

- Deployed whitebox gear can move between different commercial / private Clouds of Controllers consuming OpenWiFi
- API driven migration, ZTP over public internet
- No truck rolls or HW rip and replace

“Multi-vendor” AP support:

- Different whitebox platforms, from different vendors (ODM’s) mixed in the same deployment
- Same OpenWiFi SW used across whitebox platforms (e.g.: Mesh, RRM, WDS, Advanced Data plane)
- Common data model and telemetry

Diverse Whitebox HW Running on Single SW Codebase

Hardware Evolution

- **Existing** ODM SKU's
- Support re-flash with TIP SW

- **Harmonized** SKUs by TIP
- TIP SW pre-loaded

- **Open-source** Hardware
- 802.11ax + 6Ghz

More than 54 Diverse SKU's

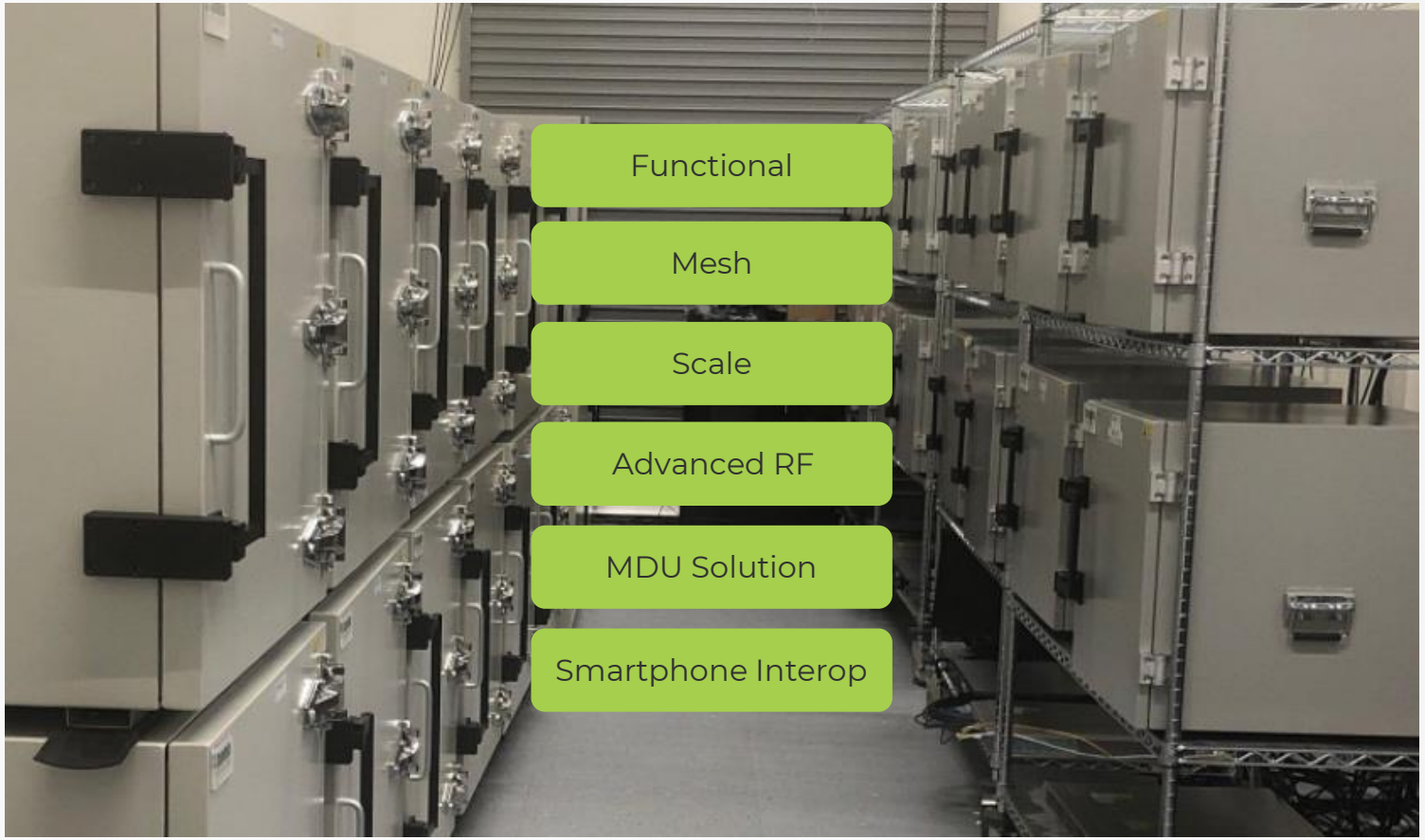
- **Wall plate, Ceiling, Desktop, Pole, Strand**
- **4+4+4 – 2+2+2 Options**

Wi-Fi 7 APs available Q3 2023

TIP OpenWiFi

Nightly Test Lab

California Community Lab



- 24+ wireless traffic generators: 10K's UE over the air, 802.11 features, L7 traffic generation VoIP/Video
- RF chambers, programmable turn tables & attenuators

Scheduled Tests

- Nightly/weekly/Release
- Results published

On-Demand Tests (WIP)

- Nightly/weekly/Release
- Results published

TIP OpenWiFi Industry Awards 2022

- WBA (Wireless Broadband Alliance) Industry Awards
  - Winner: Best Wi-Fi Innovation
  - Finalist: Best Wi-Fi Network Technology
- Mobile Breakthrough Awards
  - Winner: Commercial Broadband Internet Solution of the Year
- Light Reading Leading Lights
  - Finalist: Most Innovative Broadband Access Solution
- Wi-Fi Now Awards
  - Finalist: Best Wi-Fi Innovation
  - Finalist: Best Wi-Fi Service Providers Solution
  - Finalist: Best Wi-Fi Enterprise Solution

Thank You!

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Panel: Delivering the Best Experience

Jack Raynor

Co-Chair Open Converged Wireless Project Group, TIP OpenWifi.

Huw Rees

VP, Product Development, NetExperience.

Dr. Derek Peterson

CTO, Boingo Wireless.

Jon Buck

Sr. Director, Technical Operations & Architecture, Mobilitie

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Bruno Tomás

CTO, Wireless Broadband Alliance

Open Conference Day 1 Close

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WI-FI INNOVATION:
FOR OPERATORS, ENTERPRISES, PLACES AND THINGS

DRINKS & NETWORKING RECEPTION
POOL DECK

6.30 PM PST

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