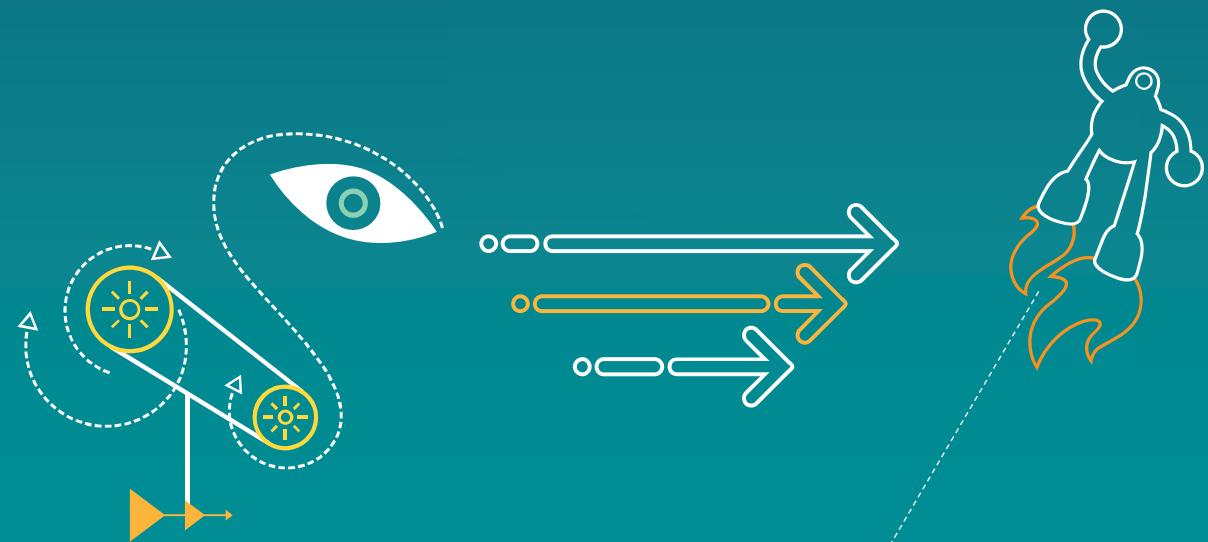


The Wi-Fi Evolution

An integral part of the wireless landscape

QUALCOMM®



Wi-Fi: An integral part of the wireless landscape

Part of the solutions to
“1000x mobile data
challenge”



Wi-Fi supported in
all smart devices

At the center of
connected home



The universal technology
for smart connected homes

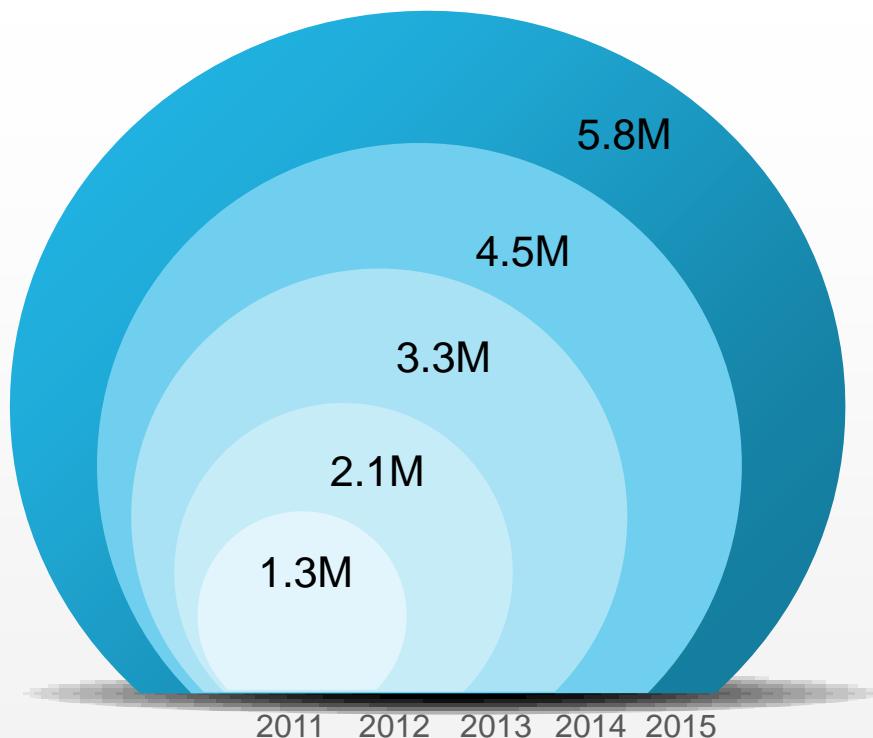
Opening new frontiers for
wireless connectivity



Leveraging ubiquity of indoor Wi-Fi for
many new applications and services

Wi-Fi is becoming ubiquitous

Growing Global Reach



Number of public hotspots worldwide.

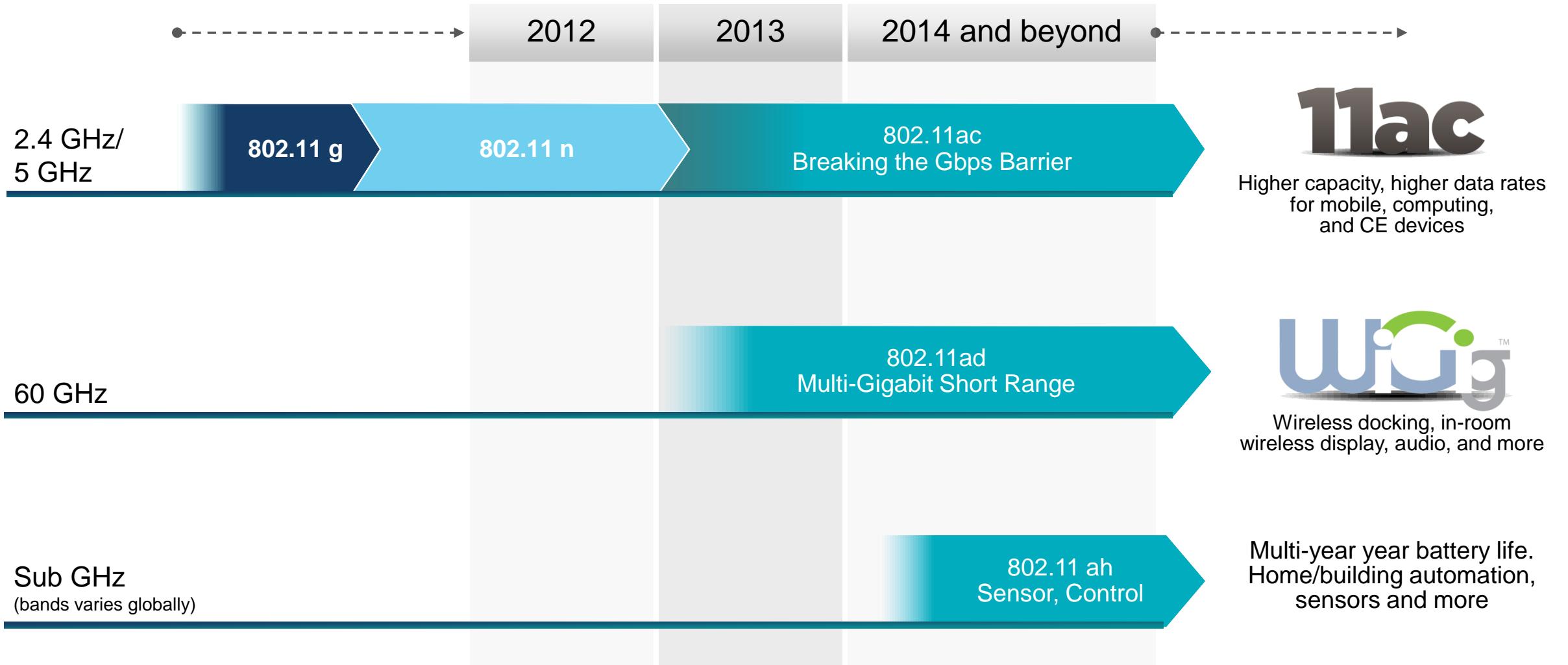
Source: Wireless Broadband Alliance (WBA) and Informa Telecoms & Media.

Expanding Device Support

Wi-Fi Enabled Devices Shipped	2012 MU	2015 MU
Phones/Accessories	685	1,459
Tablets, E-Readers, Media Players, etc	199	360
Laptops, Desktops, Peripherals, etc.	392	717
Connected Home	107	287
Others	39	338
TOTAL	1,422	3,161

Source: ABI Research forecast, December 2012. "Connected Home" category includes Flat Panel TVs, Set-top Boxes, Gaming Consoles, Gaming Console Controllers, DVD/Blu-ray Players/Recorders, OEM Remote Controls, 3D Glasses, Digital Photo Frames. "Others" include Automotive, Health, Fitness and Medical, Smart meters, automation, industrial

A strong Wi-Fi evolution path



Qualcomm VIVE™: Enabling end-to-end 11ac ecosystem



Driving 11ac in migration in mobile through pin compatible solutions

Extending industry leading Wi-Fi performance¹

~6x lower power consumption (v/s our own 11n)

¹AnandTech -The HTC One X for AT&T Review by Brian Klug on 5/1/2012; "Unsurprisingly the One X posts the highest WLAN throughput I've seen from a smartphone to date." ; This device uses Qualcomm's 802.11n solution

End-to-end portfolio maximizing 11ac benefits

Mobile

- 1-stream 11ac
- Integrated BT 4.0 & FM
- 433 Mbps capacity
- Dual-band 5/2.4GHz



Smartphones & Tablets

Computing

- 1-, 2- and 3-stream 11ac
- Integrated Bluetooth
- 433, 866 Mbps & 1.3 Gbps
- Dual-band for all solutions



Tablets, Notebooks, AIOs

Consumer electronics

- 2-, 3-stream 11ac
- Integrated Bluetooth
- 866 Mbps & 1.3 Gbps
- Dual-band, dual-concurrent



Handsets, Gaming, eReaders,
DTV, STBs, PNDs

Networking

- 2- and 3-stream 11ac
- 866 Mbps & 1.3 Gbps
- Integrated processor & switch
- Dual-band for all solutions



Switches, Routers,
Gateways, PLC, Femto

11ac



3G/4G/Wi-Fi
Smallcells/Hetnet



Seamless
3G/4G/Wi-Fi Interworking

Wi-Fi: Part of the solutions to the
“1000x Mobile Data Challenge”

Mobile data traffic growth—industry preparing for 1000x

Preparing for
1000X
Data traffic growth

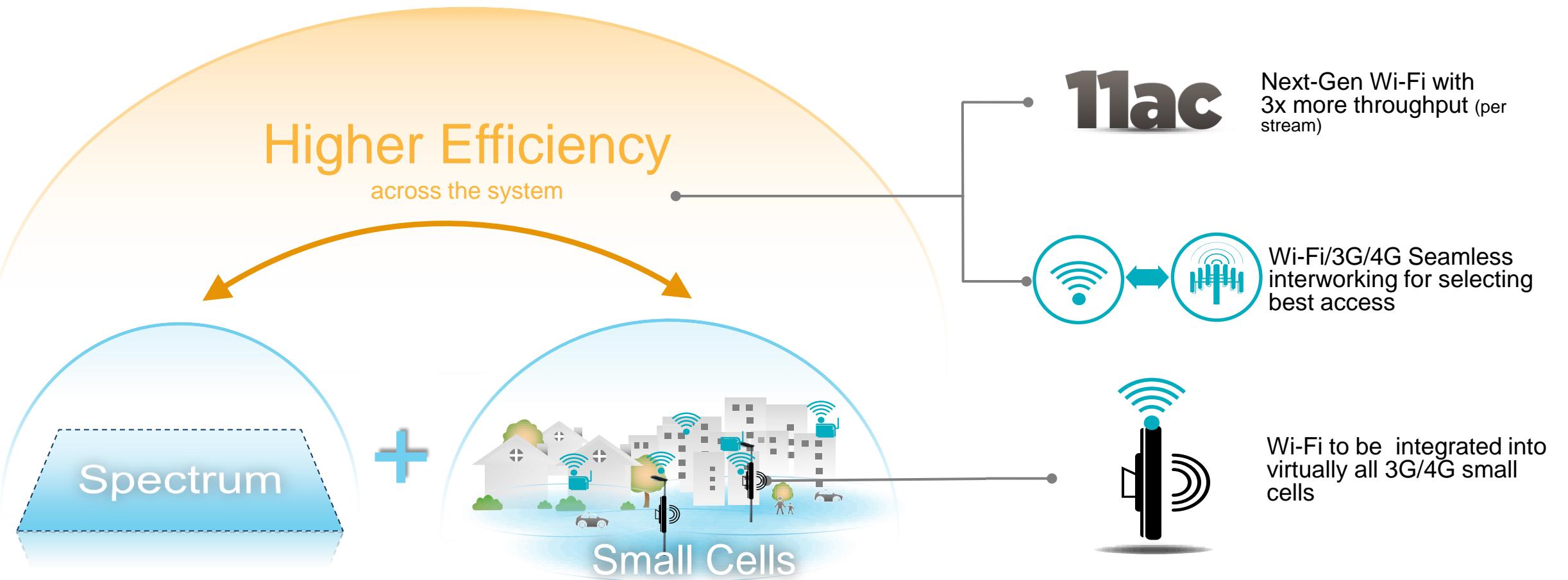
Global data
traffic growth

~2X

From 2010- 2011*



Multiple efforts needed to address 1000x – Wi-Fi is an integral part of the solutions



802.11ac: Up to 3x increase in throughput per stream

3x more in the future with MU-MIMO

3x throughput now*

3x more aggregate throughput
with MU-MIMO**

Higher data rates at all ranges

Lower latency

11ac

Multi User MIMO

Wider Bandwidth

Dynamic Bandwidth Management



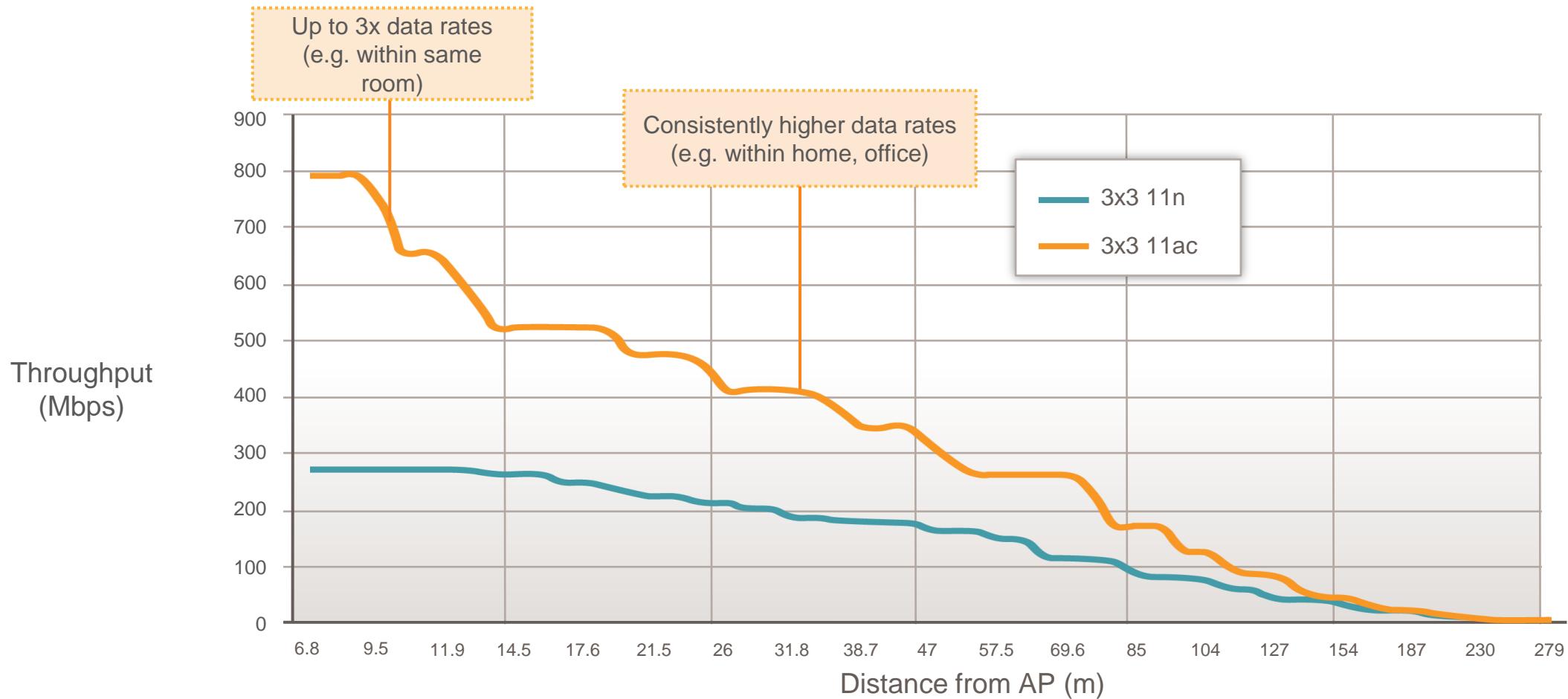
- Up to 80 or 160 MHz per channel
- Less crowded 5GHz band
- Higher order modulation (256 QAM)

- Improved interference detection and avoidance
- Bandwidth allocation based on interference



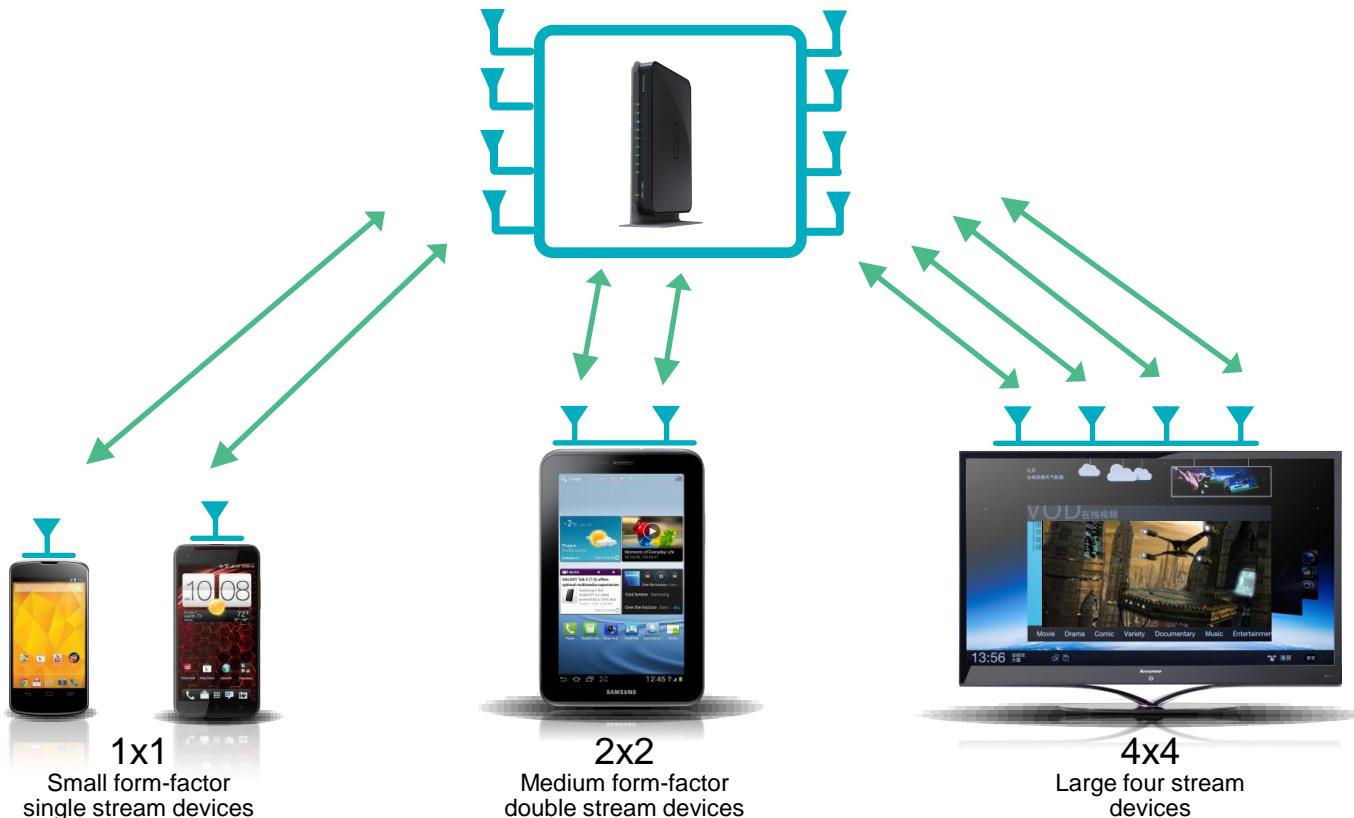
* As compared to 802.11.n; **When compared to 3-stream 11ac SU-MIMO, considering only single stream mobile devices; 802.11ac standard supports up to 8-stream MIMO

802.11ac: Higher data rates at all ranges

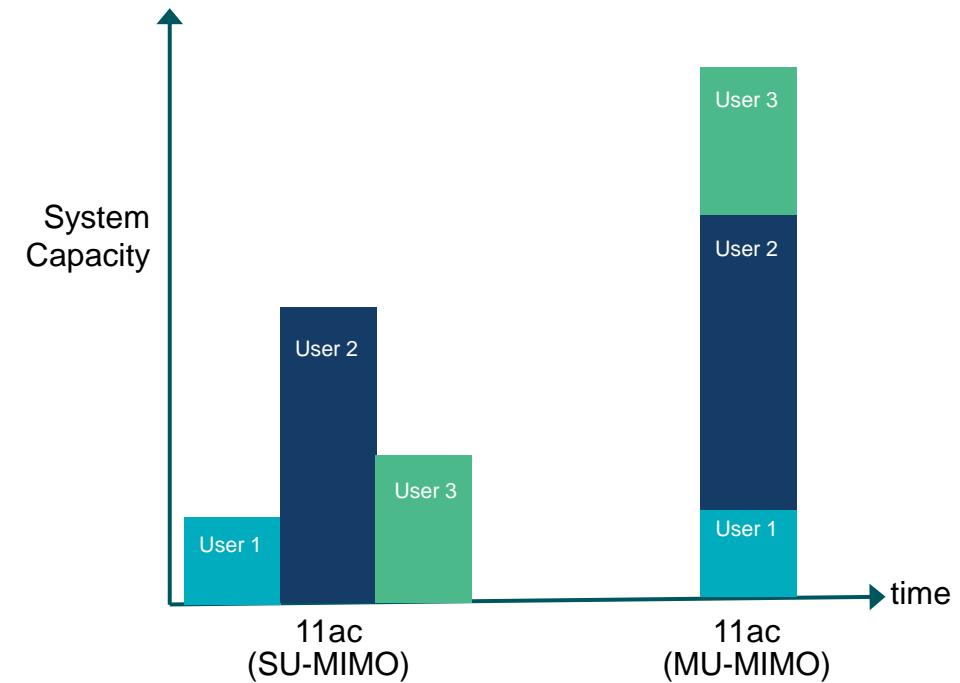


MU-MIMO: Higher capacity with mix of devices

Simultaneously serving multiple devices by reusing resources

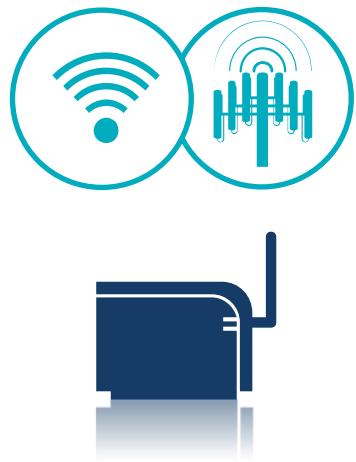


Simultaneously serves up to 4 devices

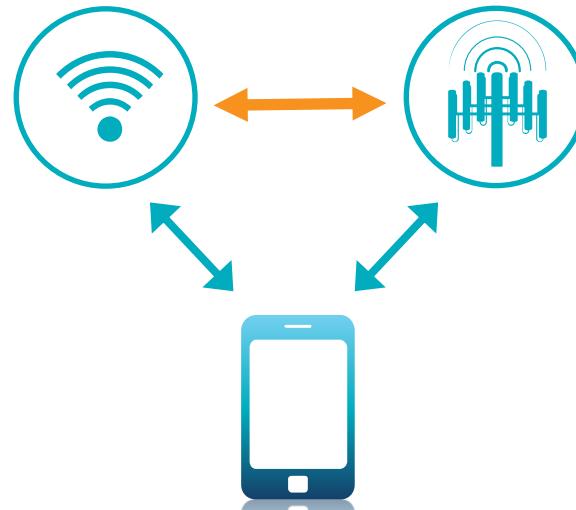


Up to 3x more aggregate throughput*

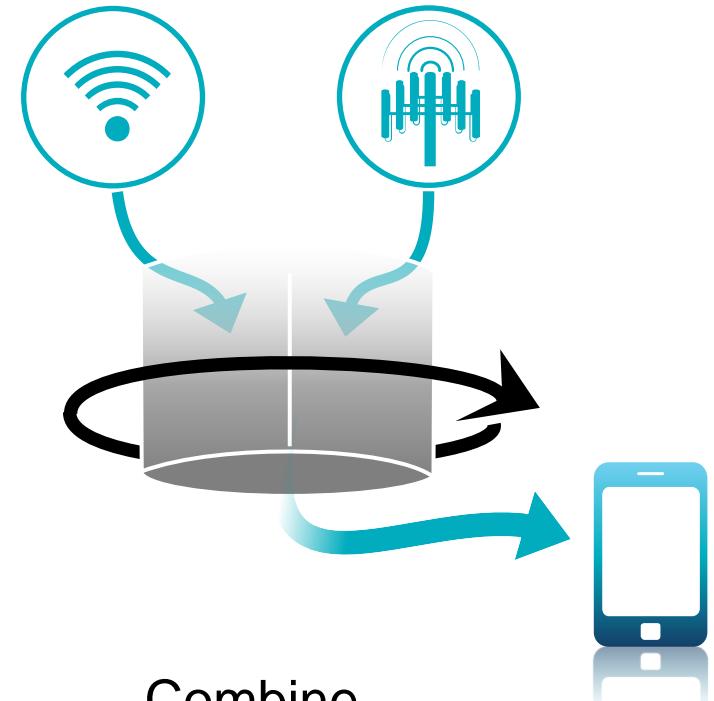
Tighter Wi-Fi—3G/4G interworking



Convergence of
Cellular and Wi-Fi
Infrastructure

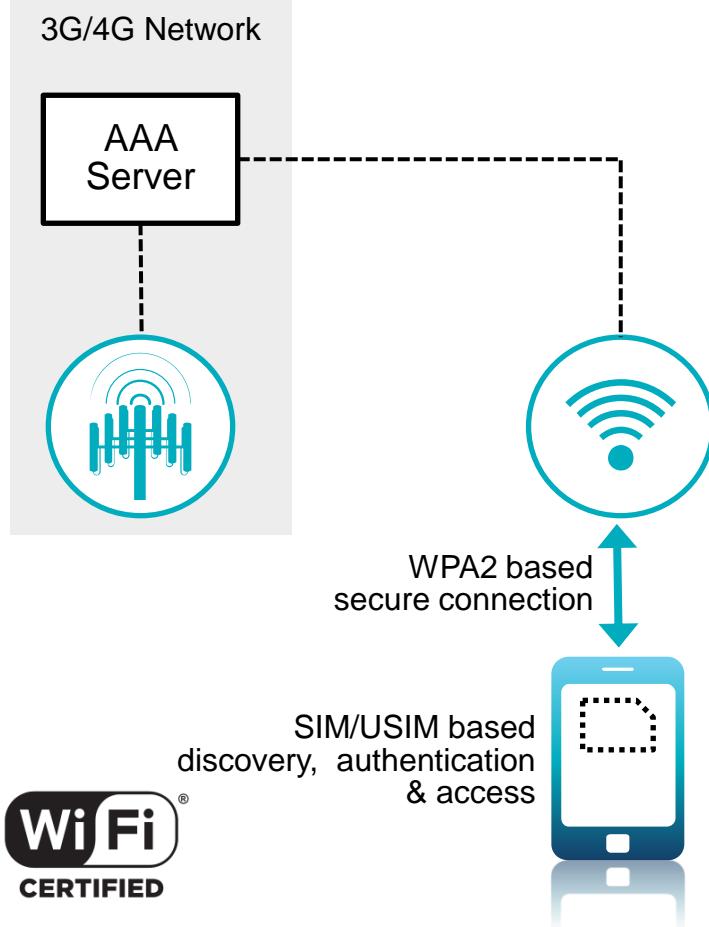


Seamless Access
and Connectivity



Combine
Wi-Fi and 3G/4G

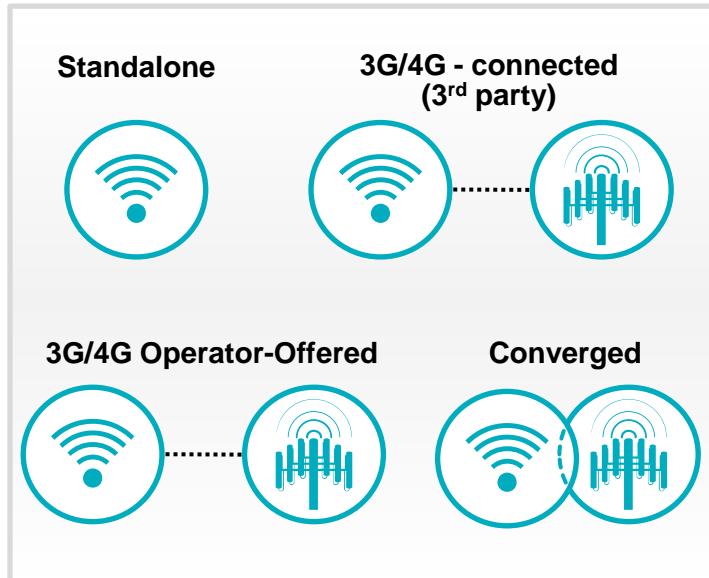
Passpoint™ – Seamless 3G/4G/Wi-Fi roaming



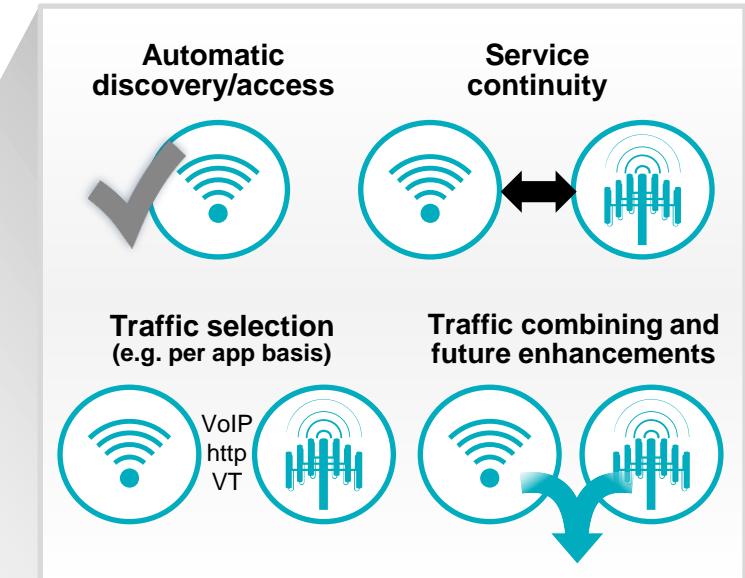
- Automatic discovery and access
 - No user intervention
 - Single set of credential for all hotspots
 - 3G/4G/ SIM/USIM based authentication
- Proven WPA2- Enterprise security
- Roaming among Wi-Fi and between 3G/4G Wi-Fi networks
- Deployments in 2013

Multi-dimensional Wi-Fi—3G/4G interworking landscape

Many Wi-Fi deployment models



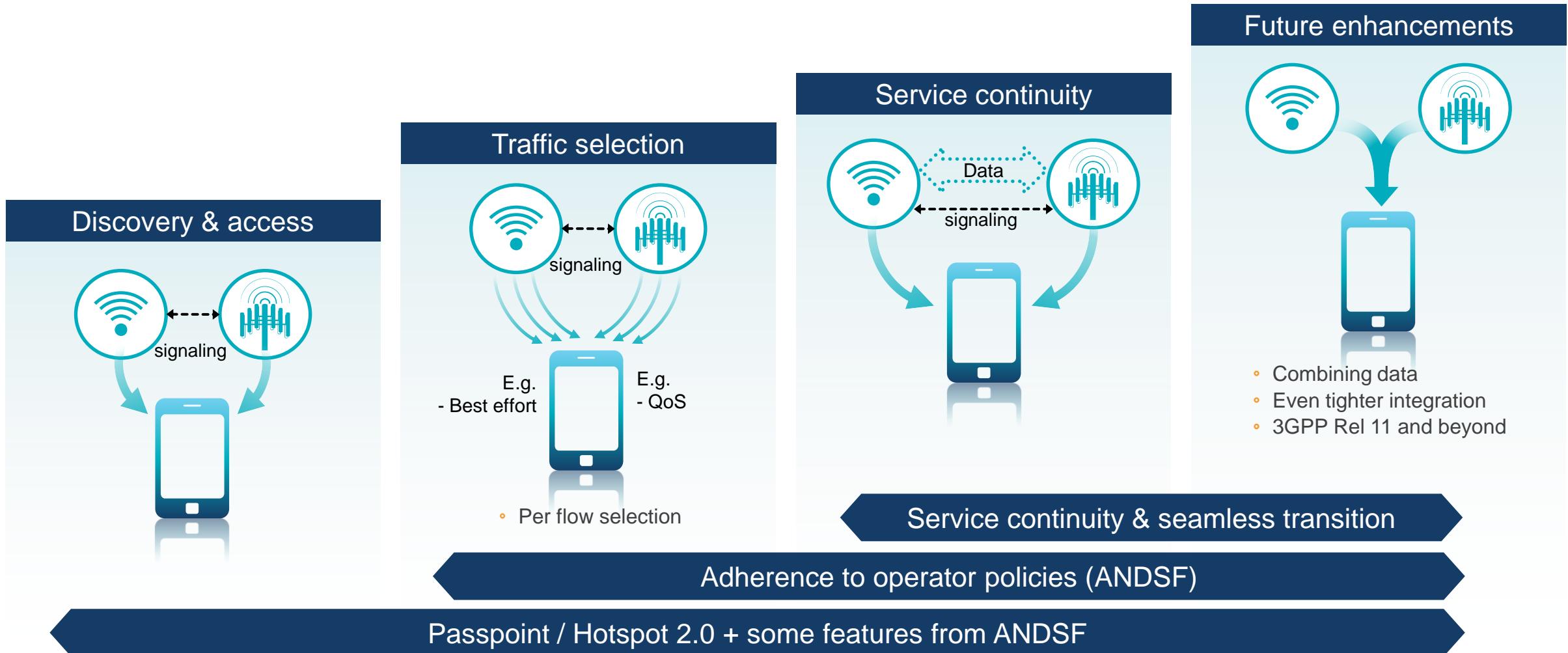
Different levels of interworking



Device in unique position to select best access/es



Seamless Wi-Fi—3G/4G interworking is evolving

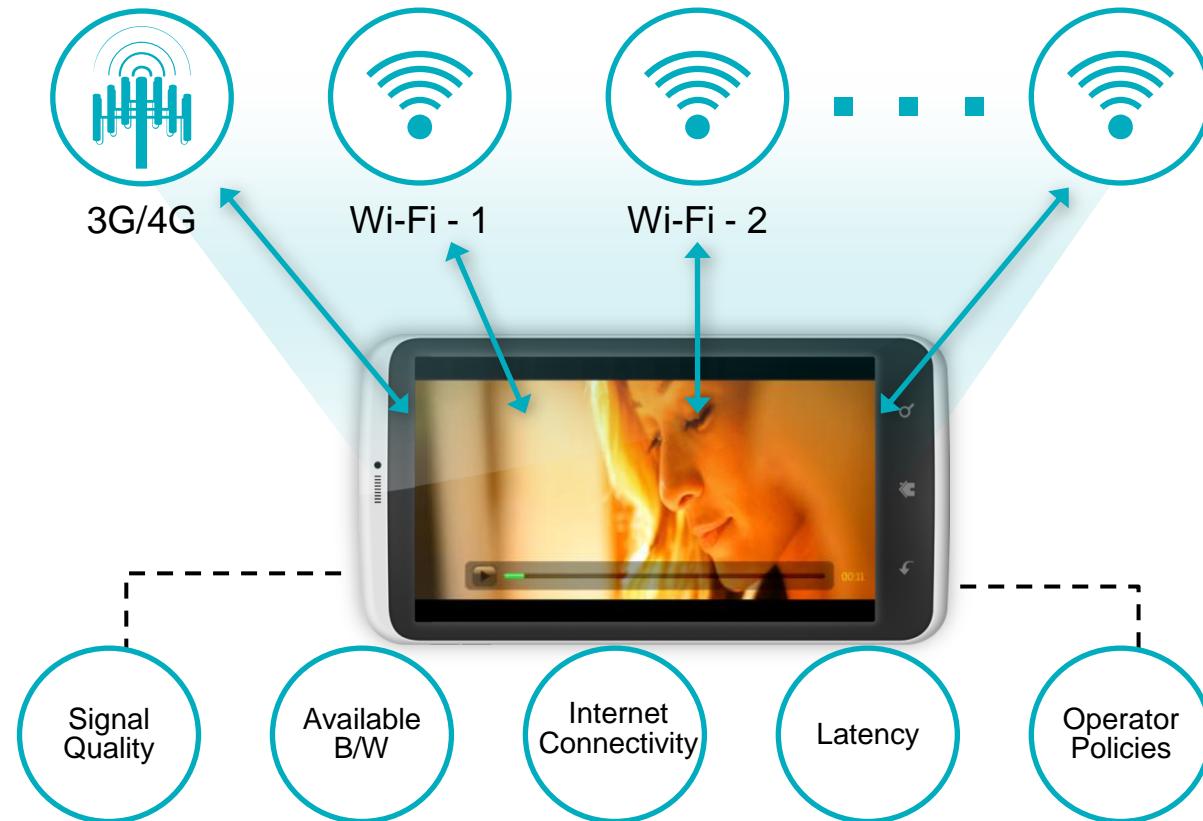


Notes: 1) ANDSF - Access Network Discovery and Selection Function defined in 3GPP :

2) The evolution shown here represents the trend in commercialization. 3GPP supports Service continuity in Rel 8 and Traffic selection in Rel. 10

Qualcomm connectivity engine (CnE) – Selecting best access

Based on end-to-end link performance



Standards compliant
(Passpoint/Hotspot2.0, 3GPP (ANDSF), IWAN)

Smart algorithms
(In addition to standards)

Part of Qualcomm chipset solutions

Qualcomm 3G/4G – Wi-Fi converged small cell Solutions



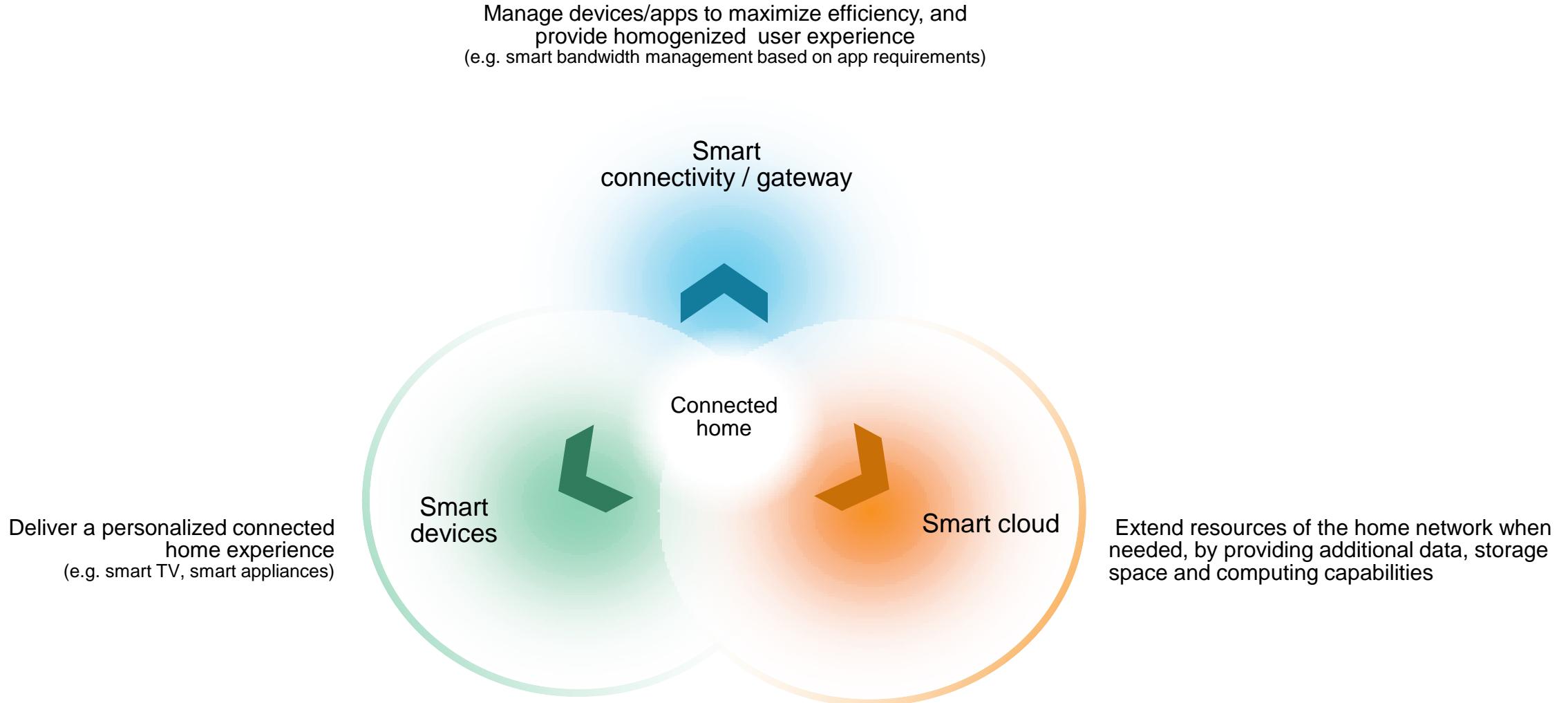
- Highly integrated SoC
 - 3G/4G, Wi-Fi (11n & 11ac)
- Complete reference designs
 - Modular, Flexible RF band support
 - RF Coexistence considerations fully addressed
- Intelligent end-to-end connection management
 - Hotspot 2.0/Passpoint support
 - Access selection based on information from both Wi-Fi and 3G/4G (QoS, resource constraints, loading, link quality etc)
 - Works even better with Qualcomm's connectivity engine (CnE)

	Qualcomm's Converged Small Cell	Standard Converged Small Cell
Device with CnE	Most optimized selection with end-to-end information	Intelligent selection based only on device info
Device w/o CnE	Intelligent selection based only on AP info	N/A

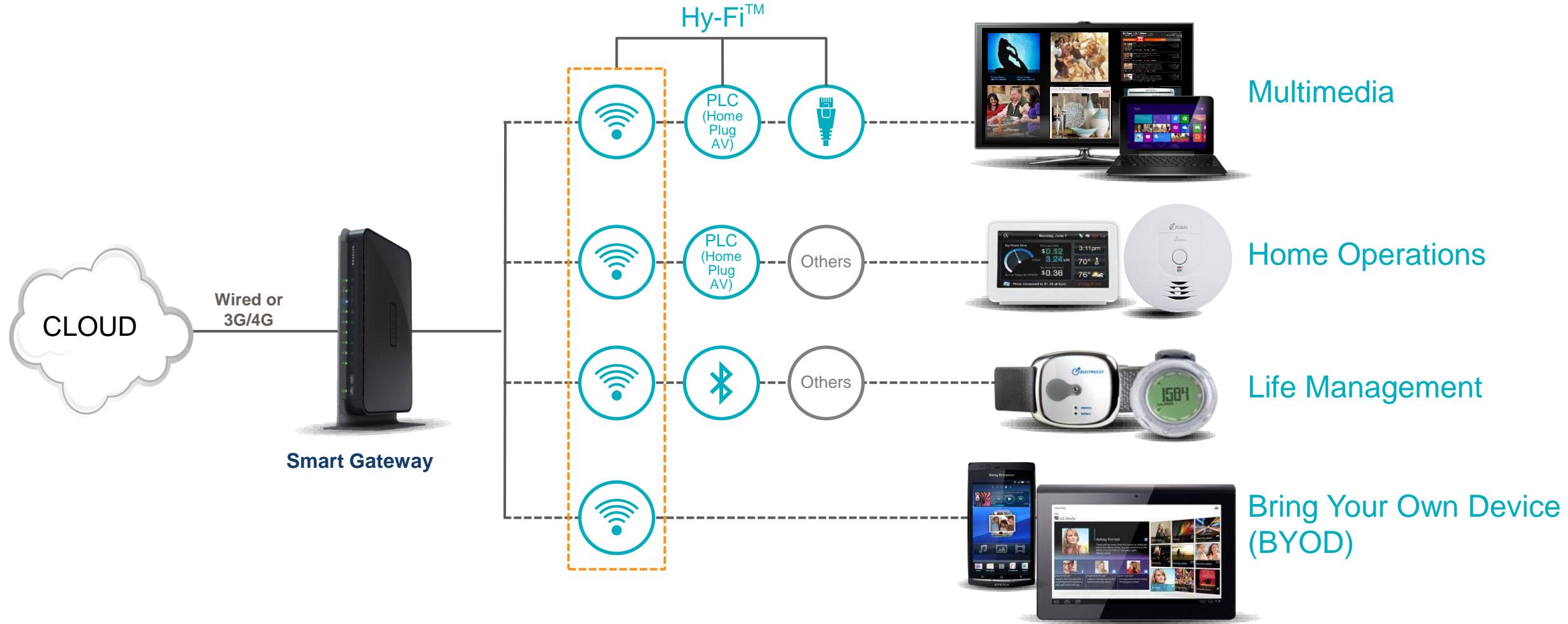


Wi-Fi: At the center of
“Smart Connected Homes”

Connected home vision: Multiple smarts working together



Wi-Fi: Universal technology in “Connected Homes”

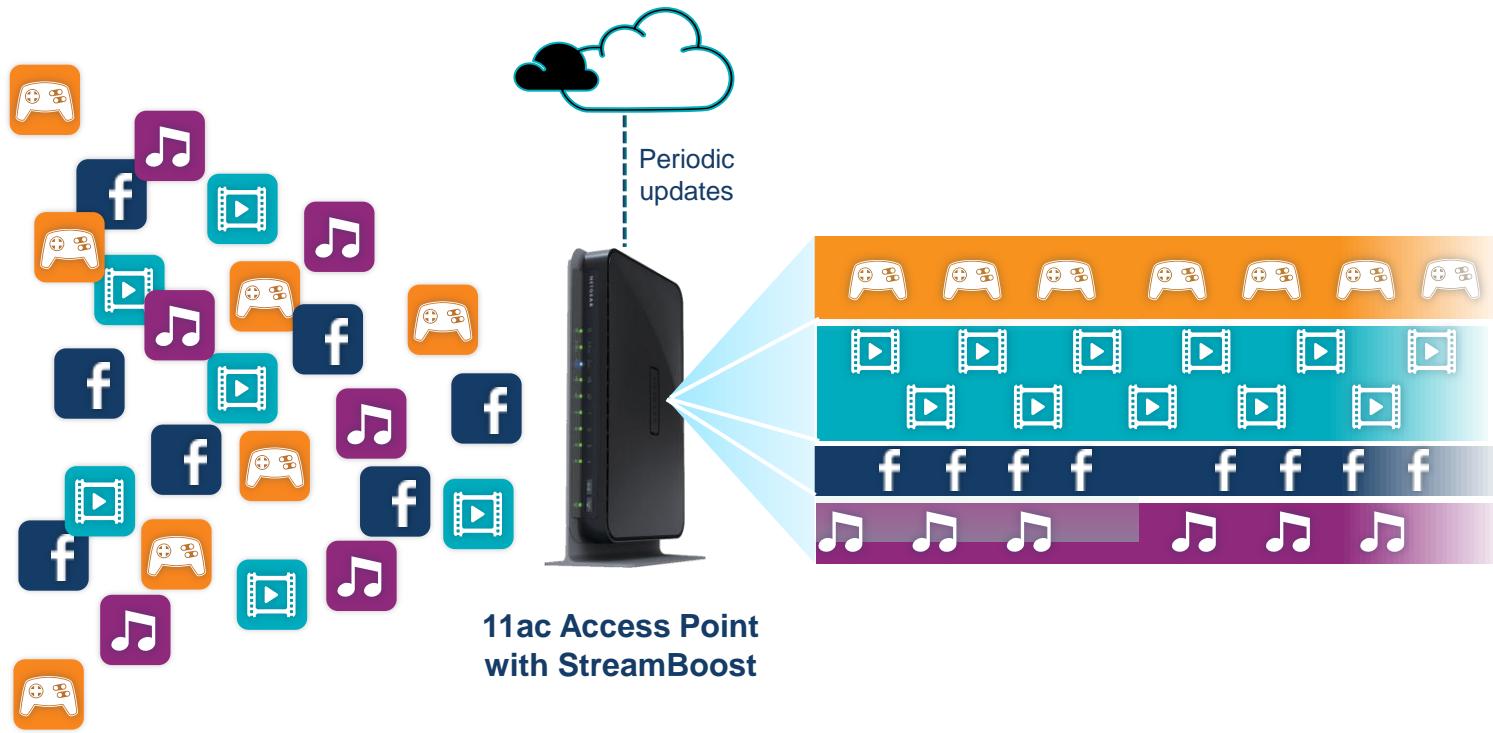


PLC – Power Line Communications

Home Plug AV – Standard for Audio/Video over PLC

StreamBoost™ : Taking 11ac to the next level

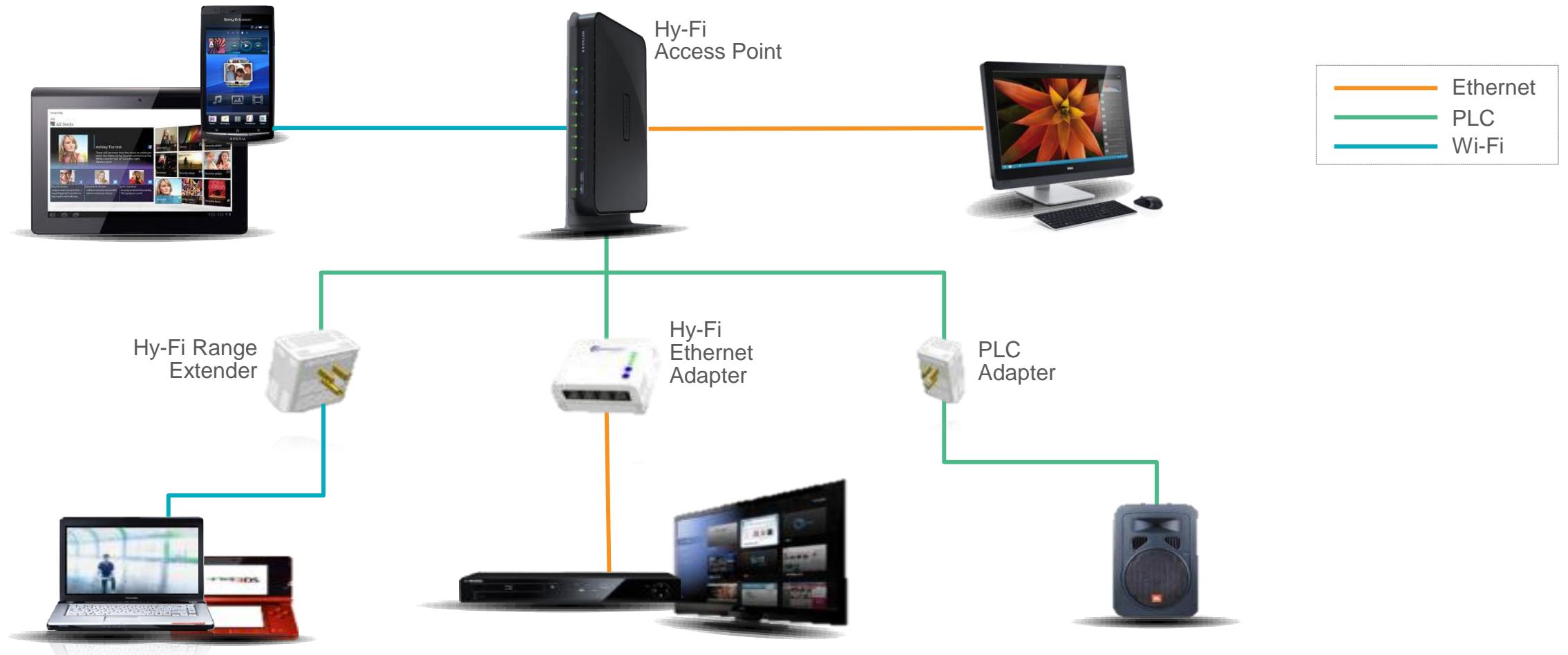
Intelligent traffic management for best possible performance



- Allocates appropriate bandwidth to each app/device for the best experience
- Makes the most of the finite available bandwidth
- Cloud-based updates continue to optimize network performance
- Supported in *all* ViVE networking chipsets

Qualcomm Hy-Fi™: Combining Wi-Fi, PLC and Ethernet

Mobility and flexibility of Wi-Fi with reliability and range of PLC





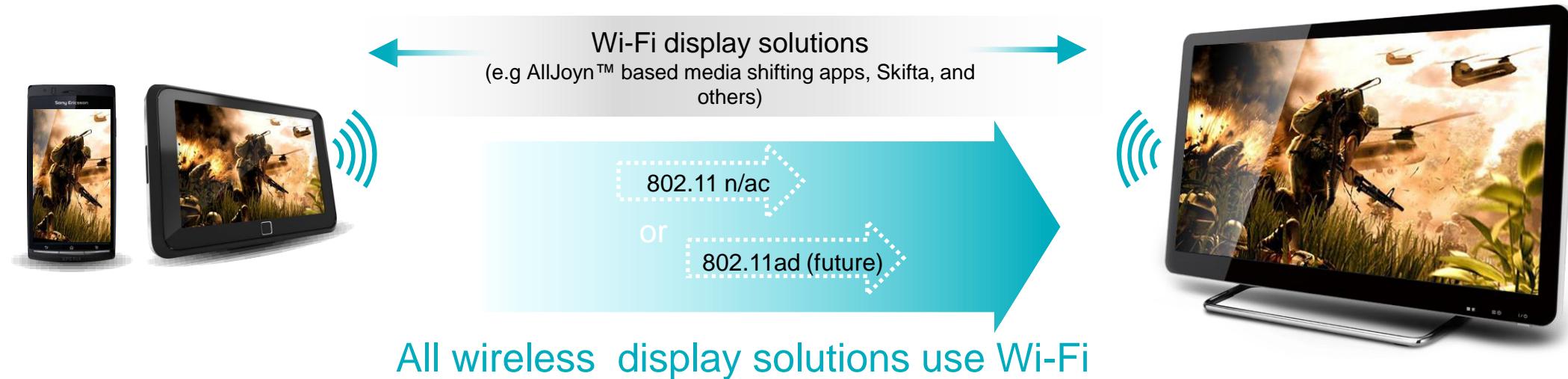
Wireless Display



Indoor Location

Wi-Fi: Opening new frontiers

Wi-Fi : Foundation for all wireless display technologies



Miracast™
Global industry standard
for Wireless Display

- Mandatorily uses Wi-Fi Direct
- Captures contents of source display and renders on the target
 - Mirrors the entire display, not just “transferring” media

WiGig: Short-distance multi-gigabit connectivity

Leveraging bandwidth-rich 60 GHz spectrum with 802.11ad



Instantaneous Docking/Synching
(Peer-to-peer)

Internet Access
(complementing 11ac)

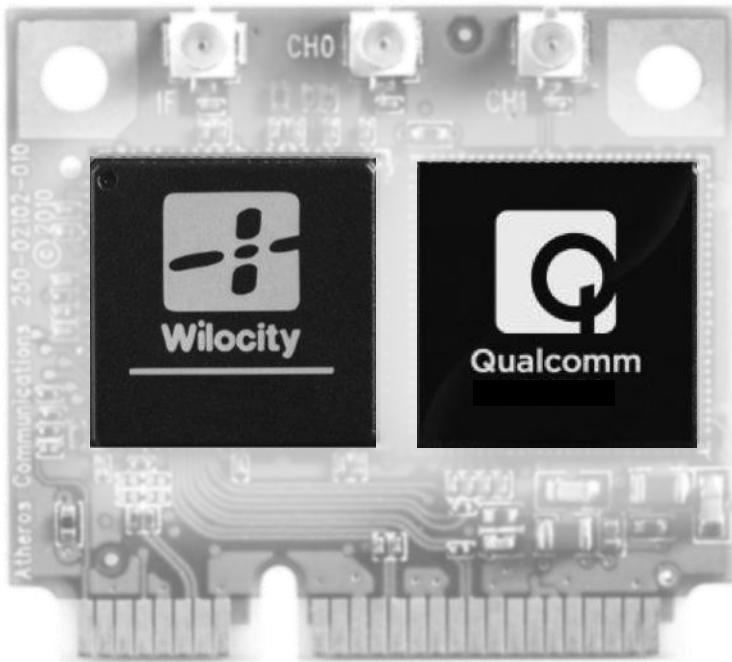
High-Performance Wireless
Display/Audio
(Uncompressed transfer, Peer-to-peer)

Globally Harmonized Band
(Up to 9 GHz available in most countries)

Complements 11ac
(for short distance/same-room communication)

Strong Industry Support
(Major players from PC, Mobile & CE segments)

Industry's first tri-band WiGig solution



Tri-band - 2.4, 5 and 60 GHz

10x more in-room performance*

Seamless transition with 11n & 11ac

Commercial now (PC/Docking Station)

Dell Latitude 6430u, world's first WiGig device – built on Qualcomm Tri-band solution

Combining Qualcomm's VIVE™ 11ac solutions with Wilocity's 802.11ad

Precise indoor positioning – Using Wi-Fi, sensors and more

Wi-Fi network based determination

- Signal strength and delay measurements
- Accuracy 5-7 mts



Device-based determination

- Signal strength and delay measurements
- Sensor augmentation
- Accuracy 3-5 mts

End-to-end solution provides highest accuracy and reliability

Qualcomm IZat™ – Precise positioning everywhere

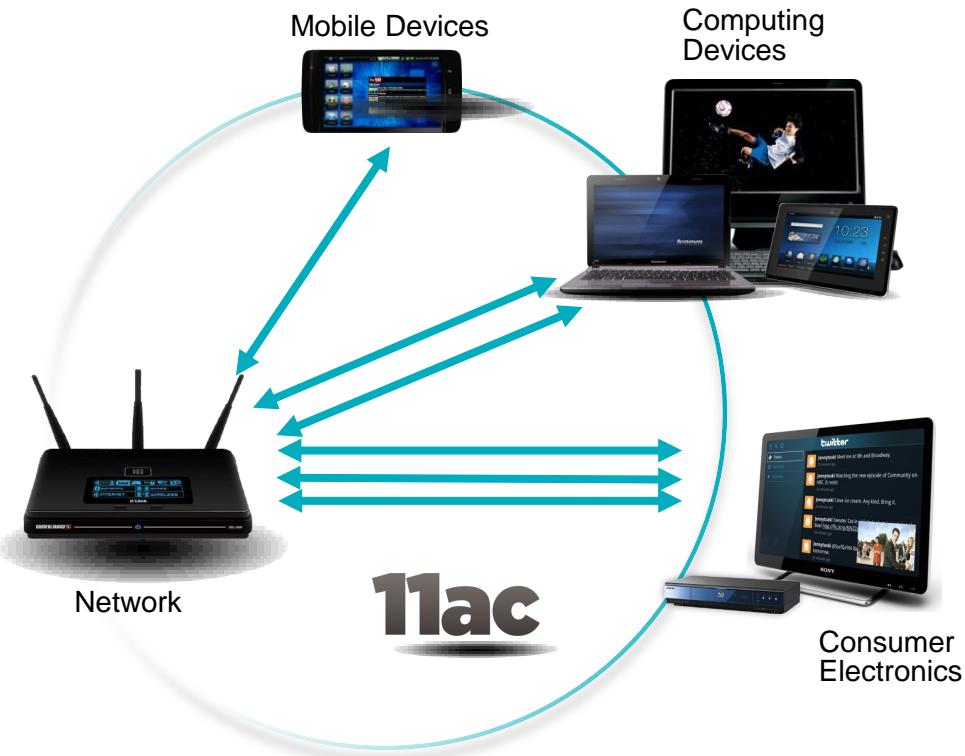
Comprehensive end-to-end solutions



Integrated into all MSM, MDM and APQ platforms
(and discrete solutions)

Qualcomm: Wi-Fi evolution leadership

Enabling robust end-to-end 11ac Ecosystem



Comprehensive connected-home solutions



Trendsetting in-door positioning & WiGig offerings

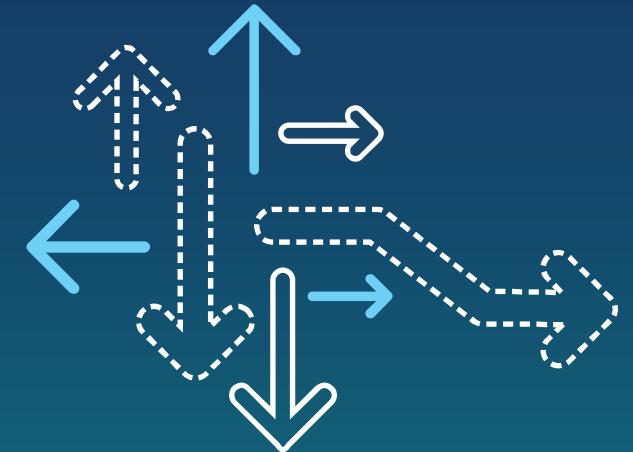


Industry leading solutions with end-to-end excellence

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