ALCATEL-LUCENT lightRadio WI-FI SOLUTION

TURNING WI-FI HOTSPOTS INTO A HOT BUSINESS OPPORTUNITY FOR WIRELESS SERVICE PROVIDERS

TECHNOLOGY WHITE PAPER

With maturity in both technology evolution and standards development, Wi-Fi has effectively become "another wireless technology" which allows extended network coverage and capacity – for both wireless and wireline network operators and service providers – through the use of operator-managed-and-controlled Wi-Fi access points.

This paper describes the Alcatel-Lucent lightRadio[™] Wi-Fi[®] solution and explains how Wi-Fi can be integrated in a service provider's network effectively and efficiently, making it a strategic lever for service innovation and revenue growth.

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1. WI-FI: UNLICENSED, GLOBAL AND EVERYWHERE

It is not hard to see the appeal of wireless LAN (WLAN) technology, commonly referred to as Wi-Fi: a set of unlicensed wireless spectrum bands that can be used globally without restrictions, fueled by the vast number of portable devices supporting it in a wide variety of variants (IEEE 802.a/b/g/n).

The global numbers for public and private hotspots (zones in which Wi-Fi is used) at the end of 2011 were estimated to be 1.3 million and 345 million, respectively (Informa Telecoms & Media, see Figure 1). These numbers, together with predictions for the future by the same analyst firm, show that usage of Wi-Fi technology will continue on a steady rise for years to come.

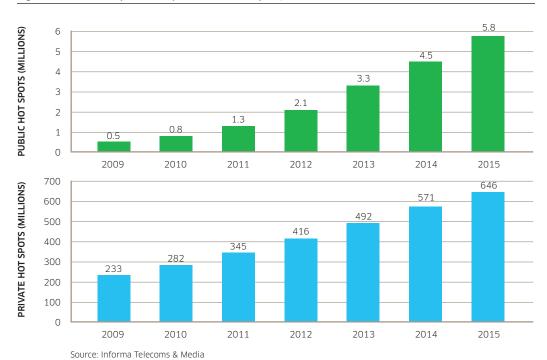


Figure 1. Numbers of public and private Wi-Fi hotspots, 2009-2015

The use of public Wi-Fi hotspots comes with a number of problems:

- Inconsistent coverage and performance
- Potential for congestion due to the shared medium with no stringent traffic policy and Quality of Service (QoS) control
- Less-than-perfect security
- A complex and at times complicated login procedure, which calls for expert knowledge about Wi-Fi protocols in order to find a network and configure security and login settings

The use of public Wi-Fi hotspots also includes a diverse range of pricing options, including many free and pay-per-use options. The strong appeal to break away from the prohibitively pricy cellular data plans and high costs of roaming was enough to make Wi-Fi a de facto choice for semi-nomadic wireless data use globally.

The further adoption of Wi-Fi will be stimulated by technological improvements aimed at the use of wider and different spectral bands (IEEE 802.11ac, IEEE 802.11af) and variants of techniques that have already found a place in the cellular world, such as multi-user MIMO (MU-MIMO).

The biggest boost to even wider adoption of Wi-Fi may result from HotSpot 2.0, an industry-wide initiative driven by the Wi-Fi Alliance (WFA) and aimed at facilitating and automating secure and trusted Wi-Fi connection with the ability to use a variety of user-or device-based credentials. HotSpot 2.0 is built around a set of new IEEE specifications (see Figure 2):

• IEEE 802.11u: network discovery

• IEEE 802.11i: encryption

• IEEE 802.11x: authentication

Hotspot 2.0 promises to automate network discovery, registration, provisioning and network connectivity – steps that today are manual when a Wi-Fi user connects to a given hotspot.

Figure 2. Wi-Fi standards and their inter-relationship



Source: www.newelectronics.co.uk, November 22, 2011

2. CARRIER WI-FI

The exponential growth of data traffic on wireless cellular infrastructures over the last several years has been matched or even surpassed by a phenomenal increase in Wi-Fi traffic originating from Wi-Fi-enabled smartphones and tablets.

From individual homes and workplaces, to coffee shops, retail stores, hotels and airports (and yes, even on the planes), Wi-Fi hotspots are continuing to proliferate and are becoming ubiquitous for semi-nomadic data connectivity. While the appeal of Wi-Fi lies primarily in its availability and relatively easy configuration, the use of Wi-Fi comes with the burden of:

- Shared (unlicensed) spectrum
- No guarantees for network performance and QoS
- A potentially high price (for example, daily or hourly fees)
- The need to manage access configuration for many Wi-Fi hot spots through protocols and passwords
- Many security concerns

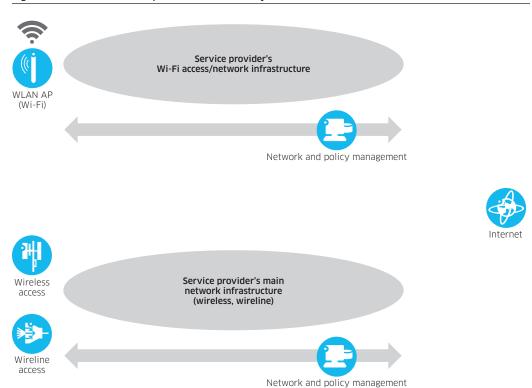
Historically, Wi-Fi hotspots have been "dark corners" on coverage maps of mobile operators because at these hotspots the operators start losing visibility into their customers: insight into their connectivity and enhanced communication preferences (for example, context and location). At these dark corners, the end-user data services riding over Wi-Fi start traversing alternative network infrastructures that do not always belong to wireless operators.

The same situation is also valid for the wireline operators, including cable operators and multiple service operators (MSOs). While their service offering has been driven by large bandwidth interconnectivity with static, big-screen requirements (Internet over DSL or cable, IPTV at home, enterprise connectivity), they also see the opportunity in the "smartphone revolution" and would like to capitalize on it.

With Wi-Fi's maturity in both technology evolution and standards development (for example, MIMO and IEEE 802.11u), wireless, wireline and converged operators alike are looking at Wi-Fi technology as an option to increase their service and business reach. Mobile service providers and wireless operators view Wi-Fi as another wireless technology that can augment their macro and small cell networks with affordable coverage and capacity, and with universal acceptance. Wireline providers view Wi-Fi as a new opportunity to light up the ends of their last miles to attract more customers and also to leverage their overall network for reselling and wholesaling opportunities. Obviously, the ability to deal with unlicensed spectrum has an additional appeal for all of these service providers and network operators.

Since 2010, many different approaches have been considered, examined and even deployed to allow the integration of Wi-Fi hotspots into wireless and wireline networks. While these approaches have been somewhat standardized, they still represent many different options, and often they mix different technologies to ensure the end-device connectivity. As a result, there is increased management and billing/charging complexity. In practice, many instances of operator-owned Wi-Fi rollouts have resulted in parallel network infrastructures with duplication of separate networks as well as subscriber/policy and traffic management systems, as seen in Figure 3.

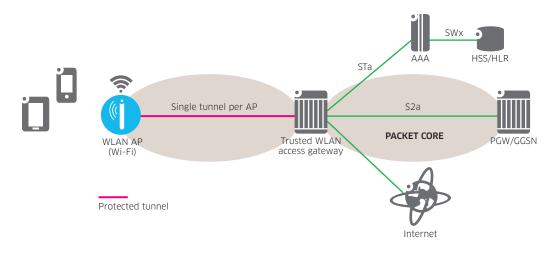
Figure 3. Carrier Wi-Fi as a separate network overlay



Until recently, standards-based approaches for carrier Wi-Fi have been based on treating WLAN (Wi-Fi) as untrusted access and have required the use of dedicated network elements which otherwise might not have been needed.

The latest 3GPP standards work is focused on trusted WLAN access to evolved packet core and based on 3GPP R11 SaMOG (S2a-based Mobility over GTP), as shown in Figure 4.

Figure 4. SaMOG architecture for trusted WLAN access to packet core over S2a interface



This approach leverages improved WLAN security (based on IEEE 802.11-2007, IEEE 802.11i, Advanced Encryption Standard) and more efficient secure tunnel management (tunnels between Wi-Fi access points and the WLAN gateway), eliminating the need for Enhanced Packet Data Gateway (ePDG) or Home Agent (HA) elements in 3GPP-only network environments. This approach results in the ability to address Internet offload directly from the Trusted WLAN gateway instead of requiring the traffic to cross the backhaul network through the packet core.

There are few or no changes in end-user equipment (mobile terminals) because this approach replaces the large-scale IPsec connectivity requirement between end-user devices and a gateway (potentially millions), per previous standards, with manageable scaling of secure tunnels between access points (APs) and a gateway (potentially thousands) using Generic Routing Encapsulation (GRE) or IPsec. With protocol support on the WLAN for interfacing Authentication, Authorization and Accounting (AAA) servers, this model allows easy integration with a network operator's billing and charging systems while ensuring AP-cellular inter-mobility.

3. ALCATEL-LUCENT lightRadio WI-FI SOLUTION AND A HIGH LEVERAGE NETWORK FRAMEWORK

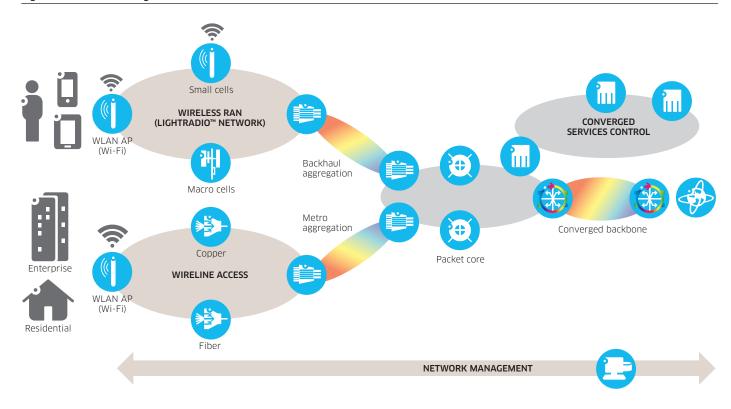
As an inventor, innovator and leader in all types of wireless technologies, Alcatel-Lucent has been investigating Wi-Fi to create and deliver a comprehensive solution for easy integration of Wi-Fi – both as an access technology and as a service — into network infrastructures and service offerings of wireless and wireline network operators and service providers.

The Alcatel-Lucent lightRadio™ Wi-Fi solution enables extending wireless coverage and increasing the network capacity delivered to end users and their mobile devices (for example, smartphones, tablets and netbooks). Operator-managed and controlled Wi-Fi APs are fully integrated with the overall network infrastructure to ensure seamless connectivity and an enriched end-user experience.

With Alcatel-Lucent, Wi-Fi no longer needs to be delivered as another parallel infrastructure that incurs additional CAPEX and OPEX and has extra complexity in the form of a separate network and separate subscriber/policy and traffic management systems. Wi-Fi technology becomes simply another wireless technology for network operators to manage and include as part of a larger heterogeneous RAN or wireline access/service strategy — and this is essential to preserve/expand the customer base and offer a more complete solution.

With the Alcatel-Lucent lightRadio Wi-Fi solution, Wi-Fi can be integrated with the rest of the operator's network in a cost-effective and trusted manner, allowing the network to become a strategic platform for service innovation and revenue growth. At the same time, the lightRadioWi-Fi solution offers the benefits of traffic offload – using the most appropriate and cost-effective part of the network to reduce overall network costs.

This solution is based on the industry-leading Alcatel-Lucent High Leverage Network™ (HLN) evolution framework. As is shown in Figure 5, HLN allows service providers to extract more value from the network, harness Application Enablement and turn challenges into growth opportunities for long-term business success.



4. ALCATEL-LUCENT lightRadio WI-FI SOLUTION FOR WIRELESS SERVICE PROVIDERS

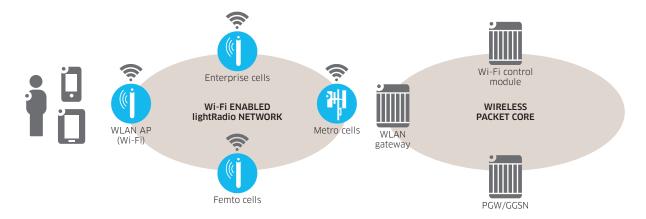
The Alcatel-Lucent lightRadio Wi-Fi solution is equally applicable to wireless service providers and network operators – and to wireline network operators (fixed service providers, cable operators/MSOs) who plan to incorporate Wi-Fi access either as a part of their service offering or as a means to boost their revenues through reselling and wholesaling opportunities.

The solution reduces the overall complexity for both end users and service providers. Relying on the latest advances in 3GPP and IEEE standards, it allows easy, secure and trusted Wi-Fi access with zero configuration for end users, improving their experience with seamless connectivity and mobility between Wi-Fi and the cellular network.

For network operators, the lightRadio Wi-Fi solution creates an opportunity to further improve their network and subscriber yield.

A simplified network diagram outlining the main components of the solution for wireless service providers is shown in Figure 6.

Figure 6. Simplified functional diagram of Alcatel-Lucent lightRadio Wi-Fi solution for wireless service providers



As Figure 6 shows, Wi-Fi access is seen as a natural extension of functionality delivered by the Alcatel-Lucent lightRadio portfolio, adding more flexibility in deployments that require a mix of small and metro cells.

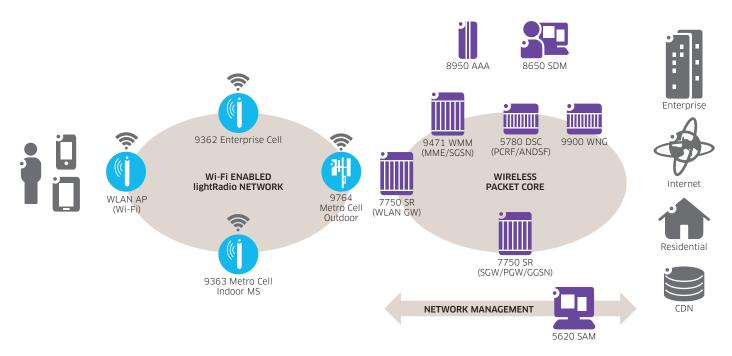
5. COMPONENTS OF ALCATEL-LUCENT lightRadio WI-FI SOLUTION

As shown in Figure 8, the Alcatel-Lucent lightRadioWi-Fi solution encompasses:

- Wi-Fi APs, realized through the lightRadio portfolio or through interworking with third-party Wi-Fi AP vendors (Please contact Alcatel-Lucent for the latest list of tested and pre-integrated AP vendors.)
- WLAN gateway, based on the Alcatel-Lucent 7750 Service Router (SR)
- Alcatel-Lucent Wireless Packet Core, which ensures inter-mobility and IP anchoring through the converged Gateway GPRS Support Node/Public Data Network (GGSN/ PDN) gateway functionality of the Alcatel-Lucent 7750 SR (as a mobile gateway)
- Wi-Fi Control Module, implemented on the Alcatel-Lucent 5780 Dynamic Services Controller (DSC), the leading policy management platform. With the incorporation of and extensions to the Access Network Discovery and Selection Function (ANDSF) in its Wi-Fi Control Module, the 5780 DSC is able to further extend its policy management capabilities and drive end users and/or their devices to automatically discover and select the best possible or the most appropriate wireless access at a time (Wi-Fi, small cells or the macro cellular network). The 5780 DSC can also perform the Policy and Charging Rules Function (PCRF). With unique abilities to leverage network intelligence and subscriber information, coupled with its tight integration with charging/billing systems, the 5780 DSC can facilitate uniform application of flexible and converged network policies across the wireless, wireline and converged network environments.

 The Alcatel-Lucent lightRadio Wi-Fi solution is managed end to end by the Alcatel-Lucent 5620 Service Aware Manager (SAM), which provides integrated element, network and service-aware management capabilities for all Alcatel-Lucent products encompassed by this solution while expanding its management capabilities to the underlying backhaul and transport networks.

Figure 7. Alcatel-Lucent lightRadio Wi-Fi solution



For more information on Alcatel-Lucent lightRadio Wi-Fi solution, please visit: www.alcatel-lucent.com/lightradio-wifi

6. READY FOR ONLOAD: ALCATEL-LUCENT WIRELESS PACKET CORE

The extension of wireless access coverage and capacity that comes with the Alcatel-Lucent lightRadio Wi-Fi solution has a direct impact on the wireless packet core. All end-user and/or end-device traffic that may have used alternative wireless and transport infrastructures (such as end-user traffic traversing over third-party Wi-Fi hotspots and Wi-Fi backhaul networks) must now be accommodated in the wireless packet core to achieve full management of end-users' QoS/QoE with seamless mobility, connectivity and policy management, for millions of connections, in real time.

To cope with this influx of bandwidth and signaling caused by the addition of users, connected devices and network applications that are served by the lightRadio Wi-Fi solution, the wireless packet core needs to deliver high data and control plane performance with the scalability required for massive delivery of wireless broadband — to potentially millions of users and devices.

Alcatel-Lucent Wireless Packet Core has been engineered for the further evolution of broadband to address the multi-dimensional and exponential increase in the number of users, devices and applications as well as higher bandwidth, lower latency and longer duration of data sessions.

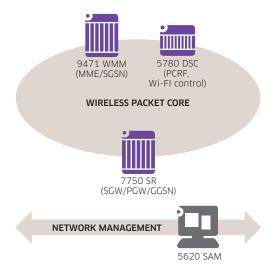
With Alcatel-Lucent Wireless Packet Core, mobile operators and service providers can converge and consolidate their wireless core — for 2G/3G/3G+, LTE/4G and now Wi-Fi on a super-scalable all-IP multiservice infrastructure with exceptional performance, advanced QoS capabilities and high operational flexibility. Significant savings can be obtained from the packet core ability to deliver traffic more reliably and cost-efficiently and by leveraging network intelligence and policy management to generate new forms of revenues from new network services and applications. Alcatel-Lucent Wireless Packet Core is also a foundation for the overall core convergence — for wireless, wireline and converged network environments.

As shown in Figure 8, Alcatel-Lucent Wireless Packet Core comprises:

- Alcatel-Lucent 7750 SR, an industry-leading service routing platform that provides converged data/user plane mobile gateway functions (SGW/PGW/GGSN) for 2G, 3G, 3G + and LTE/4G.
- Alcatel-Lucent 9471 Wireless Mobility Manager (WMM), a high-performance converged control plane element for SGSN/Mobility Management Entity (MME) functions
- Alcatel-Lucent 5780 DSC
- Alcatel-Lucent 5620 SAM

For more information on the Alcatel-Lucent Wireless Packet Core, please visit: http://www.alcatel-lucent.com/uwpc

Figure 8. Alcatel-Lucent Wireless Packet Core



7 CONCLUSION

The Alcatel-Lucent lightRadio Wi-Fi solution equips service providers and network operators with the most complete, carrier-grade Wi-Fi solution available today. By integrating trusted Wi-Fi as an essential and integral part of their network infrastructure, mobile operators can:

- Provide mobile users with a secure, seamless experience across Wi-Fi hotspots and cellular networks
- Take advantage of exponential increases in traffic from Wi-Fi enabled devices
- Open the network for reselling/wholesaling opportunities
- Further drive revenue and monetization.

8 ACRONYMS

3GPP 3rd Generation Partnership Project

AAA Authentication, Authorization and Accounting
ANDSF Access Network Discovery and Selection Function

AP access point

ePDG Enhanced Packet Data Gateway
GGSN Gateway GPRS Support Node
GRE Generic Routing Encapsulation

HA Home Agent

LTE Long Term Evolution

MIMO multiple-input and multiple-output

MME Mobility Management Entity

MSO multiple service operator

MU-MIMO multi-user multiple-input and multiple-output

PCRF Policy and Charging Rules Function

PDN Public Data Network
QoE quality of experience
QoS Quality of Service
WFA Wi-Fi Alliance

WLAN Wireless Local Area Network

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