

# Alcatel-Lucent Converged Radio Access Network Solution

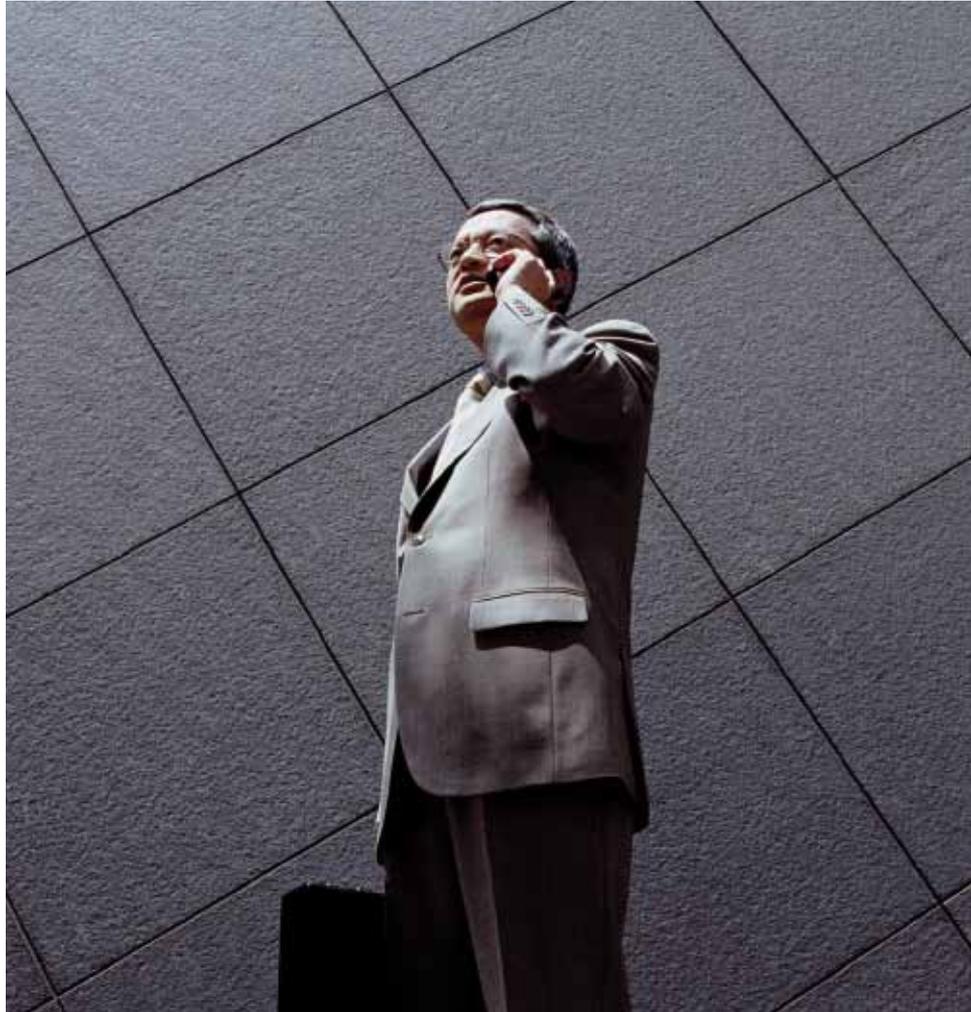
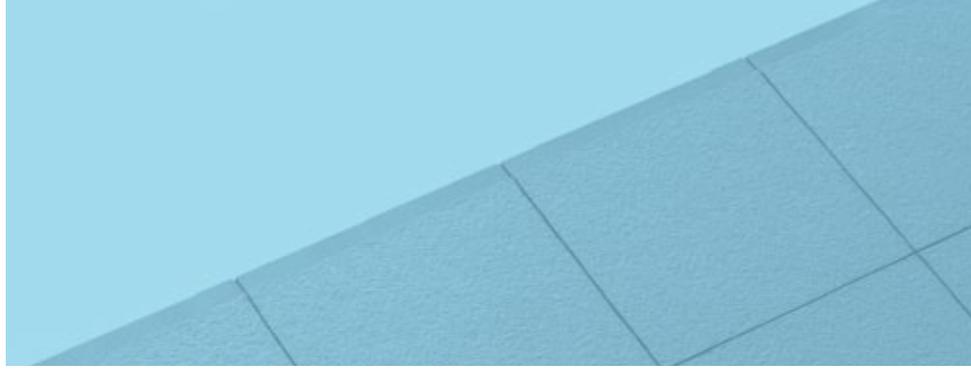


To build converging wireless networks  
(GSM, CDMA, W-CDMA and LTE)



Your mobile subscribers are adopting 3G services but the traditional 2G subscriber base keeps growing too. You face the need to expand both network layers for more capacity and coverage to improve both the quality of service and availability. And with the onset of LTE, you must further develop your networks and rationalize your investments to deliver profitable services. You need to grow your capacity today and re-allocate resources based on subscribers' demand tomorrow.

The Alcatel-Lucent Converged Radio Access Network (RAN) solution delivers Software Defined Radio (SDR), IP transport and other building blocks you need for flexible deployment and simple management of both your existing and new networks.



# How will your mobile networks evolve? How should you allocate your investments?

In the ever-evolving wireless mobile communication world, subscriber loyalty is driven by handsets, services and prices. As an operator, your focus is on providing services at the lowest price and at the lowest Total Cost of Ownership (TCO) to maintain your profits.

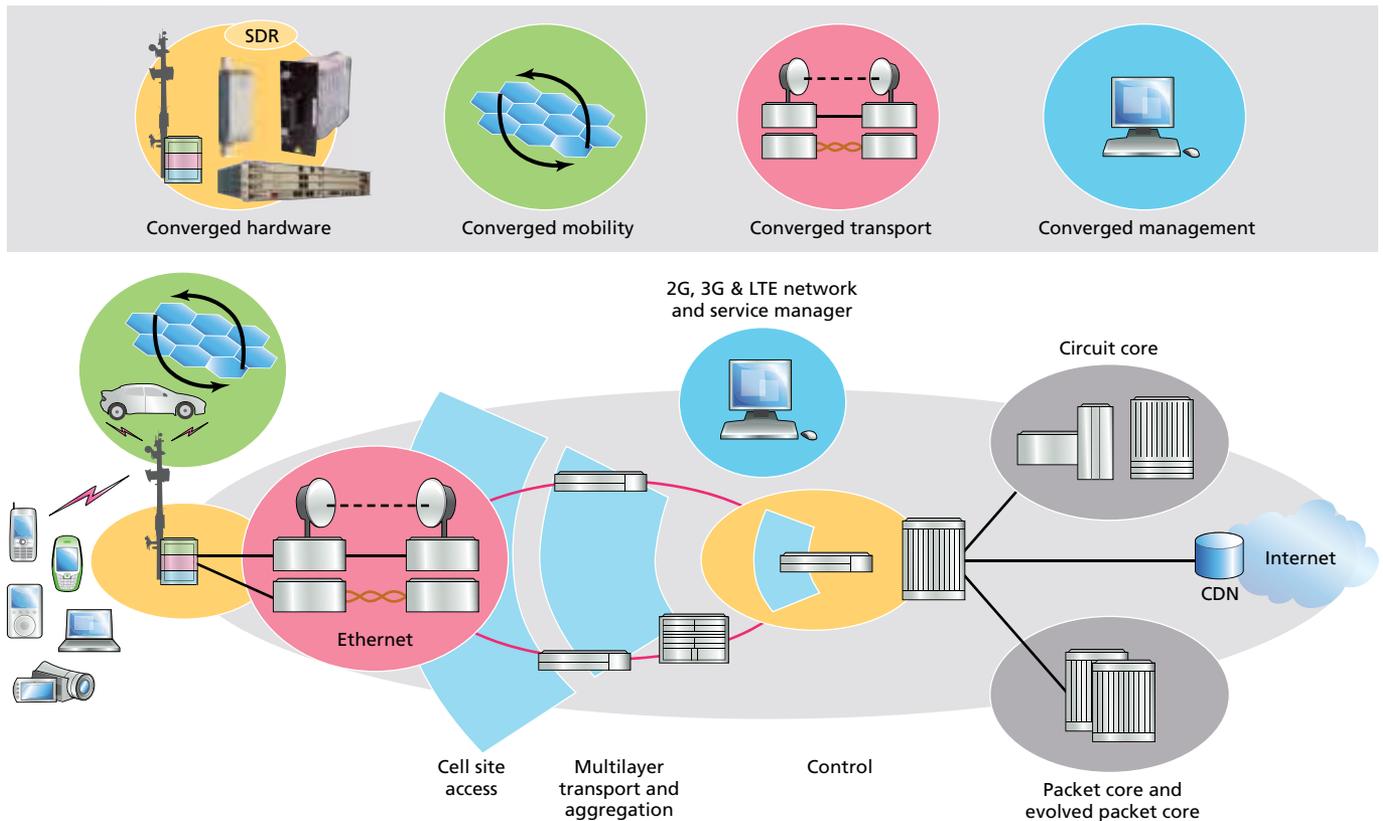
Technology evolution has led to the deployment of 2G (GSM) and 3G services (W-CDMA/HSPA or CDMA2000® 1X and CDMA® 1xEV-DO), which needs to keep growing. Long Term Evolution (LTE) is the next mobile broadband carrier and will allow over 100 Mb/s download transfers. Operators must balance development strategy, subscriber behavior, terminal availability, the competition's next move and investment costs.

To remain competitive and sustain your network growth at reasonable investment costs, you need to limit expenditures for new equipment, network management, site acquisition, site rental, installation, backhauling and power supply.

Evolving technologies lead to more compact and power-efficient products, capable of handling more traffic, which can be leveraged to rationalize the radio access and transport layers. The Alcatel-Lucent Converged RAN includes them all: Software Defined Radio (SDR), mobility features, converged transport, converged management center and converged controller. Converged RAN is the key to a smooth and cost-efficient network evolution.

**Figure1. The Converged RAN at the heart of your network**

## The converged RAN





**MULTISTANDARD BASE STATIONS**



**BASE BAND UNIT (BBU)**



**RADIO FREQUENCY (RF) MODULES**

*Alcatel-Lucent's BBU and RF modules are to be installed within your existing BTS and achieve high integration of several layers within a single cabinet.*

**A 2G/3G MULTISTANDARD SITE  
PROVIDES 40 PERCENT TCO SAVINGS  
COMPARED TO TRADITIONAL  
MACRO DEPLOYMENT**

## Converged RAN: hardware versatility and software flexibility for complementary layers

### Versatility by leveraging the installed base

A multistandard approach allows part of a system or equipment within a network to host several standards, such as GSM and W-CDMA or CDMA and LTE, with a unique management and control interface. This is currently achieved by the Alcatel-Lucent Multistandard Base Station (MBS), which integrate GSM, UMTS and LTE modules or CDMA and LTE modules within a single rack, and is managed by the Alcatel-Lucent OMC Portal.

Since 1999, multistandard design has driven the development of Alcatel-Lucent radio indoor/outdoor products to let your network evolve smoothly as new technologies emerge: from GSM to GPRS, EDGE, GERAN evolution, W-CDMA, HSPA, LTE and similarly CDMA2000 1X, CDMA2000 1xEV-DO Rev.0, Rev.A, Rev. B and LTE– the Alcatel-Lucent Multistandard Base Station adapts to your requirements. Distributed or integrated inside the cabinet, the Alcatel-Lucent modules include a Baseband Unit (BBU) and RF modules.

*Alcatel-Lucent nets four awards in CTIA's 2009 Emerging Tech Awards including the best "Network Infrastructure – Wide Area Network" Solution:*



Alcatel-Lucent's Converged Base Stations Strategy allows operators to smoothly evolve their Alcatel-Lucent CDMA installed base to LTE with maximum reuse of existing equipment. The products, part of Alcatel-Lucent's Converged Radio Access Network portfolio, use Alcatel-Lucent's existing Software Defined Radio (SDR) technology to enable operators to deploy both CDMA and LTE at the same time.

Since 1999, to enable a smoother transition for operators, Alcatel-Lucent has focused its development efforts on a multistandard approach for our indoor and outdoor radio products. And on February 5th 2009 we have marked this success by shipping our 620,000<sup>th</sup> Multistandard Base Station (MBS).

Alcatel-Lucent introduced the Multistandard approach for Indoor and Outdoor Base Stations; it allows 2G operators to upgrade their networks to 3G technologies, such as W-CDMA; and further to LTE, simply by adding additional modules inside the existing cabinet. The same principle applies for CDMA operators moving towards LTE.

This approach can help operators save up to 40% of Total Cost of Ownership (TCO) when compared with installing additional cabinets and allows a faster deployment because no extra space is required.



*Every vendor claims to have the best OAM solution, what we have seen from NPO, WQA and RFO shows that the toll capabilities were specified by real users to match their day to day work requirements. This is the type of tools that we need.*

NETWORK MANAGER, NORTH AMERICA OPERATOR

### Software flexibility with SDR modules

Are you planning to deploy or expand W-CDMA/LTE over GSM? Or LTE over CDMA?

The Alcatel-Lucent BBU will fit in your existing MBS to provide the processing capacity for W-CDMA or LTE. You can connect it using a CPRI link to either of the RF modules:

- The self-cooled Alcatel-Lucent Remote Radio Head (RRH), located close to the antenna
- Or to the TRDU RF module contained within the compact smart shelf, hosted inside the MBS or any other 19-inch rack

Similarly, you will deploy LTE over GSM, CDMA or W-CDMA with the complete range of Alcatel-Lucent modules.

Because the BBU and RF modules are based on Software Defined Radio technology, they offer the agility to reshuffle your network layers among GSM, CDMA, W-CDMA and LTE, according to your subscribers' behaviors. You may also optimize your revenue by choosing to favor high-end services such as CDMA2000 1xEV-DO, HSPA+ or LTE, rather than traditional voice services on GSM or CDMA2000 1X.

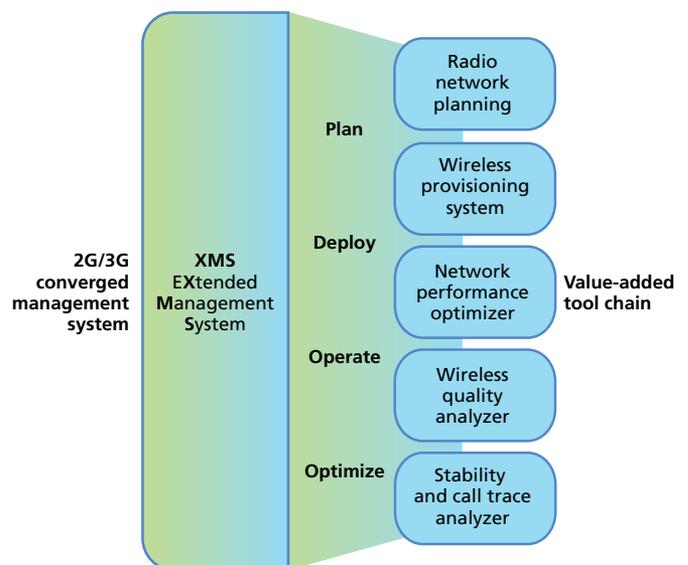
You can remotely reconfigure your network from the Alcatel-Lucent OMC portal, a client that connects to existing management interfaces. It lets you operate your network from one single point to facilitate complex operational tasks and reduce your operational expenses.

As your network grows, it becomes more complex, so Alcatel-Lucent has developed powerful tools to ease your global network operations:

- Radio Network Planning
- Wireless Provisioning System
- Network Performance Optimizer
- RF optimizer
- Wireless Quality Analyzer
- Stability Data Analyzer

These tools are within the eXtended Management System (XMS) and as a result, you can greatly improve and accelerate your network configuration and administration workload, which can lead to a significant reduction in your OPEX.

**Figure 2. The Alcatel-Lucent eXtended Management System offers all the tools you need to optimally manage your converged network**



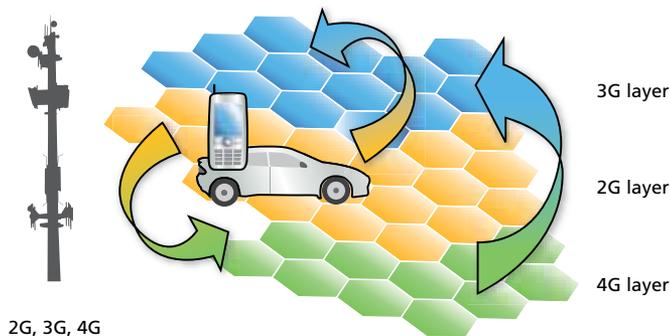


### Intelligent mobility across the layers

Common management of 2G, 3G and 4G resources increases your overall capacity. Alcatel-Lucent intelligent mobility features (Intelligent Multi Carrier Traffic Allocation, unified Radio Resource Management, among others) ensure traffic is intelligently distributed across 2G, 3G and 4G carriers, and at the same time prevents inter-layer handovers towards already congested cells. Your multi-layer network capacity is automatically optimized when you activate these features; additionally your handover performances are increased by 50 percent.

Alcatel-Lucent is also leading the way to seamless handoffs between CDMA and LTE: providing options such as eHRPD, Circuit Switch Fall Back and other interworking features to ensure excellent service continuity for operators.

**Figure 3. Alcatel-Lucent intelligent mobility features can help you better manage your multi-layer resources**





THE ALCATEL-LUCENT META END-TO-END ARCHITECTURE, SPANNING FROM CELL SITES TO THE CORE, ENABLES SERVICE PROVIDERS TO SIMPLIFY THEIR OPERATIONS THROUGH INTEGRATED NETWORK AND SERVICE MANAGEMENT.

## Sustaining the transport growth with META

To meet the growing demand for mobile broadband services and maximize profitability, your mobile transport networks must evolve to deliver increased bandwidth at a lower cost, while providing reliability and the current Quality Of Experience (QoE)

The Alcatel-Lucent Mobile Evolution Transport Architecture (META) provides an end-to-end network architecture that enables you to migrate and scale your network profitably (Figure 4). This architecture offers 2G, 3G and 4G services aggregation from the access network to the core network; it handles any type of transport protocol: IP, ATM, Hybrid (E1 over DSL). You can successfully serve the massive growth of mobile broadband services demand.

Coupling the optimal cost points of Ethernet with the proven scalability, availability and service-aware capabilities of multiprotocol label switching (MPLS), META enables mobile service providers to leverage existing infrastructure investments and evolve to all-IP networking at the pace of customer demand, and with the QoE customers have come to expect from traditional transmission services.

With META you can achieve up to 44 percent TCO savings and increase scalability and availability to enable broadband service delivery over any media — fiber, copper or wireless.

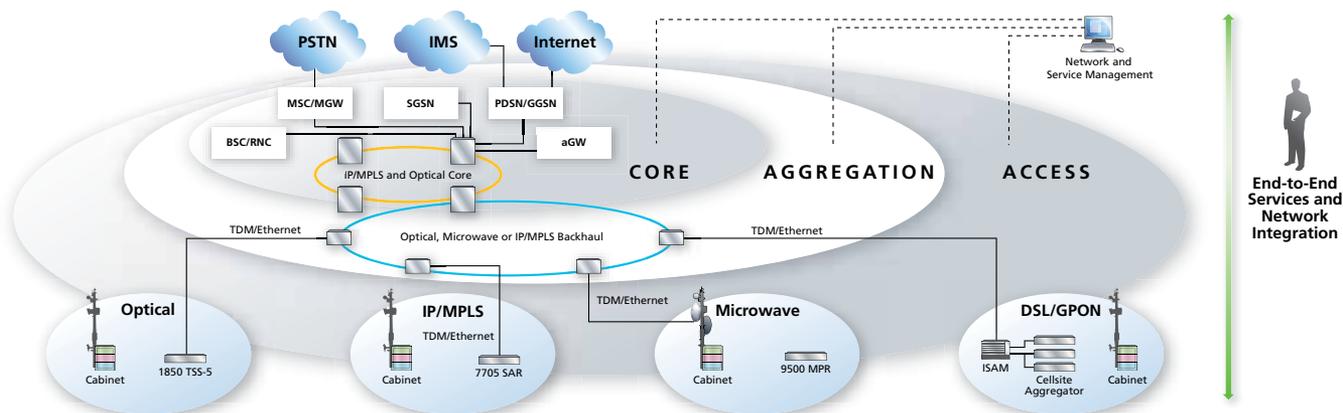


EASING CONTROLLERS INTEGRATION WITH A SINGLE AND COMMON HARDWARE PLATFORM

## Combination of controllers: BSC, RNC, MME

To complete the Converged RAN, Alcatel-Lucent delivers capacity flexibility of its 3GPP BSC and RNC within a single unit, thus reducing footprint requirements, easing the integration in the platforms and simplifying the migration from one technology to another. The synergy among the controllers will be further developed with the introduction of a single and common hardware platform to load BSC, RNC and MME software.

Figure 4. Mobile Evolution Transport Architecture is your solution to to sustain growth with end-to-end IP transport and guaranteed QoS



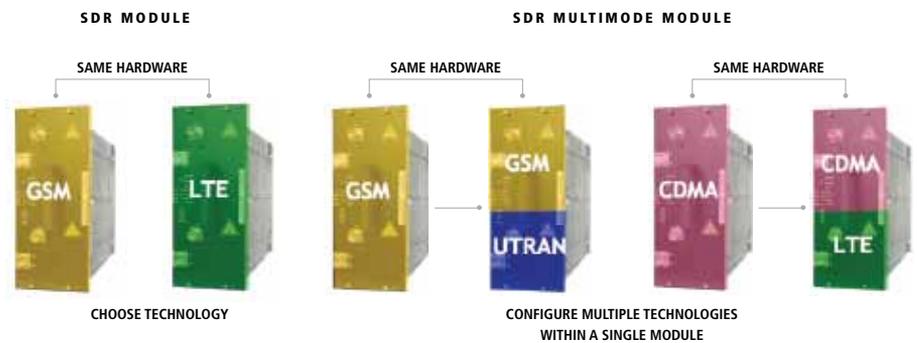
# The full range of Alcatel-Lucent SDR modules

SDR makes it possible to use your network management center to remotely allocate the modulation of your choice in the radio modules. GSM, CDMA, W-CDMA, or LTE: your network re-configuration will not require costly on-site intervention and you will enjoy the flexibility of reshuffling your network layers at will to adjust your resources according to your customers' behaviors. You may also optimize your revenue by choosing to favor high-end services such as CDMA2000 1xEV-DO, HSPA, or LTE rather than traditional voice on GSM or CDMA2000 1X.

1. The Alcatel-Lucent SDR baseband unit (BBU) supports W-CDMA or LTE, and provides up to 20 MHz bandwidth management to offer maximum LTE capacity to your subscribers.

2. For the RF part, the Alcatel-Lucent SDR approach offers maximum integration and flexibility — not just simple SDR modules with selectable modulation but also SDR multimode where a single module includes several power amplifiers or carriers and can configure each to the technology of your choice.

- RRH modules
  - Available in 40W and 60W versions
  - Allow two or three carriers
  - Offer multimode W-CDMA/LTE
- MIMO-RRH
  - Includes a twin power amplifier
  - Delivers 2x40W
  - Offers either single technology (CDMA, W-CDMA, or LTE) or multi-technology (W-CDMA/LTE or CDMA/LTE)
- MC-TRX plug-in
  - Equipped with one power amplifier (up to six carriers)
  - Delivers a total of 90W (67W ToC)
  - Can be combined among GSM, W-CDMA and LTE to deliver multimode
- MC-RRH module
  - Delivers MIMO 2x40W
  - Up to 8 carriers available
  - Can be combined among GSM, W-CDMA and LTE to deliver multimode
- Micro-RRH modules
  - Enhance W-CDMA or LTE hotspot/in-building coverage
- MCR B plug-in module
  - Multi-Carrier Radio B Module
  - Already deployed in CDMA networks
  - Supports CDMA and LTE with 2x2 MIMO operation



ALCATEL-LUCENT'S FULL RANGE OF SDR MODULES:  
RADIO MODULES (UP)  
BASE BAND UNIT (DOWN)

- TRU plug-in module
  - Integrated high efficiency amplifier
  - Reduces cell power consumption up to 75%
  - Supports CDMA and LTE
- TRDU plug-in module
  - Fits in the Compact Smart
  - Delivers 60 Watts
  - Includes a duplexer and filters
  - Allows three carriers
  - Offers multimode W-CDMA/LTE

ALCATEL-LUCENT'S FANLESS  
RRH FAMILY COVERS EXTENSIVE  
FREQUENCY BANDS TO MATCH YOUR  
LICENCES AND REFORMING PLANS

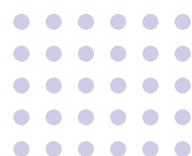


Alcatel-Lucent RF modules utilize the latest generation of high efficiency power amplifiers. The high output power is obtained from low input power consumption, which benefits OPEX. They also cover a wide range of frequencies, to cover your current and future licenses, as well as your possible reformatting opportunities: 700 MHz, 850MHz, 900 MHz, AWS (1700/2100 MHz), 1800 MHz, 1900 MHz, 2100 MHz and 2600 MHz.

Alcatel-Lucent SDR products allow you to adjust your network layer capacities quickly and easily, for each single cell, and control them from a unique management center. They use the latest power amplifiers and processors to achieve even more capacity within existing rack space and with minimum power consumption to help maintain your low OPEX targets.

**Table 1. The Alcatel-Lucent family of SDR modules covers all your spectrum requirements**

	BBU	RF MODULES						
	d2U	TRU	TRDU 60	RRH 40	RRH 60	RRH MIMO	MC-TRX MC-RRH	MCR B
SDR type	Mono	Multi	Multi	Mono	Multi	Multi	Multi	Multi
Frequencies (MHz)	Any	850, PCS, AWS	2100	850, 900, AWS, 1900, 2100	850, 900, 1900, 2100	700, 850, AWS, 1800, 1900, 2100, 2600	900, 1800	850, PCS, AWS





**DENSE URBAN**

## Let your network evolve with Converged RAN: scenarios

Alcatel-Lucent delivers Converged RAN, whatever your environment, since our modules are available for a wide set of frequencies and are compatible with any type of cabinet: indoor, outdoor, compact or distributed. You can extend, upgrade or even renew your infrastructure with a limited number of modules and reuse your existing assets to their maximum. For any site configuration, Alcatel-Lucent Converged RAN offers a suitable and optimized solution.



**URBAN**

The evolution of your network is partly driven by subscribers adopting new services, but your capacity is constrained by your available frequency spectrum. The following examples show how the Alcatel-Lucent portfolio enables typical network evolution, without the need for additional spectrum.



**RURAL**



WITH ALCATEL-LUCENT, FROM TODAY UNTIL THE ESTABLISHMENT OF LTE, YOU WILL REUSE ALL OF YOUR EXISTING EQUIPMENT AND INTRODUCE ONLY A VERY LIMITED NUMBER OF MODULES TO ADAPT YOUR NETWORK TO THE EVOLVING TECHNOLOGIES.



Figures 5 to 8 represent a network view of the installed base, with each block representing a pool of modules. This macro view of the resources shows how Converged RAN, with multistandard and SDR capabilities, allows you to protect your investments and reduce the need for additional CAPEX.

This first network matches existing network conditions. The frequency spectrum is assumed to be already available and it will remain over time:

- 850 MHz or 900 MHz: 10 MHz – bandwidth for coverage (country wide)
- 1800 MHz: 10 MHz – bandwidth for GSM capacity (urban area)
- 2100 MHz: 15 MHz – bandwidth for UMTS and LTE capacity

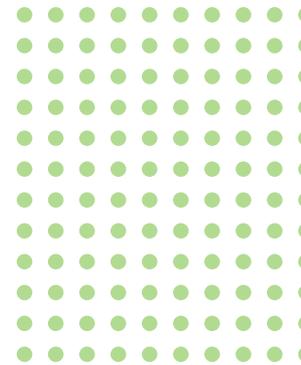
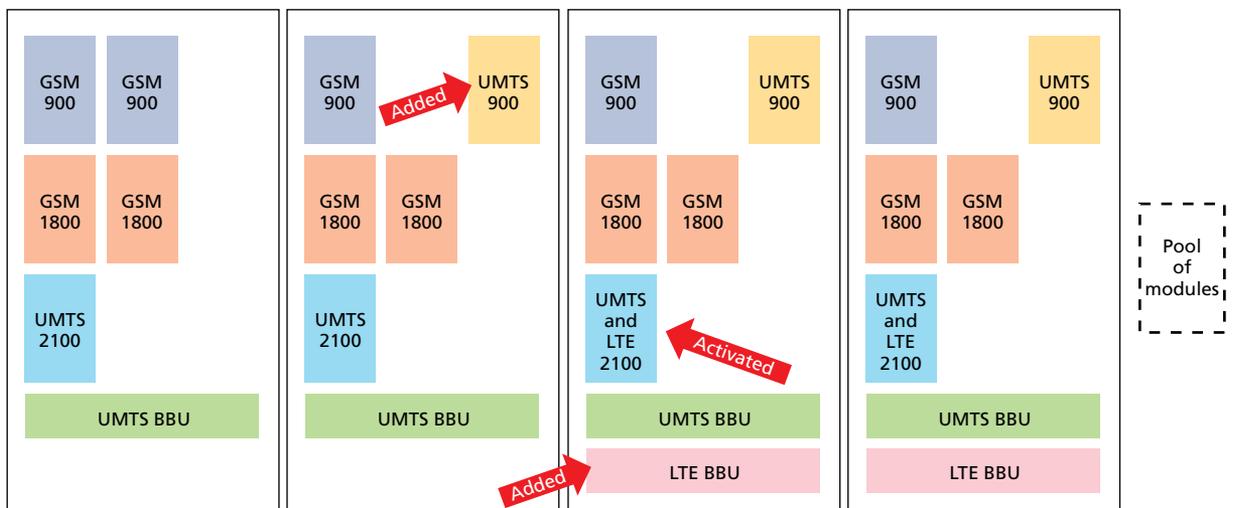


Figure 5. Evolution of an installed base with Alcatel-Lucent Converged RAN

Frequency band	Installed base Spectrum for			2009 Spectrum for			2010 Spectrum for			2012 Spectrum for		
	GSM	UMTS	LTE	GSM	UMTS	LTE	GSM	UMTS	LTE	GSM	UMTS	LTE
900 MHz	10 MHz	—	—	<b>5 MHz</b>	<b>5 MHz</b>	—	5 MHz	5 MHz	—	5 MHz	5 MHz	—
1800 MHz	10 MHz	—	—	10 MHz	—	—	10 MHz	—	—	10 MHz	—	—
2100 MHz	—	15 MHz	—	—	15 MHz	—	—	<b>10 MHz</b>	<b>5 MHz</b>	—	<b>5 MHz</b>	<b>10 MHz</b>





Each colored block represents a pool of modules of a given type for a given frequency.

- **2009:** As a first step, rearming the 900 MHz band to extend your W-CDMA coverage requires deploying a module with UMTS 900 capability. It is managed by the existing UMTS BBU and causes no other impact on your network.
- **2010:** Next, with the advent of LTE and availability of end-user devices, a dedicated BBU is introduced and the existing SDR UMTS/LTE modules will be reshuffled to match your bandwidth requirements.
- **2012:** Finally, whenever demand for LTE services grows, you simply need to reorganize your layers within the existing SDR modules.

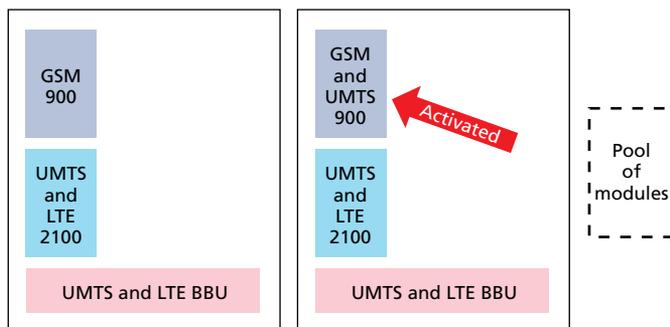
This example demonstrates the tremendous flexibility and reuse made possible with the Alcatel-Lucent Converged RAN solution. With it, you can reuse all of your existing equipment and introduce only a very limited number of modules when adapting your network to evolving technologies. Figure 6 demonstrates the case of a greenfield deployment, such as an area not yet covered with your current technology. The frequency spectrum is assumed to be already available and will remain over time:

- **850 MHz or 900 MHz:** 10 MHz – bandwidth for coverage (country wide)
- **2100 MHz:** 15 MHz – bandwidth for UMTS and LTE capacity
- **2010:** GSM remains the widest subscriber base, and UMTS keeps growing while LTE devices become available: you can maintain GSM 900 (or 850) countrywide and share the 2100 MHz among UMTS and LTE.
- **2012:** The distribution among 2G and 3G subscribers is inverting: your installed base can adapt accordingly.

This example shows that when deploying Alcatel-Lucent products, you won't need additional hardware to evolve your network layers when introducing and increasing LTE capacity.

**Figure 6. Greenfield deployment and evolution with Alcatel-Lucent Converged RAN**

Frequency band	2010 Spectrum for			2012 Spectrum for		
	GSM	UMTS	LTE	GSM	UMTS	LTE
900 MHz	10 MHz	—	—	5 MHz	5 MHz	—
1800 MHz	—	—	—	—	—	—
2100 MHz	—	10 MHz	5 MHz	—	5 MHz	10 MHz





The third network example demonstrates the case of a GSM network evolution towards LTE, without introduction of a 3G layer. The frequency spectrum is assumed to be already available and will remain over time:

- 850 MHz or 900 MHz: 10 MHz – bandwidth for coverage (country wide)
- 1800 MHz: 10 MHz – bandwidth for GSM capacity (urban area)

Each colored block represents a pool of modules of a given type for a given frequency.

- 2010: To cope with the still growing GSM demand in the network, you extend your capacity with SDR modules, used in GSM only.
- 2012: LTE devices are widely available for your subscribers and you decide to offer them a service. Since refarming has been made possible by your regulator, LTE introduction is possible based on the radio modules deployed earlier. You need to roll-out processing capacity for LTE: a BBU will be installed in each of the site targeted.

This example demonstrates how, with Alcatel-Lucent, you leverage your investments to offer new services at low cost.

Figure 7. Evolving from GSM to LTE with Alcatel-Lucent Converged RAN

Frequency band	Installed base Spectrum for			2010 Spectrum for			2012 Spectrum for		
	GSM	—	LTE	GSM	—	LTE	GSM	—	LTE
900 MHz	10 MHz	—	—	10 MHz	—	—	10 MHz	—	—
1800 MHz	10 MHz	—	—	10 MHz	—	—	5 MHz	—	5 MHz





The last network example demonstrates the case of a CDMA network transition towards LTE. The frequency spectrum is assumed to be already available and will remain over time:

- PCS: 10 MHz – bandwidth for coverage and capacity (country wide)
- AWS: 10 MHz – bandwidth for coverage and capacity (country wide)

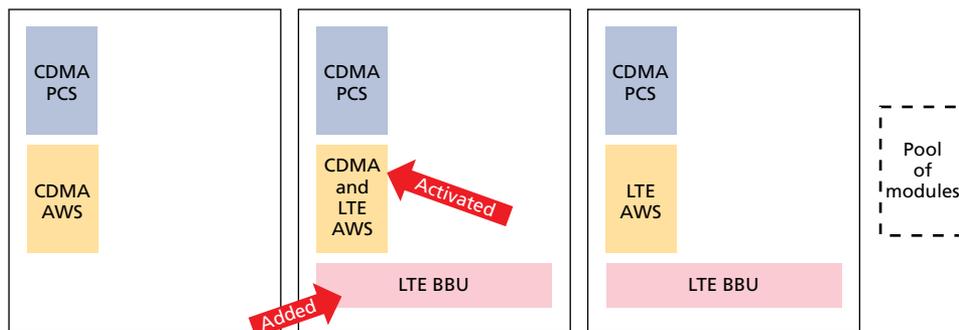
Each colored block represents a pool of modules of a given type for a given frequency.

- *Phase 1:* At first, within the existing CDMA cabinet, you will deploy an LTE BBU and activate the SDR modules to introduce LTE capability to your network, within the available AWS band.
- *Phase 2:* Whenever demand for LTE services grows, you simply leverage your asset from step one to deliver the services required.

These scenarios reflect current availability of end-user LTE devices. And layer reshuffling across the frequency spectrum requires RF optimization at each site, with or without new hardware introduction.

Figure 8. Transition of CDMA to LTE with Alcatel-Lucent Converged RAN

Frequency band	Installed base			Phase 1			Phase 2		
	CDMA	—	LTE	CDMA	—	LTE	CDMA	—	LTE
PCS	10 MHz/7	—	—	10 MHz/7	—	—	10 MHz/7	—	—
AWS	10 MHz/7	—	—	7 MHz/5	—	3 MHz	—	—	10 MHz



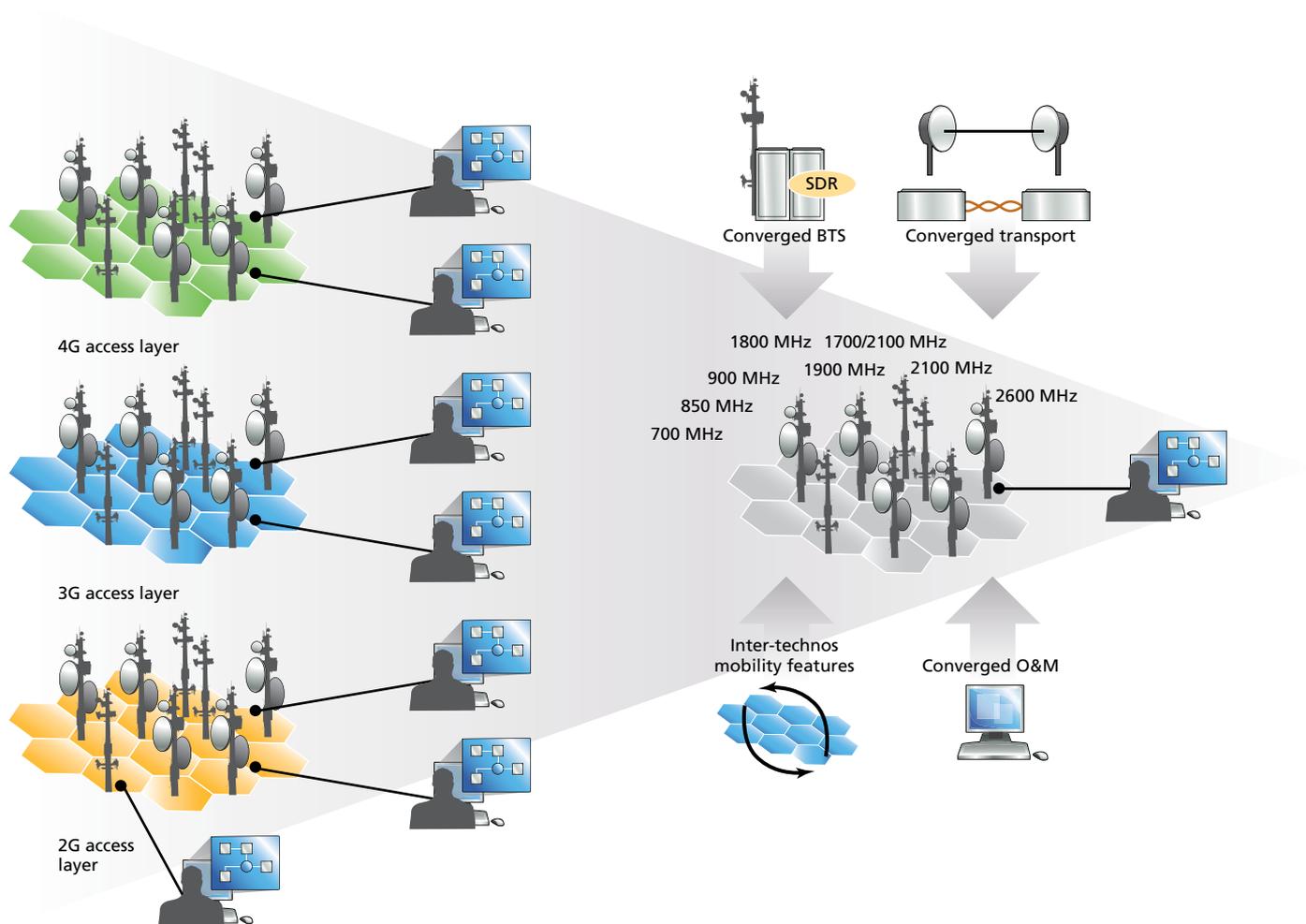
Alcatel-Lucent has developed the Converged RAN, an end-to-end approach to enable resources optimization, to accelerate your radio access network deployments together with QoS continuity over a cheaper transport network.

With Alcatel-Lucent Converged RAN you not only protect your GSM, W-CDMA or CDMA investments, but also ensure a simple path as you evolve your network to LTE.



*The Converged RAN by Alcatel-Lucent: “do not manage one layer per technology but one layer and a set of frequencies, with agility and with no compromise on backward compatibility.”*

Figure 9. Alcatel-Lucent Converged RAN: simplify your network with backward compatibility



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