Alcatel·Lucent

STRATEGIC WHITE PAPER

CDMA and LTE: Making the most of wireless broadband

An overview of strategies, issues and opportunities

Faced with increased demand for bandwidth-intensive services and rapidly changing subscriber usage patterns, wireless operators need an effective strategy for evolving to LTE networks. CDMA 2000-1x and 1x -EV-DO technologies offer a flexible and seamless evolution path. But how can operators make the transition from their reliable 3G networks to LTE, while protecting their investment — and satisfying their unique requirements concerning time to market, choice of migration path, introduction of VoIP and seamless interworking? Alcatel-Lucent helps operators meet these challenges with solutions that maximize spectrum utilization, reduce costs, provide seamless mobility and enable operators to remain competitive throughout the migration process.

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1. Introduction

The explosion of data services that transformed wireline services is now occurring for wireless operators, and this trend is intensified by the changing usage patterns of young end users, who often prefer data services, such as instant messaging, to voice services. With this transition from circuit- to packet-based traffic, wireless operators need all-IP networks that can support multimedia offerings at a lower cost per Mb. Next-generation LTE technology offers this cost-saving efficiency. But how do operators make a transition from their 3G CDMA networks to LTE?

CDMA 2000-1x (3G-1x) and 1x-EV-DO (EV-DO) technologies — also known as High Rate Packet Data (HRPD) in 3GPP2 Standards — provide a mature, smooth and stable evolution path to LTE. The key advantages of this path include investment protection and flexibility that allows service providers to remain competitive throughout the evolution process. But to fully benefit from these technologies, wireless operators need a migration strategy that addresses their own unique needs concerning time to market, choice of migration path, the importance of a technology ecosystem, VoIP and seamless interworking, as well as spectrum efficiency and CAPEX.

For example, CDMA service providers have several options to transition their existing networks to LTE. Recently ratified 3GPP2 standards for eHRPD enable seamless migration directly from EV-DO or CDMA 3G-1X to LTE, without first deploying W-CDMA or other 3GPP-based technologies. But no matter when LTE is deployed, operators need a strategy for continued evolution of their 2G and 3G CDMA networks — in parallel with LTE.

A phased transition period, where both 3G CDMA and LTE technologies co-exist, can optimize performance during migration. Alcatel-Lucent's Converged RAN solution enables operators to manage a single network with a flexible combination of technologies. Consequently, CDMA operators may benefit by upgrading their EV-DO networks to Rev. A+ and/or Rev. B before (or even after)introducing LTE, since EV-DO and LTE will interoperate for many years during the transition. During this period, EV-DO upgrades may be more cost effective than deploying additional LTE capacity. And operators can benefit from higher data rates, increased capacity and greater network efficiency — through effective use of EV-DO Rev. B,
EV-DO Rev. A+ and 1X Enhanced technologies.

This white paper examines these topics in more detail — and points out how the reliable performance and flexibility of CDMA and easy introduction of LTE using the Alcatel-Lucent Converged RAN solution can be used to remain competitive throughout the evolution process, no matter which migration strategy is chosen.

2. Drivers for next-generation wireless

Young wireless users are playing a key role in the evolution to next-generation networks, by transforming the way voice and data services are accessed and used for both business and consumer applications. In addition, new machine-to-machine (M2M) applications will redefine "wireless users" and support different needs and usage patterns. Service providers must evolve their networks to meet the demands of these new end-user segments — while minimizing costs. These trends offer a preview of the services likely to dominate mobile markets in the years ahead.

2.1 Key end-user market trends

The millennial market segment – Over the next five years, the "millennial" market segment, aged 11 to 33, will have a profound effect on wireless services. Simple mobile data services are currently growing at annual rates over 40 percent. But average users and millennials have distinctly different usage patterns. While younger subscribers are still interested in voice services, they have supplemented them with alternative communications methods, such as text messaging,

e mail, instant messaging, photos, video and online games. These users are also strong adopters of social networking sites, such as Facebook, and peer-to-peer services, such as audio and video sharing. Both wireline and wireless networks are used to access these offerings.

Business users – IT departments and individual business users are turning to mobile applications like collaboration, video conferencing and data transfer applications to connect employees to corporate data when and where they need it. A Yankee Group survey found that nearly 80 percent of responding enterprises now provide mobile access, plan to upgrade to mobile access or are evaluating the possibility for the future (Source: Yankee Group, November 2007). Business users are looking for enriched Quality of Experience (QoE) and service, and Alcatel-Lucent primary research suggests that they will be willing to pay more for these services and applications, when speed is important to the application.

Machine-to-machine applications – Finally, a growing number of businesses across many sectors are investigating M2M applications to transform the way they do business. These applications have broad potential; for example, they can be used for video surveillance and home security, automated meter reading, remote equipment monitoring, fleet management and public safety. As a result, the United States enterprise M2M cellular service market is expected to reach nearly 20 million connections by 2011, despite network operators' lack of steadfast leadership. The steadily increasing average annual connection growth rate will be close to 20 percent during the same period (Source: Yankee Group, July 2008). Given their diversity, M2M applications require a wide range of products, connectivity and support.

2.2 Challenges for service providers

Increasing Internet traffic – So far, the expanded Internet traffic generated by young subscribers has not been accompanied by a "willingness to pay." Consequently, wireless operators have controlled and contained the growth of mobile data services — to avoid potential congestion that could degrade service to higher paying customers. Existing 3G networks can handle current levels of voice and data traffic, but they will not be cost effective for carrying large volumes of lower-value, high-bit-rate data traffic.

Open access – Competitive tactics, technology trends and regulatory actions are now combining to make open access a reality. Competitive operators are pledging to adopt an open-access model that will allow end users to have the universal, easy access they demand. User devices are becoming more oriented to open application creation, as exemplified by the Apple iPhone, and nearly 50 companies have joined the Android Open Handset Alliance. In addition, spectrum auctions are lowering barriers to new entrants and more customer-friendly business models. To reflect this new reality, operators must transform their business models to enable both traditional user-paid revenue and revenues from other sources, such as ad-funded applications, premiums for advanced features or converged applications across multiple access methods and devices. Networks must also provide the scalability, agility and QoS the new models and applications require.

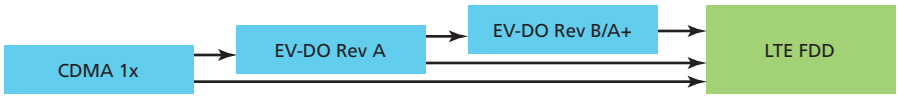
Balancing complex requirements – Wireless operators must deploy next-generation mobile networks that can meet the expectations of younger users, while remaining cost effective in a changing operating environment. This crucial step will require enough agility to remain competitive in an unpredictable marketplace, while reducing the cost per Mb of delivering complex new services. It also requires a solid evolution strategy that can combine current revenue tactics with a long-term business strategy that introduces revenue streams from new sources, while minimizing customer churn, especially among the millennial segment.

Creating an LTE ecosystem – Almost all GSM, W-CDMA, TD-SCDMA and CDMA operators are embracing LTE as their preferred next-generation mobile network technology. This widespread acceptance will facilitate development of a robust ecosystem of chipset, device and infrastructure vendors, helping to support successful introduction of LTE.

3. Wireless network evolution options

Service providers with CDMA networks have several options for how to make the transition to LTE networks, as shown in Figure 1, and migration strategies may differ.

Figure 1. Primary CDMA data evolution paths



The following factors need to be considered when identifying the appropriate technology, timing and steps to take.

3.1 Time to market

Many network evolution decisions grow out of a service provider's strategic timing and spectrum assets. Some prefer to be leaders who break new ground, while others may choose to wait until the network ecosystem matures, when handset costs and risks are lower and many compelling applications are available to drive demand for the capabilities of those new handsets and networks.

In all cases, service providers can benefit from continued evolution of their 3G networks, based on CDMA 3G-1x and EV-DO, in parallel with LTE technology introduction. For example, this approach can support data rate and capacity improvements with EV-DO Rev. B and EV-DO Rev. A+. As a result of these improvements:

- Market leading operators can continue addressing the demands of their customer base and remain competitive with other 3G service providers while the technology matures and the LTE ecosystem develops.
- Other operators can offer supplemental data plans and popular data applications along with traditional voice services. These offerings can supplement declining voice income with data and roaming revenues — and help minimize customer churn, especially within the millennial market

3.2 Ecosystem development

A migration strategy built on gradual evolution can take advantage of a more developed ecosystem. Historically, end-user devices take time to develop and gain wide usage in the marketplace. It also takes several years for devices to drop in price and become cost–friendly for the average user.

In the evolution to LTE networks, devices initially need to support multiple technologies, resulting in higher costs for early adopters. But over time, economies of scale will drive LTE device costs down, and the global focus on LTE can trigger a transition to LTE in developing markets, where low cost is crucial. While the next-generation wireless ecosystem is maturing, CDMA networks can continue to grow and support a wide range of services and traffic types.

Alcatel-Lucent is promoting development of the LTE ecosystem through the ngConnect Program, which was officially launched with 14 member companies at Mobile World Congress 2009 in Barcelona. This collaborative program brings together leading industry stakeholders who will shape and enable the direction of LTE content, applications and devices, including both single-mode and multi-mode devices, such as those supporting CDMA and LTE.

Partner ecosystems have proven their effectiveness in moving complex innovations into the mainstream. The broad spectrum of companies in the ngConnect Program will also work to remove business and technical barriers, define new business models, accelerate mass adoption of new services and devices, and speak to the market with a strong collective voice.

The goals of creating this open LTE ecosystem include:

- Attracting open innovation
- Enabling new business models
- Supporting continuous sharing of experience between wireline and wireless access
- Accelerating adoption of new devices and services
- Reducing costs for addressing complex customer requirements

4. Alcatel-Lucent vision for CDMA evolution to LTE

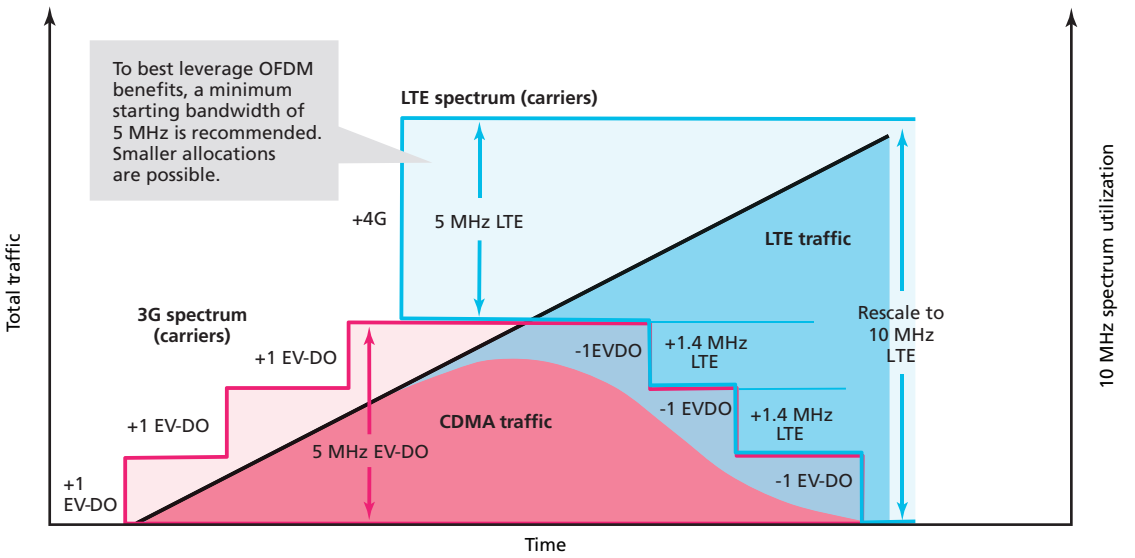
CDMA technology provides a mature, stable and seamless path to LTE. It offers substantial flexibility when operators are choosing a next-generation wireless technology — and deciding when to make their transition. With its narrow bandwidth requirements, CDMA technology facilitates in-band subscriber transition. Operators can use 1.25 MHz for CDMA and leave the rest of their spectrum open. This ongoing CDMA support can keep operators competitive — with high data rates and throughputs — until the LTE ecosystem matures and economic factors indicate the time is right for a full transition.

Alcatel-Lucent can support any migration path shown in Figure 1, with a strategy that addresses the specific requirements of each wireless operator. Because operators may employ various risk management strategies in the transition to an all-IP LTE long-term network, Alcatel-Lucent supports multiple approaches that allow graceful introduction of one technology at a time, with efficient spectrum and subscriber migration to reduce operator risk along the way. These approaches leverage 1X circuit voice, 1xEnhanced, EV-DO VoIP and IMS technologies as tools to implement an operator's preferred strategy. For example, an operator could choose to incorporate VoIP on EV-DO Rev. A then migrate to LTE VoIP or, at the other extreme, support traditional 3G-1x voice alongside LTE for data.

4.1 Maximizing spectrum utilization

Because CDMA can grow in 1.25 MHz increments, it helps reduce risk for operators who plan to deploy in a new spectrum band. A phased transition period can be planned, where both 3G CDMA and LTE technologies are deployed. This approach allows for a more gradual migration of subscribers to LTE, and bandwidth can be increased and decreased more gradually in the appropriate networks. As shown in Figure 2, separate spectrum must be assigned to 3G and LTE. Initially,

Figure 2. CDMA enables efficient spectrum and subscriber migration



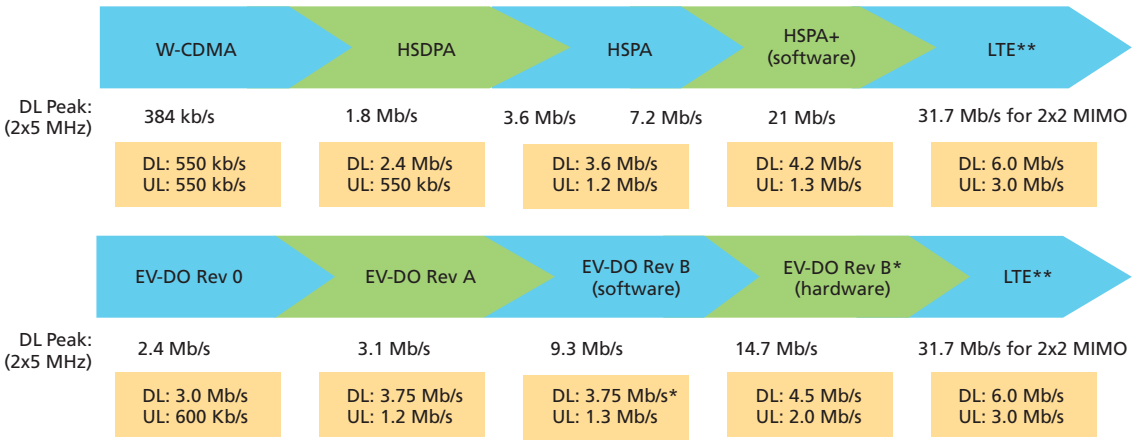
3G traffic will grow, then peak and decline as LTE traffic takes off and increases. Efficient spectrum utilization is very important during this migration period, and the narrowband nature of CDMA allows a smooth path in terms of maximizing bandwidth effectiveness.

In addition to this basic benefit of CDMA technology, 3G-1x offers many voice capacity improvements that can help maximize spectrum availability for LTE, even as voice usage and the number of subscribers grow. These enhancements include advanced codec techniques like EVRC-B, interference cancellation and mobile receive diversity — and other standards-based improvements, such as 1x Enhanced. When all these enhancements are combined, voice capacity can be increased from 26.4 Erlangs per sector-carrier, potentially, up to 94 Erlangs per sector-carrier, if all mobiles are compatible with the latest technology.

4.2 Remaining competitive

Alcatel-Lucent can keep wireless operators competitive regardless of which technology path they choose. EV-DO and HSDPA are expected to provide comparable throughput and peak rates — through upgrades to Rev. A/Rev. A+/Rev. B and HSPA+, respectively — and these technologies will arrive at LTE at roughly the same time. CDMA operators can benefit from Alcatel-Lucent market leadership in CDMA evolution, which includes a commitment to enhancing EV-DO with a comprehensive transition plan to LTE. As shown in Figure 3, this evolution path will provide significant improvements in CDMA forward and reverse link peak data rates and throughput. CDMA operators may choose to upgrade their EV-DO networks before or after they introduce LTE, while EV-DO and LTE interoperate during the transition. During this early phase, it may be more cost effective to upgrade existing EV-DO networks rather than deploy additional LTE capacity.

Figure 3. Technology Evolution Paths – Competing Pre-4G Technologies



DL = Downlink
UL = Uplink
DL/UL = Average aggregate throughputs per sector (in 5 MHz)
* with Rev A+ hardware upgrade; fully backwards compatible with existing devices
** performance in larger bandwidths is significantly different

EV-DO Rev. B benefits – The Alcatel-Lucent Radio Access Network (RAN) software upgrade to EV-DO Rev. B offers peak data rates of 9.3 Mb/s downlink and 5.4 Mb/s uplink — up to three times higher than the rates provided by Rev. A. In addition, the perceived user data experience and net throughput are significantly improved by Rev. B, when compared to providing more capacity with an equivalent number of Rev. A carriers. To fully benefit from many of these capacity gains, operators must deploy Rev. B handsets — and upgrade multiple Rev. A carriers to Rev. B in the same band class within 10 MHz bandwidth.

EV-DO Rev. A+ options – Operators can also leverage a hardware upgrade to Rev. A+. This provides reverse link interference cancellation technology that enables significant price/performance improvements.

Operators do not have to choose between Rev. A+ or Rev. B. They may deploy one or both technologies based on market conditions and competitors' upgrade plans. In fact, the maximum performance improvement can be gained by deploying both Rev. A+ hardware and Rev. B software, resulting in a peak downlink rate of 14.7 Mb/s. All existing EV-DO devices are supported in the same spectrum when upgrading to Rev. A+ and Rev. B.

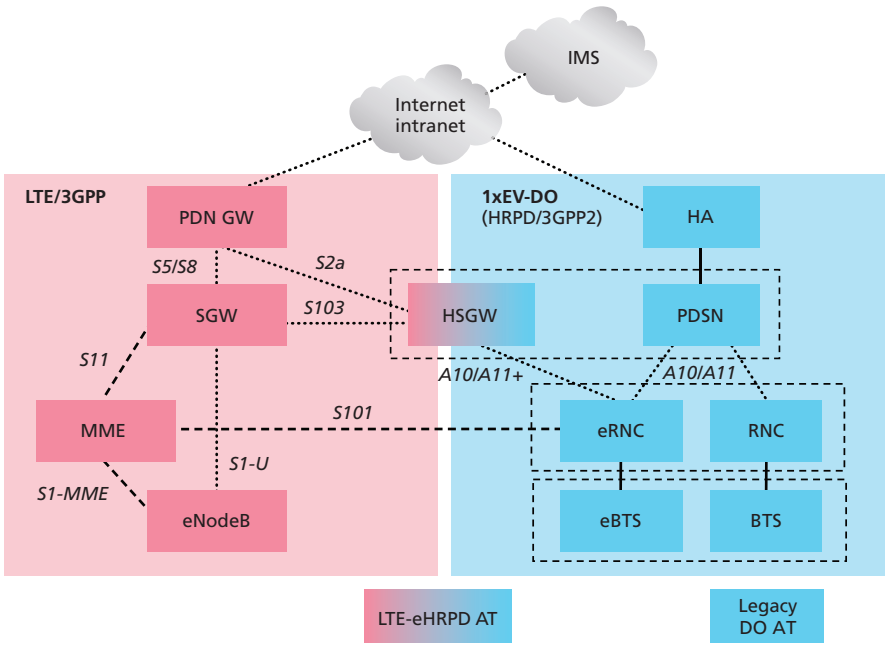
In brief, the Alcatel-Lucent evolution path will support continual improvements within CDMA — including increased VoIP capacity, higher peak data rates for forward and reverse links, and greater throughput.

4.3 Seamless mobility through CDMA/LTE interworking

Seamless mobility will be critical for successful LTE deployment, because LTE coverage will not be ubiquitous from its onset. Instead, operators will implement LTE in affordable stages. LTE deployments will begin in areas where data traffic is most concentrated to minimize cost per Mb and maximize spectrum efficiency. Then LTE expansion will proceed gradually into less critical areas, as budgets allow, ultimately enabling ubiquitous coverage. Because end users will demand uninterrupted coverage for their data services throughout this process, seamless handoff between technologies is crucial to make the migration transparent — and keep customers satisfied.

Alcatel-Lucent is leading efforts to create a network-assisted solution for seamless EV-DO (HRPD)/LTE mobility, which incorporates standards development, end-to-end solution definition and trials. Evolved HRPD (eHRPD) is an evolution of High Rate Packet Data (HRPD) which enhances traditional EV-DO to enable future seamless IP mobility with LTE, A combined EV-DO/eHRPD and LTE network is illustrated in Figure 4.

Figure 4. LTE-eHRPD interworking end-to-end network architecture



AT: Access terminal
eRNC: Enhanced RNC
HA: Home agent
HRPD: High rate packet data
HSGW: HRPD serving gateway
LTE: Long term evolution
MME: Mobility management entity
PDN GW: Packet data network gateway
PDSN: Packet data serving node
RNC: Radio network controller
SGW: Serving gateway

A network-assisted solution based on eHRPD offers key advantages over a multi-radio handset solution. First, it can improve handoff performance while eliminating the need for two simultaneous transmitters in the handset — which reduces handset cost and complexity and maximizes battery life. By interconnecting the LTE system with the EV-DO system through a network signaling tunnel, LTE/EV-DO handsets can pre-register and setup their sessions in EV-DO while still connected to LTE. As a result, when they move into the EV-DO network to complete a handoff, users will not perceive a break in service. Because of the inter-network signaling link, handsets can accomplish this handover with virtually no loss in service, despite using only one transmitter. Alcatel-Lucent is driving standards to specify these signal tunneling interfaces and other handoff optimizations, which will be built to open standards in implementation.

Upgrading EV-DO networks to support eHRPD requires software upgrades of the EV-DO RNC and base stations as well as an upgrade of the PDSN to support HRPD serving gateway (HSGW) functions. To support eHRPD, existing EV-DO networks must also implement the following changes:

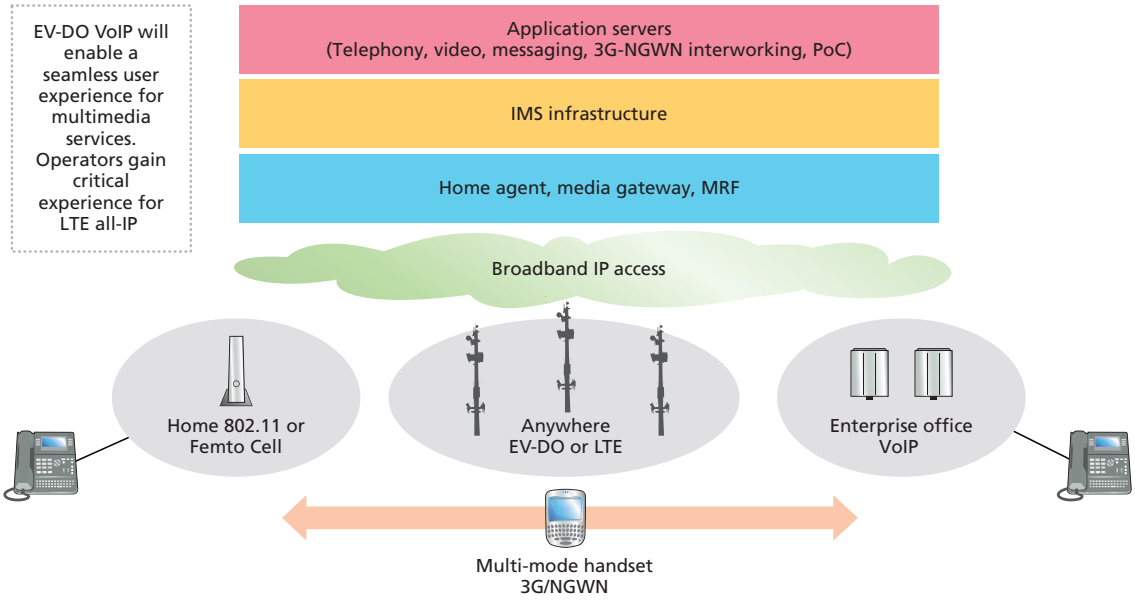
- The IP mobility anchor must move from the Home Agent (HA) to the LTE PDN Gateway (PDN GW).
- The mobility management model must change from client-mobile IP to proxy mobile IP (PMIP).
- The Foreign Agent in the PDSN will not be used. Instead, the HSGW implements PMIP and the handset uses simple IP for packet data session assignment.
- Switch from PAP/CHAP authentication to EAP-AKA. This is a more secure method which is common to the EPS-AKA authentication method used for LTE access which conforms to 3GPP standards.

Interworking an eHRPD network with an LTE network will require new multi-mode eHRPD/LTE user equipment and management and bearer traffic handoffs been the LTE Evolved Pack Core (EPC) and the eHRPD Core elements. Alcatel-Lucent is developing its own EPC solution which is an integral part of the Alcatel-Lucent end-to-end LTE architecture. It uses high-performance, purpose-built platforms that leverage Alcatel-Lucent's extensive experience and leadership in service-aware, IP/MPLS routing with advanced QoS and dynamic mobility and policy management. It also incorporates Alcatel-Lucent's strengths in integrated end-to-end network and service management to provide a complete CDMA EV-DO/eHRPD to LTE interworking solution supporting seamless handover of subscriber data services.

4.4 IMS and VoIP — critical enablers for LTE services

CDMA service providers can start deploying IMS and VoIP capabilities using EV-DO Rev. A VoIP and QoS, as shown in Figure 5. This approach can deliver a seamless, access-agnostic user experience for voice telephony supplemented by multimedia services, giving operators a competitive edge when they ultimately migrate to next-generation radio access. It also minimizes the risks involved in introducing new technologies, by avoiding the need to transition to VoIP and LTE simultaneously. In addition, having an IMS VoIP service infrastructure in place on top of EV-DO radio access will make the "rich voice" service experience available to users over a much broader area, if an operator chooses a phased deployment of next-generation radio access.

Figure 5. Leveraging IMS and VoIP for seamless all-IP service model



As a leader in bringing end-to-end mobile VoIP solutions to market, Alcatel-Lucent has completed many years of R&D and testing — to produce a high-quality service offering that operators can leverage for mobile networks. Field testing has demonstrated quality and capacity that is superior to today's cellular networks, and functionality has been integrated and tested end-to-end with multiple ecosystem partners who provide handsets, clients, RAN, packet core and IMS core networks.

4.5 Interworking 3G-1x voice with LTE data

CDMA standards permit the following three approaches to leveraging the existing 3G-1x voice network when migrating to LTE:

- **3G-1x circuit switch fallback** – This approach is appropriate when LTE is used for data only, and 3G-1x circuit voice is used for all voice calls. LTE coverage overlaps 3G-1x coverage. No IMS VoIP is required. However, dual-mode handsets will not be capable of simultaneous voice and data service.
- **LTE VoIP interworking with 3G-1x circuit networks -Call delivery only** – This approach is an option when LTE is used for voice (IMS VoIP) and data. If users' home networks are well covered with LTE access, handoff is not typically required, but users also need support while roaming. In these cases, an IMS VCC application server with an IMS Media Gateway call anchor delivers calls to the 3G-1x circuit voice network. Therefore, calls are delivered regardless of the network users are in — allowing them to rely on a single mobile number.
- **LTE VoIP interworking with 3G-1x circuit networks -Voice call continuity** – This approach is appropriate when LTE is used for voice (IMS VoIP) and data, and 3G-1x circuit voice provides support when users move outside LTE coverage areas. Handoff is required to assure uninterrupted calls for users because LTE coverage is spotty within the home network area. In addition to call delivery, calls will hand off from VoIP in LTE to the 3G-1x Circuit Mobile Switching Center.

These three options provide maximum flexibility when operators combine circuit-switched voice and VoIP to supplement their LTE deployment strategy.

4.6 Investment protection

Alcatel-Lucent leads the industry in bringing LTE solutions to market, taking an active role in developing 3GPP and 3GPP2 standards, LTE/CDMA interworking, technological expertise, mobile high-speed data backhaul solutions, end-to-end IP solution integration and partnering to development a strong ecosystem. As a result, the Alcatel-Lucent Converged RAN solution allows operators to manage a single network with a flexible combination of technologies. The evolution path for converged BTS, converged IP Networking and converged OA&M includes the following investment protection.

Leverage converged base station assets to reduce capital expenditures

Support for multi-standard technologies – Alcatel-Lucent converged base stations support multi-standard technologies, which allows significant reuse of existing base station assets, including cabinets, power supplies, battery back-up, RF assets, antennas, and transport. These base stations are LTE-ready and are equipped with (or can be upgraded to include) software-defined radios. As a result, operators can upgrade to LTE with a minimal or zero-footprint impact. LTE-ready base stations also offer high RF flexibility to match various spectrum constraints, supporting both new and existing spectrum. Simultaneous CDMA and LTE operation is possible using the software-defined radios.

Designs that reduce TCO – Next Generation Alcatel-Lucent base stations are optimized for transition from CDMA to LTE, with reduced Total Cost of Ownership (TCO) and eco-friendly design. Targeted to meet a range of capacity demands, these base stations provide for single- and multi-band configurations in a minimal base station footprint. Flexible modular designs and highly integrated modules enable higher efficiency and reliability, simplified sparing and faster commissioning. Software Defined Radios and CPRI-based interfaces provide simultaneous multi-technology support (CDMA and LTE), as well as the ability to use the same assets in multiple deployment applications. These capabilities provide flexible options for supporting LTE deployment in the same band as CDMA or in a separate band.

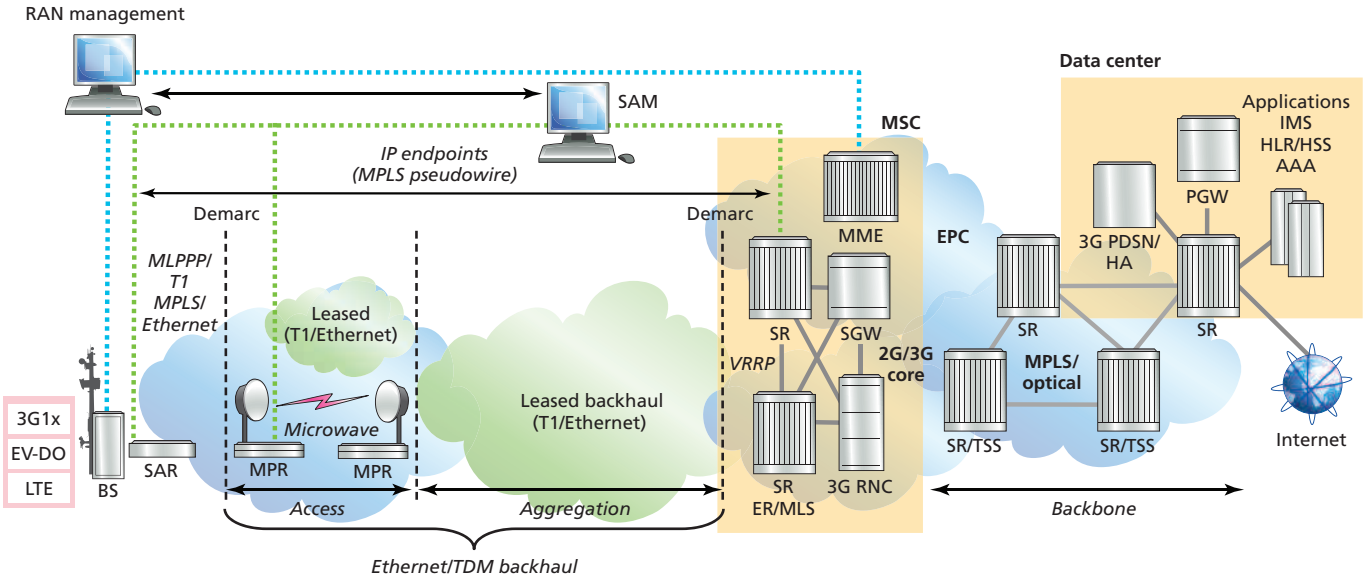
Reduce backhaul costs through converged IP networking with shared transport

The Alcatel-Lucent Mobile Evolution Transport Architecture (META) solution provides a comprehensive product portfolio for the evolution of mobile transport networks from TDM to all-IP technologies. This converged IP networking solution enables easy and efficient introduction of next-generation (all-IP) technologies, while dramatically reducing 2G and 3G transport OPEX. It includes unmatched QoS and integrated management support for all mobile services, increased network optimization and capacity and improved cost per Mb.

By leveraging the META solution with existing Alcatel-Lucent CDMA base stations, CDMA and LTE backhaul can be aggregated and shared efficiently on a single Ethernet backhaul network. In addition, when leveraging Alcatel-Lucent microwave or optical backhaul, base stations can use a combination of leased and private backhaul, with optimized aggregation capabilities at the base station, further reducing OPEX costs.

Figure 6 shows how Alcatel-Lucent CDMA networks can use an existing Service Aggregation Router (SAR) as the Ethernet aggregation device to support CDMA as well as LTE traffic. Ethernet interfaces can be aggregated from multiple sites onto existing SARs deployed to support CDMA Ethernet backhaul.

Figure 6. CDMA backhaul architecture for Internet Protocol backhaul (IPBH), Ethernet backhaul (EBH) and LTE



The Alcatel-Lucent transport solution provides advanced QoS capabilities to manage and prioritize LTE applications along with CDMA applications — and provide fair traffic management treatment of these services across the Ethernet access transport network. As with CDMA applications, LTE applications will be encapsulated in pseudowires for transport across the Ethernet access transport network.

The same Service Routers (SRs) deployed to support CDMA IPBH and EBH applications can also be used to aggregate and backhaul LTE traffic coming from the eNodeBs. Provisioning and monitoring of these new LTE services will be provided with the same Service Aware Manager (SAM) system used to manage the end-to-end CDMA backhaul network.

Simplified operations with a converged OA&M integrated management solution

Alcatel-Lucent provides a comprehensive converged OA&M integrated management solution for CDMA operators who plan to migrate to LTE. This solution leverages and extends already deployed OA&M assets, as well as field-proven wireless and IP OA&M applications. As a result, operators can take an integrated approach to managing their end-to-end CDMA RAN, LTE RAN, LTE EPC and the IP/MPLS network — with a single operational management system.

Alcatel-Lucent offers a range of tools and capabilities to address operators' management challenges in the planning, deployment, network operation and network optimization stages. Key features include:

- Troubleshooting wireless end-to-end bearers over a flat IP/MPLS network using service-aware management tools
- Multi-standard radio network planning leveraging CDMA RAN knowledge to ensure an optimized and integrated LTE design
- A strong mass LTE provisioning system for error-free configuration, fast roll-out and audits

- Plug-and-play eNB and self-organized/self-optimized RAN for rapid roll-out and tuning
- Centralized security management, single sign-on and first-alert capability
- Multi-standard network QoS optimization with counters, traces and outage diagnostics
- Multiple platform deployment options which accommodate different scalability needs and provide system resiliency

5. Conclusion

CDMA technologies provide a mature, smooth and stable evolution path, which offers investment protection, flexibility and important advantages for remaining competitive during the evolution to LTE. Alcatel-Lucent can help service providers meet the key challenges of migration regardless of the technology path chosen.

Alcatel-Lucent offers a comprehensive product portfolio — with CDMA RAN, LTE RAN, META, LTE EPC and IMS VoIP solutions. These solutions support a straight-forward migration path to seamless network-assisted CDMA/LTE interworking, reliable end-to-end VoIP and shared transport options to minimize CAPEX and OPEX during the transformation to all-IP networks.

Alcatel-Lucent has launched the ngConnect Program to bring together leading industry stakeholders who will shape the direction of LTE content, applications and devices, including multi-mode devices that can support both CDMA and LTE.

The Alcatel-Lucent Converged RAN solution provides the following key benefits and capabilities:

- Converged base stations support multiple technologies — offering strong investment protection for migration to LTE, with significant reuse of existing base station assets
- eHRPD technology supports converged inter-technology mobility — by enabling CDMA networks to seamlessly interwork with LTE networks
- The Alcatel-Lucent META solution supports converged IP networking — in which CDMA and LTE backhaul can be aggregated and shared efficiently on a single Ethernet backhaul connection
- The Alcatel-Lucent purpose-built LTE Evolved Packet Core — to seamlessly interwork with existing CDMA and LTE radio access networks
- The comprehensive Alcatel-Lucent Converged OA&M integrated management solution — provides a single system for managing multiple technology networks end-to-end.

6. Contacts

For more information on the ngConnect program, including member companies and goals of the program, visit www.ngconnect.org.

For more information on Alcatel-Lucent's CDMA to LTE evolution plans, please visit www.alcatel-lucent.com/lte or contact your Customer Team representative.

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7. Acronyms

3GPP	Third Generation Partnership Project
3GPP2	Third Generation Partnership Project 2
3G-1X	CDMA 2000-1x
AAA	Activation, Authorization & Accounting
AT	Access Terminal
BTS	Base Station
CAPEX	Capital Expenditures
CDMA	Code Division Multiple Access
CHAP	Challenge Handshake Authentication Protocol
CPRI	Common Public Radio Interface
EAP-AKA	Extensible Authentication Protocol - Authentication and Key Agreement
EBH	Ethernet Backhaul
eBTS	Enhanced BTS
eHRPD	evolved High Rate Packet Data
eNodeB	evolved NodeB (LTE BTS)
eRNC	Enhanced RNC
EPC	Evolved Packet Core
EPS-AKA	Evolved Packet System - Authentication and Key Agreement
ER	Edge Router
EV-DO	Evolution-Data Optimized
EV-DO Rev A	1x EV-DO Revision A
EV-DO Rev B	1x EV-DO Revision B
EVRC-B	Enhanced Variable Rate Codec B
GSM	Global System for Mobile communications
HA	Home Agent
HLR	Home Location Registry
HRPD	High Rate Packet Data (also known as EV-DO)
HSDPA	High-Speed Downlink Packet Access
HSGW	HRPD Serving Gateway
HSS	Home Subscriber Server
IMS	IP Multimedia Subsystem
IP	Internet Protocol
IPBH	Internet Protocol Backhaul
LTE	Long Term Evolution
M2M	Machine to Machine
META	Mobile Evolution Transport Architecture
MIMO	Multiple Input Multiple Output
MLPPP	Multi-Link PPP
MLS	Multi-Layer Switch
MPLS	Multi-Protocol Label Switching
MPR	Microwave Packet Radio
MSC	Mobile Switching Center
OFDM	Orthogonal Frequency Division Multiplexing
OPEX	Operational expenditures
PAP	Password Authentication Protocol
PDN GW	Packet data network gateway
PDSN	Packet data Serving Node
PMIP	Proxy Mobile IP
QoE	Quality of Experience
QoS	Quality of Service
RAN	Radio Access Network
RNC	Radio Network Controller
SAM	Service Aware Manager
SAR	Service Aggregation Router
SDR	Software Defined Radio
SGW	Serving Gateway
SR	Service Router
TCO	Total Cost of Ownership
TD-SCDMA	Time Division - CDMA
TSS	Transport Service Switch
VCC	Voice Call Continuity
VRRP	Virtual Routing Redundancy Protocol
VoIP	Voice over IP
W-CDMA	Wideband Code Division Multiple Access
WiMAX	Worldwide Interoperability for Microwave Access

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