ALCATEL-LUCENT LIGHTRADIO WI-FI

A STRATEGIC LEVER FOR NETWORK EXPANSION AND SERVICE INNOVATION

TECHNICAL WHITE PAPER

Alcatel-Lucent lightRadio Wi-Fi equips wireless and converged service providers with an end-to-end carrier Wi-Fi solution. By integrating Wi-Fi with their cellular network, wireless and converged service providers can provide mobile users with secure and trusted connectivity across Wi-Fi hotspots and cellular networks for a seamless mobile broadband experience. At the same time, they can cost effectively manage the exponential increase in Wi-Fi traffic and capitalize on important new revenue and monetization opportunities.

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1. A NEW TAKE ON WI-FI

Wi-Fi seems like an ideal solution for nomadic users because unlike cellular networks, it uses the same frequency bands and protocols worldwide. However, the Wi-Fi hotspot environment is still fragmented and sometimes difficult to access, even for tech-savvy users. Service provider packages that bundle national Wi-Fi access with a user's fixed or mobile contract are a good start to improving Wi-Fi access. They are also a cost-effective choice for users compared to the daily or hourly Wi-Fi options currently available at hotels and airports.

Today, Hotspot 2.0 is being defined by the Wi-Fi Alliance (WFA) and Next Generation Hotspot (NGH) is being defined by the Wireless Broadband Alliance (WBA). These definitions will enable simple, seamless and secure interworking among Wi-Fi solutions and hotspots. Adding capabilities from a new Third Generation Partnership Project (3GPP) specification for the Access Network Discovery and Selection Function (ANDSF) will allow end users to seamlessly roam between cellular and Wi-Fi access. Together, these initiatives allow service providers to tightly integrate Wi-Fi and cellular technologies into their networks, making Wi-Fi another viable radio access technology. For example:

- For wireless service providers using Wi-Fi to simply offload traffic from a Radio Access Network (RAN), Wi-Fi will become a cost-effective way to preserve and expand the customer base and offer a complete cellular and Wi-Fi package.
- For fixed service providers and cable multiple system operators (MSOs), built-in Hotspot 2.0, NGH, and 3GPP capabilities that enable seamless roaming from Wi-Fi onto and between cellular networks will allow them to integrate hotspots with their existing fixed networks. They can then offer mobile broadband services that complement existing portfolios without investing in expensive spectrum.
- For users, simple roaming capabilities and seamless handover will mean they can continue using data services — such as streaming video — as they move from cellular macro cells and small cells to and from Wi-Fi hotspots, with no need for further authentication or user intervention.

Service providers that adopt these new solutions early on will be able to market add-on Wi-Fi services with existing offers for a small incremental monthly charge. By providing simple, seamless and secure Wi-Fi and cellular roaming they can secure customer loyalty despite free Wi-Fi hotspot competition. This strategy will also create an opportunity to capture market share from competitors that don't offer a similar complete solution. As a result, Wi-Fi becomes a strategic lever to drive new revenue streams without the crippling costs of additional spectrum.

2. WHAT'S DRIVING THE MARKET?

Wi-Fi is here now. It's used on many different devices every day. And it's on the rise. According to the Wireless Broadband Alliance, figures for 2011 put the total number of Wi-Fi hotspots worldwide at 1.3 million. That number is forecast to grow 350 percent to 5.8 million by 2015[1].

There are few new devices coming to market that do not feature integrated Wi-Fi. Smartphones, tablets, netbooks, laptops, even e-readers and game consoles all support Wi-Fi. This rapid and widespread proliferation of Wi-Fi -enabled devices has seen data traffic across Wi-Fi hotspots already match or overtake cellular network data traffic. With 61 percent[2] of networked homes using Wi-Fi, this creates a huge opportunity for operators as Wi-Fi moves into carrier offerings.

3. OVERCOME WI-FI CHALLENGES WITH CARRIER WI-FI

While the appeal of Wi-Fi lies primarily in its availability and relatively easy configuration, using Wi-Fi comes with some encumbrance, including:

- Shared (unlicensed) spectrum
- No guarantees for network performance or quality of service (QoS)
- A potentially high price driven by daily or hourly fees
- The need to manage access configuration for many Wi-Fi hotspots through protocols and passwords
- Many security concerns

Historically, Wi-Fi hotspots have been "dark corners" on wireless service providers' coverage maps because they are the points at which wireless service providers start losing visibility and insight into their subscribers' connectivity, context and location. At these dark corners, subscriber data services using Wi-Fi begin traversing network infrastructures that do not always belong to wireless service providers.

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 they often mix different technologies to ensure device connectivity. As a result, there is increased management, billing and charging complexity. In practice, many instances of service provider-owned Wi-Fi rollouts have resulted in parallel network infrastructures with duplication of separate networks as well as subscriber, policy and traffic management systems.

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1 http://www.wballiance.com/2012/07/25/wba-next-generation-hotspot-ngh-initiative
2 ©2011 Home Networking: The Big Bang Theory of the Connected Home, Sept 2011, Stratecast |Frost & Sullivan, Vol 1, No. 4.

Until recently, standards-based approaches for Wi-Fi have treated wireless LAN (WLAN), or Wi-Fi, access as untrusted and have required dedicated network elements which otherwise might not have been needed. The latest 3GPP standards work is focused on trusted WLAN access to an evolved packet core and is based on the 3GPP R11 SaMOG study on S2a interface mobility over GPRS Tunneling Protocol (GTP), as shown in Figure 1. 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.

Figure 1. The SaMOG architecture provides trusted WLAN access to the packet core over the Sa2 interface
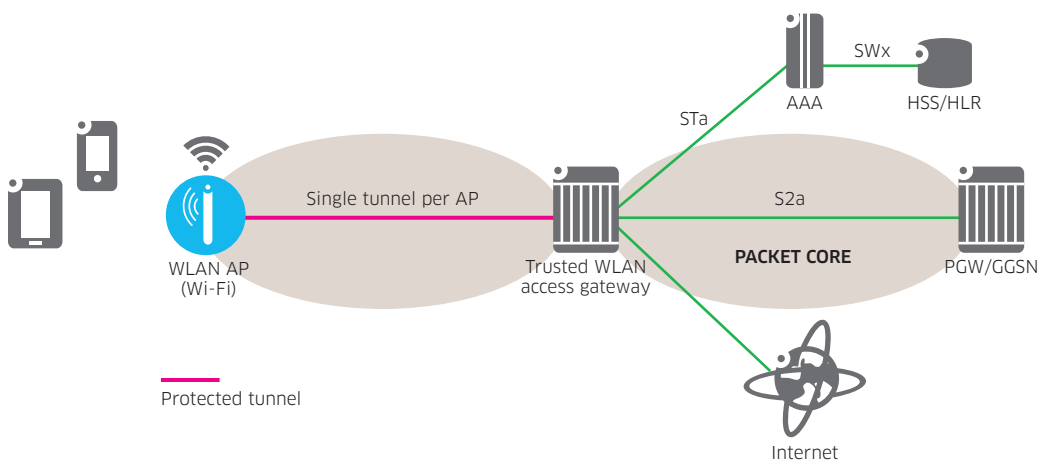
There are few or no changes required in end-user mobile devices because the SaMOG architecture replaces the potentially millions of IP security (IPsec) connections between end-user devices and a gateway required by previous standards with manageable scaling of thousands of secure tunnels between access points (APs) and a gateway using Generic Routing Encapsulation (GRE) or IPsec. With protocol support on the WLAN G/W for interfacing with Authentication, Authorization and Accounting (AAA) servers, this model allows easy integration with service providers' billing and charging systems while ensuring AP-cellular inter-mobility.

With Carrier Wi-Fi, service providers can:
- Extend macro networks with affordable network coverage and increase network capacity because Wi-Fi is integrated as an access technology
- Drive service innovation by cost effectively providing continuous, uninterrupted data connectivity to their users wherever they are
- Improve quality of experience (QoE) with happier users who are always connected with trouble-free anytime, anywhere coverage
- Generate new revenues by increasing yield from current subscribers while attracting new customers
- Open the door to wholesale opportunities for reselling to mobile virtual network operators (MVNOs) and other strategic markets

4. A CLOSER LOOK AT ALCATEL-LUCENT LIGHTRADIO WI-FI

Alcatel-Lucent lightRadioTM Wi-Fi® is a result of Alcatel-Lucent leadership in wireless and IP technologies. Building on the company's long heritage of wireless experience, the solution:

- Integrates Wi-Fi as part of a larger heterogeneous RAN solution
- Enables operators to augment their macro networks with affordable coverage and capacity
- Includes a full spectrum of licensed wireless technologies, including 2G, 3G and 4G/LTE to complement Wi-Fi

Figure 2 illustrates Alcatel-Lucent lightRadio Wi-Fi and its main components.

Figure 2. Alcatel-Lucent lightRadio Wi-Fi leverages Alcatel-Lucent's wireless and IP expertise
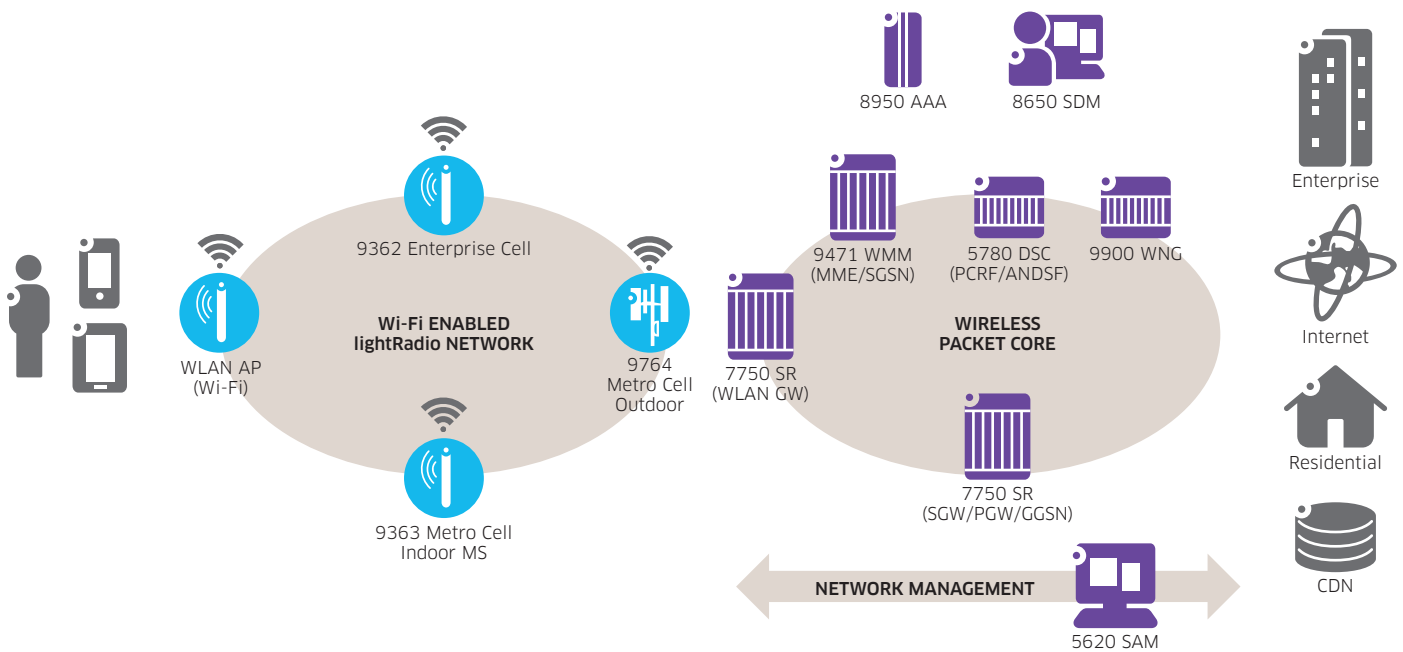
The solution components include:

- **Wi-Fi APs** that are provided through the lightRadio portfolio or supplied by third-party Wi-Fi AP vendors that are tested by Alcatel-Lucent to ensure delivery of premium Wi-Fi connectivity to end users.
- **A trusted and secure Wi-Fi gateway (WLAN)** on the Alcatel-Lucent 7750 Service Router (SR). This approach extends leading high-performance routing and traffic management capabilities to Wi-Fi gateway functionality, ensures secure connectivity to Wi-Fi APs and enables integration with AAA systems and packet cores.

- **The Alcatel-Lucent Wireless Packet Core** to ensure inter-mobility across Wi-Fi, 2G, 3G and 4G/LTE technologies. IP and mobility anchoring is enabled by the converged Gateway GPRS Support Node (GGSN) and Packet Data Network (PDN) Gateway functionality provided by the Alcatel-Lucent 7750 SR which functions as a mobile gateway.

  The Alcatel-Lucent 7750 SR in its roles of WLAN gateway, Packet Data Network Gateway (PGW) and GGSN enables handoff to wireless and converged service providers, MVNOs and Internet service providers (ISPs). It also facilitates accounting with support for standard interfaces toward online and offline charging systems and allows integration into policy control and charging (PCC) architectures. With advanced traffic processing features, the Alcatel-Lucent 7750 SR ensures delivery of QoS.

- **Policy management based on the Alcatel-Lucent 5780 Dynamic Services Controller (DSC)** to enable converged and uniform network policy management across all parts of the network and integration with network intelligence. The implementation of ANDSF capabilities allows users to be connected to the optimum network based on flexible criteria such as location, subscription, performance and analytics.

- **The Alcatel-Lucent 5620 Service Aware Manager (SAM),** which delivers end-to-end solution management and expands management capabilities across the underlying backhaul and core networks while facilitating network management integration of third-party elements

- **Wi-Fi professional services** that include specific and unique field-proven tools and processes to clearly define where, when and why APs should be deployed. The Alcatel-Lucent professional services team offers services from the earliest stages of business consulting through network design, network integration, Operations Support System and Business Support System (OSS/BSS) implementation and maintenance. A full-fledged professional services set specific to Carrier Wi-Fi rollouts allows service providers to maintain their focus on business goals. Network integration is de-risked, enhancing subscribers' QoE and accelerating potential new revenue streams.

Solution benefits

Alcatel-Lucent lightRadio Wi-Fi brings benefits to both end users and service providers.

Table 1. Alcatel-Lucent lightRadio Wi-Fi benefits

END USER	SERVICE PROVIDER
Access and connectivity • Easy hotspot detection • Worry-free Service Set Identifier (SSID) authentication configuration • Secure and trusted network access	• Authentication based on an expanded set of user credentials, helping customers to access Wi-Fi and keeping them on one network • Ability to add new wireless services without the high cost of licensed spectrum • Ecosystem of lightRadio Wi-Fi-certified partners simplifies network introduction
Network and mobility • Subscribers move seamlessly between the service provider's Wi-Fi and cellular networks • Customers stay connected on one network • Customer experience improves with one seamless wireless broadband experience	• Increased network coverage and capacity through integration of Wi-Fi with 2G, 3G and 4G/LTE networks across femto, metro and macro cells • Full visibility into customer connectivity and communications preferences • Ability to optimize the end-user experience based on location, context and content • Increased opportunities to address customer concerns and offer more personal services • Improved yield and reduced customer churn • New revenue channels for retail and wholesale models

5. THE ALCATEL-LUCENT ADVANTAGE

As a leader in both IP and wireless, Alcatel-Lucent has engaged with more than 20 service providers globally since the launch of Alcatel-Lucent lightRadio Wi-Fi. The knowledge we have acquired from these early field experiences further solidifies our leadership in the Carrier Wi-Fi domain. With Alcatel-Lucent lightRadio Wi-Fi, service providers can:

- **Accelerate end-to-end deployments and mitigate risk**

  Wi-Fi APs are deployed wherever they are most needed. A wide range of certified third-party Wi-Fi APs can be deployed in timely manner.

- **Enhance network efficiency by:**
  - ¬ Integrating Carrier Wi-Fi access with lightRadio-based, multi-standard small cells for seamless coverage and increased capacity.
  - ¬ Unifying converged billing and charging systems to support real-time charging for tiered service plans that are applicable to both standalone Wi-Fi and to Wi-Fi within a mobile broadband offering.
  - ¬ Simplifying network management with the Alcatel-Lucent 5620 SAM managing the Alcatel-Lucent lightRadio Wi-Fi and the underlying backhaul and transport networks.
  - ¬ Using the Motive AAA server for Hotspot 2.0 authentication and for the application of flexible and granular subscriber and application policies on the WLAN gateway to drive revenues.

- **Optimize total cost of ownership (TCO) and QoS**

  Re-using the installed Alcatel-Lucent 7750 SR allows service providers to benefit from the wide range of Alcatel-Lucent 7750 SR WLAN gateway capabilities for optimized QoS and security. These capabilities include lawful interception, scalable deep packet inspection (DPI) and application assurance (AA) as well as accounting, quota management and credit control.

- **Get ready to scale-up**

  Alcatel-Lucent lightRadio Wi-Fi uses soft GRE tunneling to support thousands of Carrier Wi-Fi APs from different Wi-Fi home gateway/Access Point vendors and users. The solution further reduces integration complexity through its integrated Layer 2-aware Network Address Translation (NAT) capabilities.

- **Offer superior QoE with advanced device management**

  The Alcatel-Lucent Motive device management platform can correctly configure, manage and monitor devices across all mobile technologies.

6. CONCLUSION

Alcatel-Lucent lightRadio Wi-Fi improves network coverage and increases capacity by integrating Wi-Fi with 2G, 3G and 4G/LTE network technologies across femto, metro and macro cells. Users can move seamlessly between wireless and converged service providers' Carrier Wi-Fi and cellular networks to enjoy an affordable, continuous and uninterrupted experience. By keeping customers on their network, service providers can offer more personalized and bundled services and pursue new business models. As a result, they can increase subscriber stickiness while attracting new subscribers.

Alcatel-Lucent lightRadio Wi-Fi is part of the larger Alcatel-Lucent heterogeneous RAN product and solution family, leveraging the multi-service Alcatel-Lucent 7750 SR platform. It can be used as a mechanism to offload data from macro wireless networks as well as a strategic tool for service innovation, opening doors to new revenue streams.

For more information about Alcatel-Lucent lightRadio Wi-Fi, please visit www.alcatel-lucent.com/lightradio-wifi or contact your local Alcatel-Lucent sales representative.

"Delivering secure, seamless access to Wi-Fi networks is a key requirement in the market right now…Alcatel-Lucent lightRadio Wi-Fi provides operators with a comprehensive solution that smartly draws from the company's strengths in radio access technology and IP routing. The result is an offer that lets operators leverage existing network assets while delivering demanding smartphone users an outstanding customer experience."

– Ken Rehbehn, principal analyst at Yankee Group

7. ABBREVIATIONS

3GPP	Third Generation Partnership Project
AA	application assurance
AAA	Authentication, Authorization and Accounting
ANDSF	Access Network Discovery and Selection Function
AP	access point
BSS	Business Support System
DPI	deep packet inspection
DSC	Dynamic Services Controller
GGSN	Gateway GPRS Support Node
GRE	Generic Routing Encapsulation
GTP	GPRS Tunneling Protocol
IPsec	IP security
ISP	Internet service provider
MSO	multiple system operator
MVNO	mobile virtual network operator

NAT	Network Address Translation
NGH	Next Generation Hotspot
OSS	Operations Support System
PCC	policy charging and control
PDN	Packet Data Network
PGW	Packet Data Network Gateway
QoE	quality of experience
QoS	quality of service
RADUIS	Remote Authentication Dial In User Service
RAN	Radio Access Network
SAM	Service Aware Manager
SR	Service Router
SSID	Service Set Identifier
TCO	total cost of ownership
WBA	Wireless Broadband Alliance
WFA	Wi-Fi Alliance
WLAN	wireless LAN

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