

Are Wi-Fi and 4G LTE on a collision course?



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Without Wi-Fi, data services and content wouldn't be consumed at the levels they are today. Wi-Fi technology has moved from insecure, point access to full-featured, 'carrier-grade' network capabilities approaching those of traditional mobile operators. As interoperability between Wi-Fi and LTE gains traction, the notion of mobility is being redefined, and the lines between mobile operators and cable providers are blurring. The result is a need for participants across the mobile ecosystem to rethink business strategies and operating models.

The emergence of carrier-grade Wi-Fi offers the industry an opportunity to differentiate this Wi-Fi service.

The way Wi-Fi technology has grown over the last two decades is nothing short of phenomenal. What began as a simple way to wirelessly network isolated clusters of home or business infrastructure within a limited area has become an essential component of wireless communications.

From the days of ‘warchalking’,¹ when users identified open Wi-Fi access points (a.k.a. hotspots), to today’s active advertising of Wi-Fi availability, consumers have grown to expect a Wi-Fi signal nearly everywhere they go. They expect not only ubiquitous but, frequently, also free Wi-Fi access. Once, considered a threat to network security, enterprises often shunned the technology. But the needs of workforce mobility, cloud computing and virtual desktop applications have made high-performance, secure Wi-Fi networks indispensable.

Mobile devices have evolved in a similar manner. From cellular network, voice-only devices, they have become multi-mode smartphones that support high-definition streaming video, Voice over IP, Internet browsing and interactive gaming. The arrival of Wi-Fi capability in these devices a little over a decade ago² heralded the age of explosive growth in data consumption – one where Wi-Fi would *complement* the macro cellular network for connectivity and throughput.

Today, two trends in Wi-Fi technology are setting a direct collision course with cellular technologies such as LTE. The first is the advent of ‘carrier-

grade’ Wi-Fi. What has been until today ‘best-effort’ Wi-Fi now has the attributes of cellular technology, such as security, transparent registration, higher availability and improved quality of service. The second is the development of interoperability. Cellular and Wi-Fi are now capable of handing over call and data sessions seamlessly as well as authenticating and automatically billing customers.

The evolution of Wi-Fi technology has implications — strategic and operational — across the industry, for both mobile and cable operators. Strategically, cable operators are using Wi-Fi as a way to enter the mobile space. Cablevision’s January 2015 announcement of Freewheel,³ a mobile-phone service based on Wi-Fi, is one example of a cable operator’s challenge to mobile operators. Similarly, Comcast and Liberty Global formed a global Wi-Fi roaming agreement⁴ that’s akin to roaming agreements between mobile operators.

Such agreements likely will take a bite out of mobile operators’ roaming revenue streams. Mobile operators, though, are beginning to think about Wi-Fi as more than just a tool for offloading data traffic. T-Mobile USA’s Wi-Fi calling capability is an example of Wi-Fi going beyond offloading data and extending farther into the full suite of mobility services. And, Sprint offers Wi-Fi calling from overseas locations as a way to lure customers who incur high international roaming charges.⁵

Operationally, the implications of Wi-Fi’s evolution include rethinking

both the commercial and the technical areas. On the commercial side, considerations include products and services offered, pricing plans, the customer experience on Wi-Fi vs. cellular and strategy for supporting consumers across multiple networks. On the technical side, elements include coordinating the building of the Wi-Fi and cellular network, managing and operating the networks and developing an overall technology road map.

Spectrum strategy is another area with myriad implications. Evaluating the need for licensed spectrum is influenced by the increasingly strong capabilities of Wi-Fi because of how much spectrum an operator will buy as opposed to using techniques for offloading onto ‘free’ spectrum. Furthering the debate is the potential use of unlicensed Wi-Fi spectrum for LTE service, sometimes called LTE-U or Licence Assisted Access (LAA).⁶ The debate is pitting the Wi-Fi standards bodies against the cellular standards bodies.

Wi-Fi continues to pose one challenge to all those that deploy, manage and rely on it: how to make money on it. Other than pay-per-use models in captive hospitality and transportation settings, the willingness to pay for best-effort Wi-Fi has been low because, perceiving its quality and reliability to be low, consumers expect the service to be available for free. The emergence of carrier-grade Wi-Fi offers the industry an opportunity to differentiate this Wi-Fi service from its predecessor and claim value for the improvements it brings.

In many respects, the relationship between Wi-Fi and cellular has been symbiotic.

Consuming mobile data — the cellular/Wi-Fi synergy

Globally, 46% of the total mobile-data traffic was offloaded onto Wi-Fi networks in 2014. That number is expected to rise to 54% for smartphones and to 70% for tablets by 2019⁷ (see *Figure 1*).

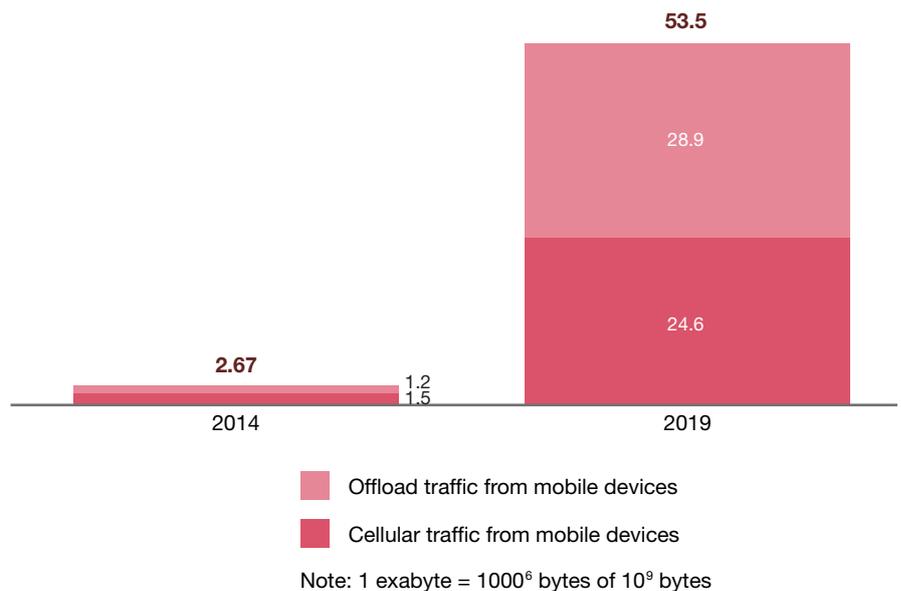
To date, mobile operators have followed a ‘mobile first, Wi-Fi next’ strategy in designing their networks: devices connect predominantly to an operator’s network, with Wi-Fi used to enhance capacity and coverage in congested and indoor locations such as stadiums and shopping malls. Even with such a paradigm currently in place, end users have adopted Wi-Fi as a high-bandwidth, lower-cost (often free) alternative, leading to impressive levels of use.

In many respects, the relationship between Wi-Fi and cellular has been symbiotic. Without Wi-Fi, the mobile industry likely wouldn’t have experienced such spectacular growth in data usage. On the contrary, the industry might have been saddled with enormous capital expenditures to keep up with the demand. Without cellular and in particular 4G LTE, consumers wouldn’t have an industry ecosystem as rich as it is today with the diversity of devices, almost all embedded with Wi-Fi capability. And evidence⁸ shows that where both 4G and Wi-Fi access is good, traffic over networks increases. Use on one stimulates use on the other — creating synergy between the two and a better overall experience for the end user.

With more than half of mobile data consumed over Wi-Fi, it’s

Figure 1: Projected moving of data traffic from cellular to Wi-Fi networks, 2014-2019

Cellular traffic vs. offload traffic, exabytes/month 2014-2019



imperative that mobile operators see the technology as more than just an option for offloading data. They need to include Wi-Fi as part of their network portfolio and consider Wi-Fi in their continuum of service experience.

Mobile operators typically face serious challenges in deep indoor coverage. Their solutions reflect an increased emphasis on heterogeneous networks, including pico, femto and micro cells, as well as distributed antenna systems – all of which have a managed deployment aspect to them. But Wi-Fi technology has become a viable solution to this coverage challenge.

T-Mobile USA⁹ has been demonstrating the benefits of Wi-Fi calling by showcasing customers in the basements of their homes making Wi-Fi calls. To complement their existing services, Verizon and AT&T plan to launch Wi-Fi calling in mid-2015.¹⁰ Vodafone and EE in the UK plan to offer voice services over Wi-Fi as well in the summer of 2015.¹¹

Another example of a strategy not based on offloading was Sprint’s launch of Wi-Fi calling and messaging on two Android phones in 2013.¹² Operators are already recognising that Wi-Fi needs to be an integral part of their access strategy and architecture.



Introducing the global standards bodies

Separate standards bodies define and shape cellular and Wi-Fi technologies. With carrier Wi-Fi, greater collaboration has resulted between the bodies.

3GPP (3rd Generation Partnership Project): Group dedicated to defining standards and specifications for cellular radio-access networks such as GSM, UMTS and LTE.

IEEE (Institute of Electrical and Electronics Engineers): Define specifications related to Wi-Fi access technologies (e.g., 802.11 standard).

WBA (Wireless Broadband Alliance): Consortium of cable and mobile operators as well as infrastructure vendors created to deploy ubiquitous wireless broadband services through next-generation Wi-Fi.

WFA (Wi-Fi Alliance): Nonprofit organisation that certifies products indicating they have met industry-agreed standards for interoperability, security and other application-specific protocols.

Understanding consumers — and the promise of carrier-grade Wi-Fi

Legacy Wi-Fi generally isn't trusted, is considered a best-effort access technology, and lacks sufficient methods to transport data traffic securely. Its access points typically were set up by end users in their homes, by Internet service providers as public hotspots, as a courtesy service in certain venues or by enterprises for employees and visitors. Carrier-grade Wi-Fi is a set of capabilities that improve on best-effort Wi-Fi with dramatically better security, authentication, availability and quality of service.

The Wireless Broadband Alliance, one of Wi-Fi's standards-setting bodies, has created a set of requirements that Wi-Fi networks need to meet in order to be branded 'carrier-grade'. The standards require a carrier Wi-Fi network to provide three core attributes: a consistent user experience; a fully integrated, end-to-end network; and network

management capabilities (see *Figure 2*).

Other than seeing less demand on their own networks, mobile operators today have little insight into the traffic that has been offloaded from their network. They don't know about users' behaviour, the quality of service or other performance issues of the offloaded traffic. As they vie to have more control over what users experience, carriers need to develop a better understanding of Wi-Fi data traffic by gaining more intelligence about how these networks perform. The introduction of carrier-grade Wi-Fi equipment capable of being integrated into mobile networks promises increased visibility into the user's experience.

As part of their natural technology life-cycle process, mobile and cable operators alike are implementing carrier-grade technology as the next generation of Wi-Fi technology. They'll get security advantages as well as help improve their users' experience.

Figure 2: Wi-Fi features compared — best effort & carrier grade¹³

Features	Carrier-grade Wi-Fi	Best-effort Wi-Fi
Dynamic network discovery/ selection	Ability to discover and select the network and access point	Limited ability; user needs to be proactive in discovering and selecting access point
Authentication & security	Strong admission control based on authentication; can be SIM or non-SIM based	Admission control is localised and often weak
Service experience	Service experience configurable by device or by user and managed by operator	Limited service experience capability by individual/device; typically localised control
Architecture	Capabilities to allow multiple interfaces, roaming - IPv6 among others	Much more localised architecture and less distributed in nature; less prescriptive in design
End-to-end service provisioning	Subscriber provisioning and enforcement	Localised roaming within existing network
Network quality	High reliability and availability; dynamic load sharing	Availability and reliability not guaranteed
Network security	Strong detecting and preventing of intrusion	Limited detecting of intrusion
Network manageability	Standards-based provisioning of devices	Less management of the network from a centralised service



Getting Wi-Fi ready for carriers

The current surge in Wi-Fi activities is geared towards making Wi-Fi carrier friendly.

Hotspot 2.0: A Wi-Fi Alliance (WFA) initiative that has access points certified for Wi-Fi and that aims to allow seamless and secure authentication at hotspots.

NextGen Hotspot (NGH): An initiative closely linked to Hotspot 2.0, run by Wireless Broadband Alliance (WBA) and that aims for deeper integration with cellular networks, such as transporting Wi-Fi via mobile core.

Passpoint: Developed to allow automatic authentication and access to Wi-Fi networks.

ANDSF (Access Network Discovery and Selection Function): Developed by 3GPP; part of the new Evolved Packet Core (EPC) specifications for cellular networks; lets mobile devices discover and connect with Wi-Fi networks and enforce policy controls.

I-WLAN: Based on 3GPP; aims to connect a device on Wi-Fi back into an operator's core network via a VPN tunnel.

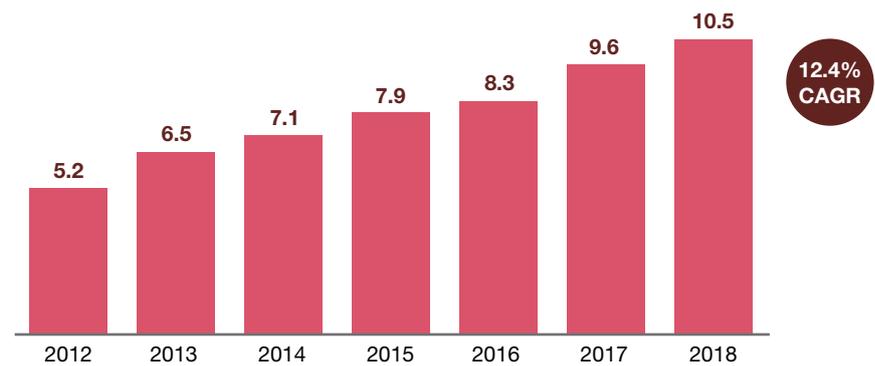
EAP (Extensible Authentication Protocol): Developed to enhance authentication for Wi-Fi hotspots.

Cable operators are leading the deployment of carrier-grade Wi-Fi access points. In the US, an example is the effort of the Cable Wi-Fi Alliance, a consortium of five cable operators: Bright House, Cablevision, Comcast, Cox and Time Warner Cable. The consortium created a nationwide Wi-Fi roaming network consisting of more than 6 million access points, 300,000 of which are deemed carrier grade.¹⁴ Around the world, deploying carrier Wi-Fi is gaining traction (see *Figures 3 and 4*). And the carrier Wi-Fi equipment market is projected to be worth US\$3bn in revenue by 2018.¹⁵

Mobile operators are noticing the opportunity carrier-grade Wi-Fi presents and are beginning to make moves to capitalise on it. The Wireless Broadband Alliance announced¹⁶ significant carrier-grade Wi-Fi deployments, including multiple operators from the US (Boingo, Towerstream, Time Warner Cable), Asia (KT, NTT DOCOMO, SKT, Telkom Indonesia), Europe (Orange), South America (Linktel) and the Middle East (Mobily).

Figure 3: Growth of carrier-grade Wi-Fi hotspots, 2012-2018

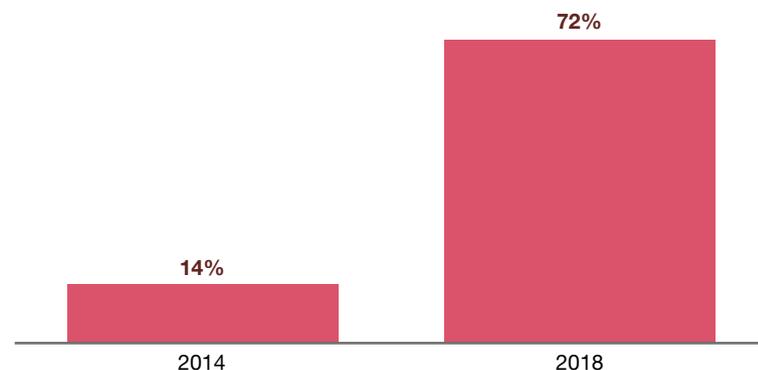
Deployment of new carrier-grade Wi-Fi hotspots by mobile operators
Million, 2012-2018



Sources: SNL Kagan; PwC's analysis.

Figure 4: Deployment of carrier-grade Wi-Fi, 2014-2018

Carrier grade Wi-Fi deployments as a % of total Wi-Fi deployments
%



Sources: Survey — Commissioned by Amdocs and conducted by Real Wireless and Rethink Technology Research, 2014

The overall communications value chain will be affected — everyone from consumers to original manufacturers of infrastructure and devices to network providers and content providers.

Mapping a Wi-Fi strategy

With Wi-Fi connectivity being widely available, cable operators have been able to venture into mobile phone services. Cablevision’s announcement of Freewheel, a low-cost phone service based entirely on Wi-Fi, has opened the door to a possible future of cable-led mobile initiatives. Comcast has been building its own Wi-Fi network aggressively by also relying on a crowd-sourced approach that turns customers’ Wi-Fi routers into Xfinity® access points.¹⁷ As mobile phone use moves more towards data services, a whole new set of players could be offering Wi-Fi only or Wi-Fi *first* mobile services soon.¹⁸

On the mobile operator side, the ability to initiate and pass a call or a data session back and forth between Wi-Fi and LTE is now available commercially. Operators like T-Mobile USA¹⁹ have embraced this technology. As mobile operators finish rolling out Voice over LTE (VoLTE) on their networks, and establish VoLTE interoperability across networks,²⁰ they likely will turn their attention to making wi-fi interoperable.

The interoperability of carrier-grade Wi-Fi and cellular Wi-Fi serves only to further disrupt the industry status quo with broadly ranging operational impacts and new capabilities. The overall communications value chain will be affected – everyone from consumers to original manufacturers of infrastructure and devices to network providers and content providers (see *Figure 5*).

Figure 5: Operational implications of carrier-grade Wi-Fi for cable and mobile operators

	For cable operators	For mobile operators
Commercial offerings	<ul style="list-style-type: none"> The possible need to deploy, and charge more for, Hotspot 2.0 devices and in-home routers The ability to get more business from mobile operators for wireless communications 	<ul style="list-style-type: none"> The ability to use the Wi-Fi network to provide additional coverage (potentially with a degree of monetisation and differentiation) Commercial agreements and pricing for Hotspot 2.0 access
Customer experience	<ul style="list-style-type: none"> The ability to offer an outstanding experience outdoors, consistent with the speeds provided indoors 	<ul style="list-style-type: none"> The ability to offer a seamless mobility experience in high-traffic and indoor locations where speed and coverage have always been a concern
Care operations	<ul style="list-style-type: none"> The need to respond to issues related to a completely different technology and across disparate networks The need for a new set of technical skills and capabilities 	
Technical operations	<ul style="list-style-type: none"> The need to plan and manage a wireless footprint and manage cellular interoperability Regulatory implications of supporting E911, call tracing etc. 	<ul style="list-style-type: none"> The need to integrate frequency planning on Wi-Fi as well as cellular infrastructure and, potentially, share spectrum through Licence Assisted Access The need to manage call control over multiple networks for prepaid services
Technology road map	<ul style="list-style-type: none"> Deploy technology that allows handing off to cellular Deploy high-bandwidth Wi-Fi access technology, such as 802.11ac 	<ul style="list-style-type: none"> Choose between cellular technologies and Wi-Fi Focus on technologies that allow handing off seamlessly to Wi-Fi

Moving towards the promise

Mobile operators are facing a threat to their revenues as a result of Wi-Fi becoming ubiquitous. But with carrier-grade Wi-Fi, they have an opportunity to close coverage problems and give users a more managed experience. All operators should establish a formal Wi-Fi strategy that explicitly incorporates Wi-Fi into their network road maps. The strategy should consider Wi-Fi to be another network in their portfolio, complete with capital expenditures and operating expenditures managed by a full-fledged, operational Wi-Fi department. Wi-Fi should play an important role in addressing coverage problems, giving users a better experience and managing backhaul and core network expenses.

LTE in the unlicensed bands (LTE-U) considers the use of cellular technology in the unlicensed spectrum that is today the mainstay for Wi-Fi. As the 2.4GHz band gets even more crowded, and with the growing use of the 5GHz

unlicensed band, there's likely to be more regulatory review of how the unlicensed bands are fairly used. Mobile operators should begin to analyse the implications of such spectrum use across technologies and what regulatory scrutiny of that use to expect.

Wi-Fi providers - typically the cable operators - should recognise that cellular technology can complement their strategy to achieve true mobility. As the industry faces consumers who want mobility of content, the interoperability of Wi-Fi and cellular becomes a critical mechanism for breaking the tie to the home cable box and to competing better with the growing number of over-the-top video providers.

With carrier-grade Wi-Fi, mobile and cable service providers have an opportunity to distinguish themselves from the, so far, unmanaged Wi-Fi offerings that make no commitment on security, availability or purpose of use. And, potentially, service providers can charge a premium for

carrier-grade Wi-Fi, an offering that will appeal particularly to enterprise customers who demand a higher level of security and availability.

By wanting simplicity and flexibility when they consume content - how, when, where and what they consume - users are creating a clear opportunity ahead for both mobile and cable operators. Carrier-grade Wi-Fi and the interoperability of Wi-Fi and LTE are giving operators the flexibility to deliver on the promise of ubiquitous coverage: a seamless, great experience and value for money.

Carrier-grade Wi-Fi already is part of the mobile landscape, and its impact is increasing. The strategic, operational, technical and regulatory issues associated with it merit operators' attention. As with any disruptive technology, carrier-grade Wi-Fi holds both promise and threat. Have you formulated a strategy for your company to follow in navigating a course through this changing environment?

Endnotes

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- 4 Source: <http://corporate.comcast.com/news-information/news-feed/comcast-and-liberty-global-announce-agreement-to-connect-u-s-and-european-wi-fi-networks>.
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- 14 Sources: Comcast, Cox, Time Warner Cable, Bright House Networks, Cablevision, Verizon, FCC.
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- 19 T-Mobile USA website/Wi-Fi calling — source: <http://www.t-mobile.com/offer/wifi-calling-wifi-extenders.html>.
- 20 Verizon and AT&T to make VoLTE networks interoperable in 2015 (11/3/2014) — source: <http://www.verizonwireless.com/news/article/2014/11/verizon-and-att-move-toward-voice-over-lte-volte-interoperability.html>.

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