STRATEGIC WHITE PAPER

Islands of Life

Planning In-Building Continuity for LTE and Beyond

This year will see the first deployments of Long-Term Evolution (LTE), the next generation of wireless access. Providers are already looking at ways to cope with 3G and LTE in high-volume, indoor and near-building locations that receive a lot of traffic. The phenomena of dense mobile data activity can also be considered as a trend towards small cells, or the move to more and more cells to handle capacity requirements. In this context, In-Building Solutions are becoming more critical, increasingly complex and linked to multiple constraints. In-Building Solutions require well-considered design and planning, especially with LTE. This paper will demonstrate best-in-class procedures and methods for designing In-Building in light of LTE and current trends in the mobile market.

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1. Introduction

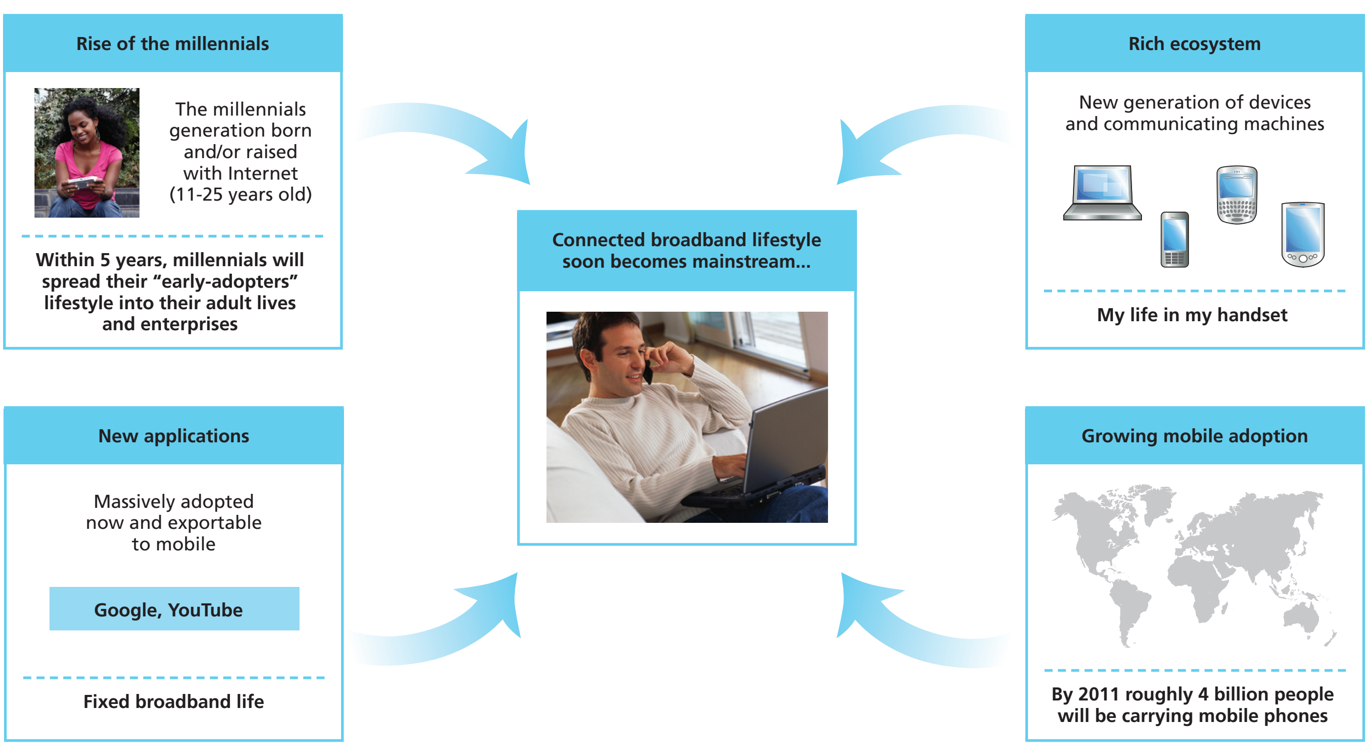
1.1 Mobile data drives move toward LTE

Long Term Evolution (LTE) is the preferred development path of GSM/W-CDMA/TD-SCDMA/HSPA networks currently deployed, as well as a strong option for evolution of CDMA networks. This essential evolution will enable networks to offer the higher data throughput to mobile devices that's needed to deliver new and advanced mobile broadband services and to address capacity issues brought about by heavy mobile data use on 3G networks.

The primary objectives of this network evolution are to provide these services with a quality at least equivalent to what an end-user experiences with fixed DSL broadband access at home, and to reduce operational expenses with a flat IP architecture. LTE has the potential to offer greater bandwidth to a wider array of users, even those located at the edge of cells. Nonetheless, hotspots and sites covering greater area, such as businesses, public venues and homes, will continue to see a large share of mobile data uses.

Although 3G/3.5G technologies such as HSPA/EV-DO deliver significantly higher bit rates than 2G technologies, they do not fully satisfy the "wireless broadband" requirements of instant-on, always-on and multi-megabit throughput. Tomorrow's wireless users, both consumers and businesses, will demand and consume improved Quality of Experience (QoE) and enriched services. With LTE delivering even higher peak throughput and much lower latency, mobile operators (either 3GPP- or 3GPP2-based) have a unique opportunity to evolve their existing infrastructure to next-generation wireless networks. As depicted in Figure 1, these networks will meet subscriber QoE expectations in terms of real-time services such as Voice Over IP, Multi-User Gaming Over IP, High Definition Video On Demand and Live TV, digital signage, location based services as well as better connectivity for collaboration, video conference, data transfer and other business needs. While initial LTE customers may be focused on data access via USB dongles and laptops, the used of smart phone mobile, tablets, and alternative devices for machine-to-machine (M2M), will flourish. Demand ushered in by the 3G revolution will carry over strongly to the new, more powerful LTE alternative.

Figure 1. Market Evolution Toward Broadband Access



Meanwhile, mobile usage continues to grow significantly in public and indoor locations, including at home and work representing more than 20% data traffic.

1.2 In-building: An overview

In-Building Continuity is a solution that covers and connects different indoor (in-building) public spaces. It allows more consumers to utilize mobile services, especially bandwidth-intensive data services, in and around high-traffic indoor locations or facilities.

A well-engineered indoor solution allows mobile service providers, site owners and alternative service providers with comprehensive solutions that can be configured with various combinations of network elements to address the specific site needs. Components include access products and services, as well as end-user applications that often leverage location as an attribute.

In-Building Continuity can be illustrated through the "islands of life" concept: From work to home, from the mall to the train station, voice and data continuity is there when you need it. Figure 2 depicts some of the islands of life that In-Building Solutions help cover. As we move to an island like a mall, one or a mix of access technologies should be available based on size and business justification. The challenge is then to provide the right solution at the right time.

Figure 2. Islands of Life

1.3 LTE in In-Building: Reinforcing the islands of life concept

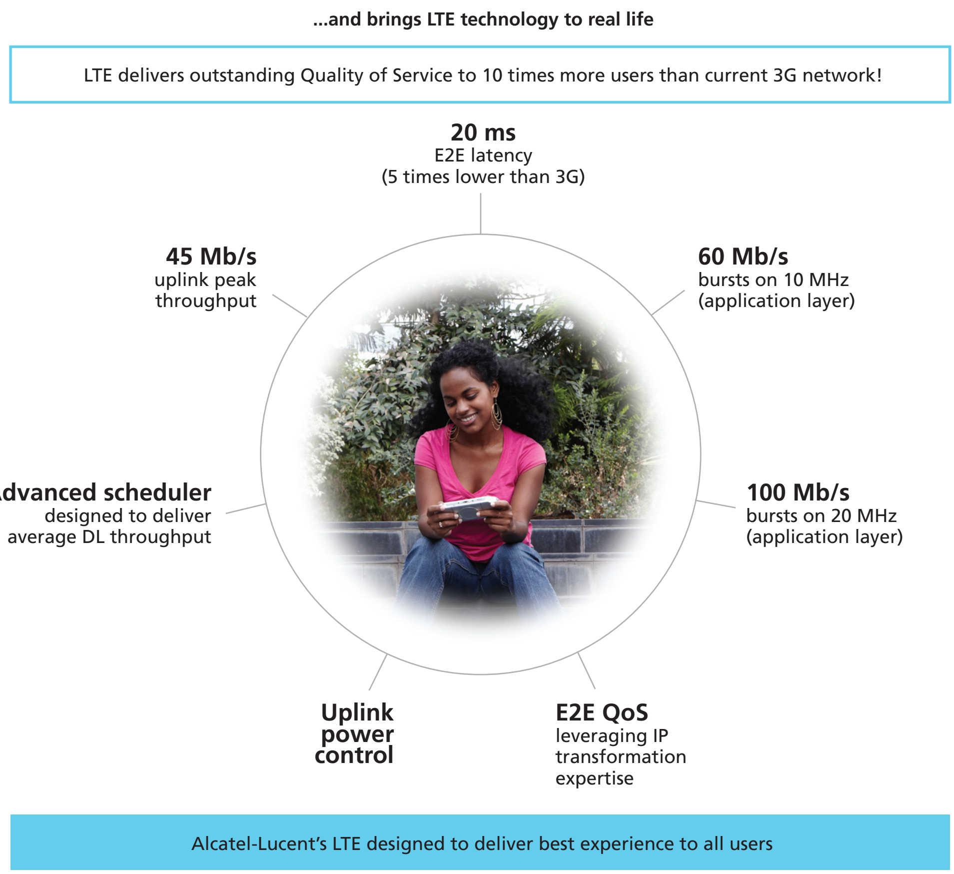
Business models are changing, and providers need to evolve their network in light of higher bandwidth demands, flat-fee or bundled-fee offerings, and rising QoE expectations from mobile users. At the same time, human and technical resource constraints, investment limitations, and backhaul and transport costs put pressure on profitability.

For operating expenses, well-constructed in-building and near-building coverage helps de-correlate OPEX from traffic, reducing overall transport costs and optimizing spectrum. In terms of CAPEX, In-Building can help in prioritizing investments. Assets can be reused, new site acquisition can be avoided, and services continuity does not suffer. LTE in this domain is the solution of choice.

LTE will bring about higher QoE and better overall performance. Figure 3 shows some findings based on early Alcatel-Lucent LTE customer trials and deployments. Mobile performance services quality is expected to be much greater than with 3G.

In terms of revenue, LTE for In-Building Solutions will help in retaining users and capturing new ones, and in increasing ARPU.

Figure 3. LTE Performance Quality

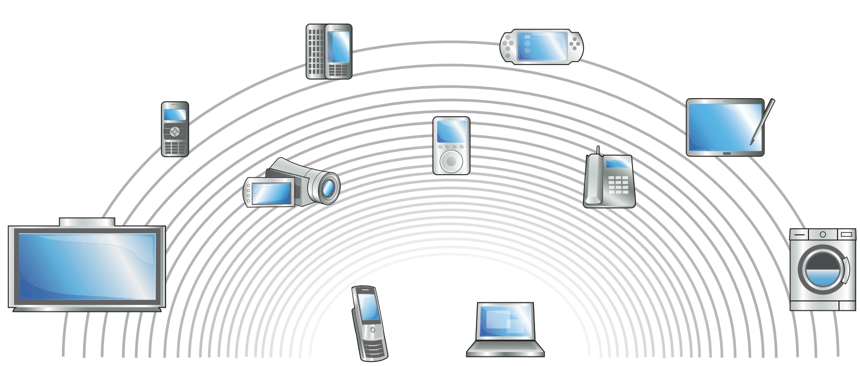


All above figures measured on Alcatel-Lucent LTE trials

1.4 Acting as a platform for mobile end-user applications

In this concept, the In-Building Solution is acting as a platform supporting mobile applications for end-users. It facilitates a cooperative relationship between telco and enterprise network providers and the development community — with the distinct aim of driving more value for the end-user, contributing towards an application enablement strategy.

Figure 4. Machine to Machine (M2M)



As an example, 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 worldwide M2M cellular market is expected to reach 57 million connections by 2011 (source: IDATE). Given their diversity, M2M applications require a wide range of products, connectivity and support. The In-Building Solution should support this strategy.

1.5 The move to smaller cells is increasing In-Building needs

The need for In-Building Solutions is also being driven by the emergence of a “small cells” strategy and by small cells in general.

Small cells are:

- public wireless access nodes, using licensed spectrum, based on picocells or femtocells with substantially lower coverage offering high capacity, serving a smaller number of users than typical deployed macro cells
- often owned and deployed by mobile operators to provide a transparent indoor or outdoor capacity layer in complement to a macro-cell “umbrella” coverage layer

Figure 5, from the Yankee Group, shows the general trend toward an increasing number of smaller cells, some in the form of pico and femto.

Infrastructure small cells can provide contiguous or noncontiguous coverage. Small cells may be provider-owned and may be complemented by residential femtos or enterprise femtos.

There are several factors behind the trend to smaller cells, including the perceived risks to health and visual appearance. Larger cells that transmit more radio waves sometimes spark concerns about radiation, while at the same time are held to be less aesthetically pleasing, especially in dense locations. Smaller cells also consume less power, reducing energy demands and offering potential environmental benefits.

Other reasons for the shift to small cells are to increase capacity in In-Building engineered coverage, to offload macro coverage from high-consumption users and to complement macro coverage.

Figure 5. Cells Structure Evolution

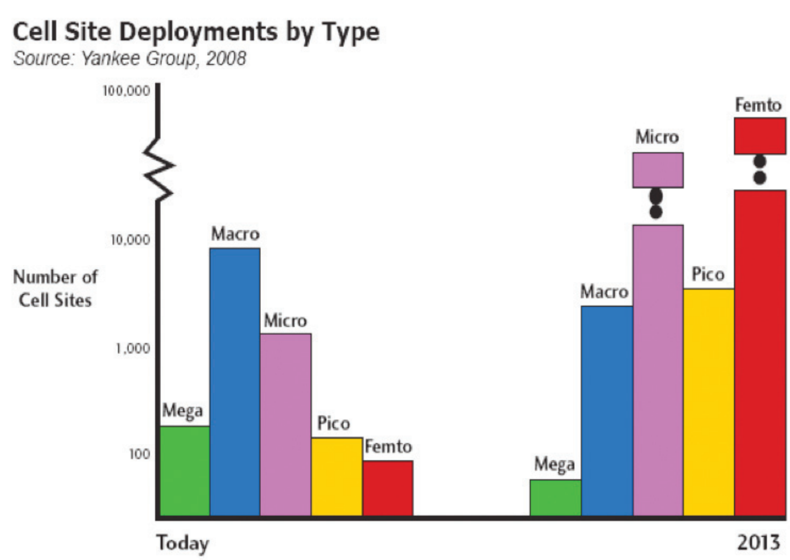
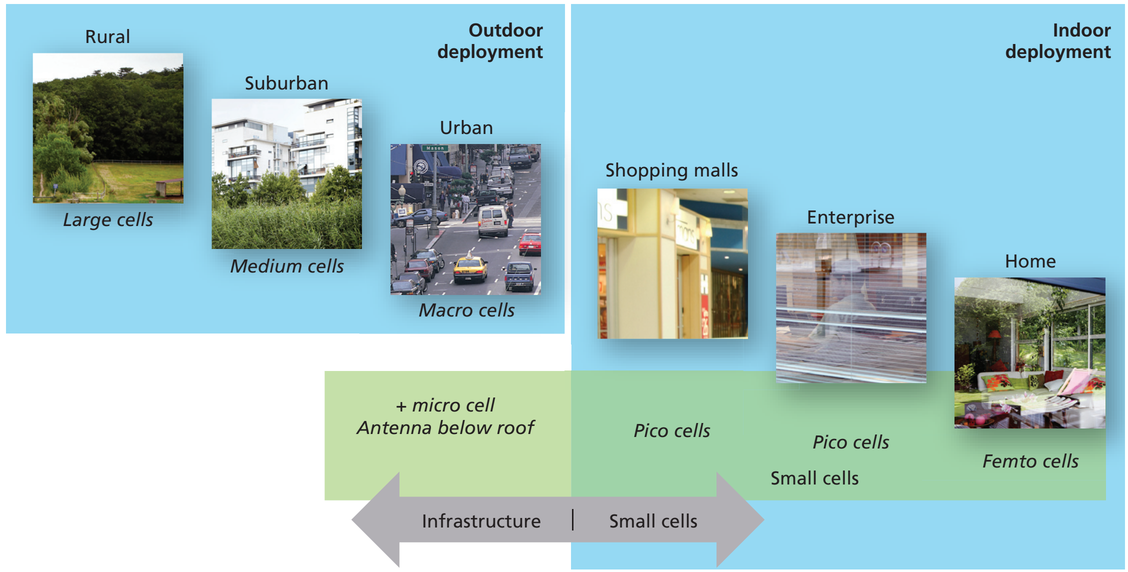


Figure 6. Cells Type Evolution



Service providers have noted that the growth potential for efficiency and spectrum is diminishing over the next several years, while the number of cells required to fulfill the needs to end users mobile data is increasing (see Figure 5). When this is combined with the significant growth in public and indoor mobile usage, capacity peaks are concentrated at hotspots or zones, meaning more cells will be required given the lack of other options and the aforementioned health, aesthetic, and cost concerns.

2. Challenges and requirements

As the number of cells rises along with the demand for anywhere, anytime access, mobile service providers face a major challenge: How to define and deliver high-quality services cost-efficiently, and how to address the corresponding infrastructure and management challenges. Meeting this challenge means looking at the full set of requirements from a solutions-lifecycle perspective, beginning with architecture and finishing with deployment.

2.1 Architecture and design

Designing for small-cell environments near and in-building can be a daunting task. There is a host of legal, logistical, technological, and other issues to consider from the outset. Nonetheless, quality of design is key to creating a sustainable In-Building solution spanning time, location and mobile generations.

In terms of architecture, LTE introduces new concerns and is more complex than 2G or 3G. Capacity requirements must be carefully considered, along with the impact of the macro network. Moreover, new antenna features such as MIMO and Beam Forming have to be taken into account, as well as end-to-end planning, integration and validation of IP networking and applications.

Given the range and complexity of these issues, solution architects need to create an end-to-end reference architecture document detailing the necessary products and the interconnectivities among different elements and subsystems of the LTE network. The Solution Architect must also deliver a high-level design and well-documented technical interfaces. Technical deliverables must be reviewed to assure consistency with solution architecture, customer requirements, and quality goals. All of this is undertaken in keeping with the mission of the Solution Architect to mitigate delivery risk through careful scrutiny of the scope of work and clear communications.

Solution Architecture support for LTE and In-Building should reflect the complex nature of LTE multi-domain design and deployment by covering the following:

- LTE access
- IP backhaul
- Packet core (e.g. eUTRAN/EPC/MME/Converged Core)
- IMS
- 2G/3G/4G interworking

Multi-vendor design aspects — such as HSS, eUTRAN, P/S GW, and pico/femto equipment — are also essential. This requires and understanding of new technologies and evolving standards, as well as the potential interoperability impact.

Then, two scenarios must be considered:

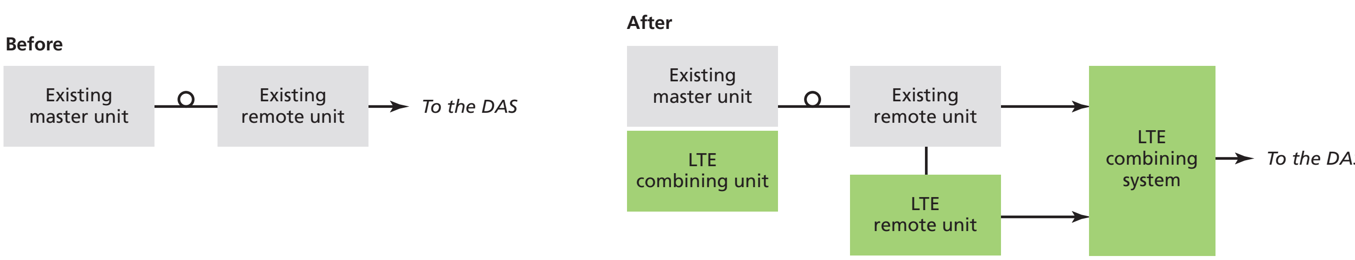
1. a 2G or 2G/3G infrastructure is in place
2. there is no infrastructure in place

In the first scenario, the existing installation has to be captured — from building layout to design of the indoor network to the technical specifications of each element. Different processes can be used to accomplish this, depending on the level of information availability. It can range from acquiring the radio indoor design document to conducting a complete site survey that includes on-site measurements.

The applications introduced with LTE will require a new set of key performance indicators (KPIs) to go with the traditional indoor coverage analysis. To take benefits from all the LTE features at their best performance, capacity KPIs will become the most important part of the indoor study. Using these KPIs, the operator will be able to ensure the right Quality of Service (QoS) levels within the mobile networks, while analyzing QoE to help enrich the customer experience.

With this information, and with the appropriate procedures and tools, a network design analysis and total cost analysis can begin, in order to determine the most appropriate and best optimized solution. Solution options might range from building a dedicated LTE infrastructure, to adding an LTE-combining solution, to changing certain existing DAS infrastructure elements — such as antennas, connectors or splitters that are frequency dependent (see Figure 7).

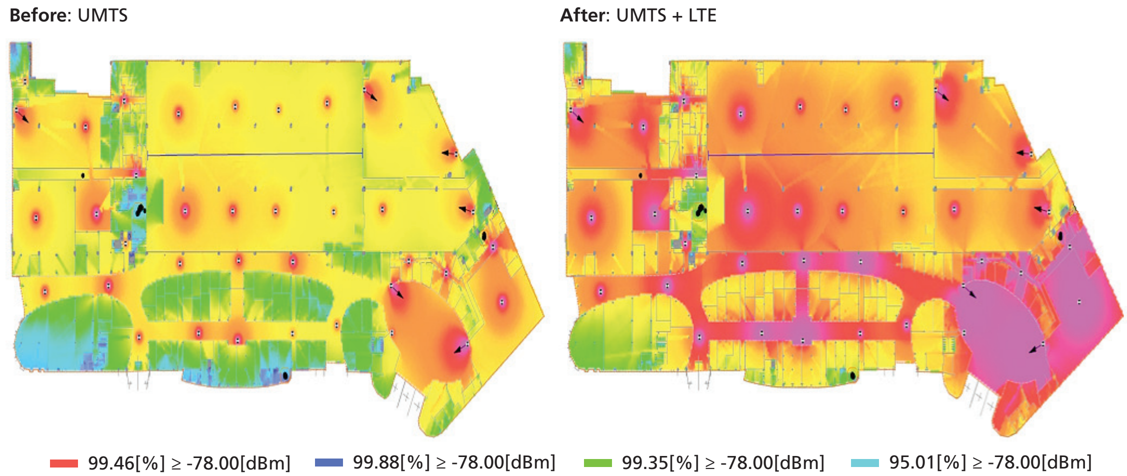
Figure 7. Adding LTE Active Elements on an Existing Architecture



The use of a design tool able to superpose and/or integrate with other access technologies is also a necessity. In certain cases, 3D design capability can help in getting the complete picture. Propagation simulations must then be run in order to compare and optimize the final solution. Obviously, the result of the propagation will be different depending on the frequency allowed for LTE by the regulatory authority in each country (from 700 MHz till 2.6 GHz).

As an example, consider the simulation of LTE at 2.6 GHz on top of an already deployed active network of UMTS 2.1 GHz (see Figure 8). Note that without changing the antenna positioning, the LTE signal is strong enough to meet the coverage KPI. (In this case, the remote unit LTE delivered, in fact, more output power than the UMTS, explaining the signal strength.)

Figure 8. Comparison Between UMTS and UMTS + LTE Propagation



2.2 Installation and integration

What are the specific challenges of an LTE installation? LTE is a completely new end-to-end all-IP architecture that will simplify the network design. Thus one of the major integration challenges is to transform today's architecture to full all-IP architecture. This will impact the end-to-end integration process considerably in terms of upgrading the remote access and backhaul networks to deploy, in parallel, the indoor solutions.

That makes expert and certified project management essential. The best project management provides experienced resources to manage all components of the in-building solution, including third-party components specified in the defined scope of the project, to ensure that key scheduling, quality and budget objectives are met. Moreover, specific integration services may be required for customer premises equipment (CPE), including PCs and laptops, PDAs, phones and other devices and peripherals.

Technical analysis, implementation, roll-out and training must be adapted accordingly, as well as help-desk preparation, and service level agreement (SLA) definition. Following are specific considerations that could impact the integration phase:

- Integration of the DAS in the RAN IP network, such as Micro BTS, Pico BTS, and Femto, including IP services (VPN data design and implementation)
- Adherence to local IT rules
- Security integration, such as encryption; strong authentication
- Specific fixed-mobile integration issues, such as development and integration of unified communications, for example:
  1. PBX and Virtual PBX functionalities integration
  2. Audio, video and data conferencing integration
  3. Wi-Fi and cellular integration
  4. Dual-mode phone
  5. RFID integration
- Specific applications integration, such as location-based services, M2M, and home networking

2.3 Optimization

Given the preceding, the optimization phase must also be performed as an end-to-end process.

First, performance measurement must be conducted, including radio coverage in the complete building or area, the handover zones, the interference zones, and the capacity in critical areas. These measurements must then be compared with the KPIs agreed to with the customer, after which some tuning of parameters may be required.

To cover the aggregate list of network elements that make up the LTE and in-building network, a full-scale network management and optimization plan must be in place. With this approach, better QoE/QoS, lower OPEX, and lower TCO can also be achieved. In addition, specific tools, such as traffic analysis tools combined with radio network and core analysis tools provide guidance for enhanced business models.

2.4 Streamlined operations and IT

Again, the move to LTE is much more than a radio access upgrade; it is in fact a tool for a strategic business, network and operational transformation.

In order to launch and operate LTE effectively, processes, teams, and tools need to be completely aligned to achieve efficiencies. Provisioning and assurance systems must span the appropriate complete access network (GSM, CDMA, UMTS, W-CDMA, LTE) including in-building elements (e.g. Pico, Wi-Fi routers) the core (Evolved Packet Core, MME, media servers), and the application and content servers.

Because there are often multiple parties that need to verify service fulfillment and end-user quality measurements from providers to local site owners (such as malls or other public venues), In-Building Solutions must take a modern, service-oriented approach, including use of a single multi-standard operational experience. A unified supervision solution approach ought to enhance the ability of In-Building engineers, managed services staff, and operational units to help OSS/BSS management measures and control quality from the customer viewpoint.

A component In-Building Solution requires a comprehensive assurance, fulfillment, and charging design, along with the appropriate processes. Fulfillment and delivery solutions support the automation of new service orders and routine delivery of content and application to users. These solutions are supported by inventory, activation, authentication, orchestration systems and processes including multi-vendor products by ISVs and Web services. Billing and care systems need tight, secure interfaces with OSS and SDP systems to monetize services quickly and to provide coordinated, expedited customer management. This involves everything from billing mediation to effective customer requirements management (CRM).

The end result of all of this streamlining is improved operations efficiency and customer experience for In-Building Solutions.

2.5 Migration process in adding LTE to existing infrastructure

One of the major challenges with LTE is how to introduce it into an existing wireless network — easily, smoothly and with minimal outage.

As with each new wireless technology deployed on an existing one, familiar challenges arise:

- How to ensure the continuity of the existing services
- How to maintain QoS levels during and after the migration
- How to identify the potential interferences
- How to minimize the risks and inconveniences for end users

A typical migration comprises three phases:

- Design and capability built
- Execution
- Tests

The following are abbreviated versions of the challenges and requirements associated with implementing an In-Building Solution for LTE and other technologies.

2.5.1 The Design and Capability Built

In line with the new design, a transition plan and associated transition process based on specific methods of procedures have to be defined. This will help identify the areas which will be affected, the equipment to be dismantled, the new elements to be installed and configured, the sequence of element re-activation, and so forth. This phase must be prepared in taking into account the final customer-/site owner-specific requirements and critical area of attention.

2.5.2 The Execution

Prior to any rollout of LTE equipment, detailed preparation work will have to be executed for each site, including survey, civil works and power supply.

Then the rollout can be executed, including the dismantling of old equipment, installation and commissioning of new hardware, and coordination of the installation and integration activities.

In parallel to the site activities, the operation center will load the relevant parameters and data bases into the new equipment, activate the new network elements and integrate them into the Network Management System (NMS).

2.5.3 The Tests

The final step is to perform the acceptance not only of the LTE network, but also to prove to and ensure the customer that all the other wireless technologies deployed retain the same levels of performance.

The best way to make a radio quality comparison between the previous installation and the future LTE-capable solution is to perform a voice, video telephony, mobile TV and data quality campaign.

3. LTE In-Building solution components

There are several In-Building Solution components that merit discussion. These include feeding technologies and antenna technologies.

3.1 Feeding technologies

A range of access technologies in line with the LTE architecture are emerging. These include eNodeBs, RRH, and Pico.

When selecting feeding technologies, reducing TCO and protecting investment are key. Calculations can help determine if existing RF, such as SDE or R-COM, and other site equipment should be kept or replaced. With newer radio modules having more upgrade and multi-band capabilities, full analysis is needed to determine the most cost-effective option. Also, the variations in legacy GSM, UTMS, CDMA and other access technologies may have ramifications for providing coverage to 3G and LTE. In an In-Building environment, the Pico cells have a historically strong position, as they have been used most commonly. Spectrum flexibility and needs will also influence choices.

3.2 Distribution and antenna systems (DAS)

DASs remain the same in terms of architecture: passive and active/hybrid. Nevertheless, with LTE, several issues may impact the design of the final architecture.

3.2.1 MiMo capability

The use of MiMo will have a direct impact in terms of TCO, since it requires duplication of antennas. In a passive architecture, full infrastructure duplication will be required (see Figure 9); in an active architecture, only the last mile to the antennas will require duplication (see Figure 10).

3.2.2 LTE frequency

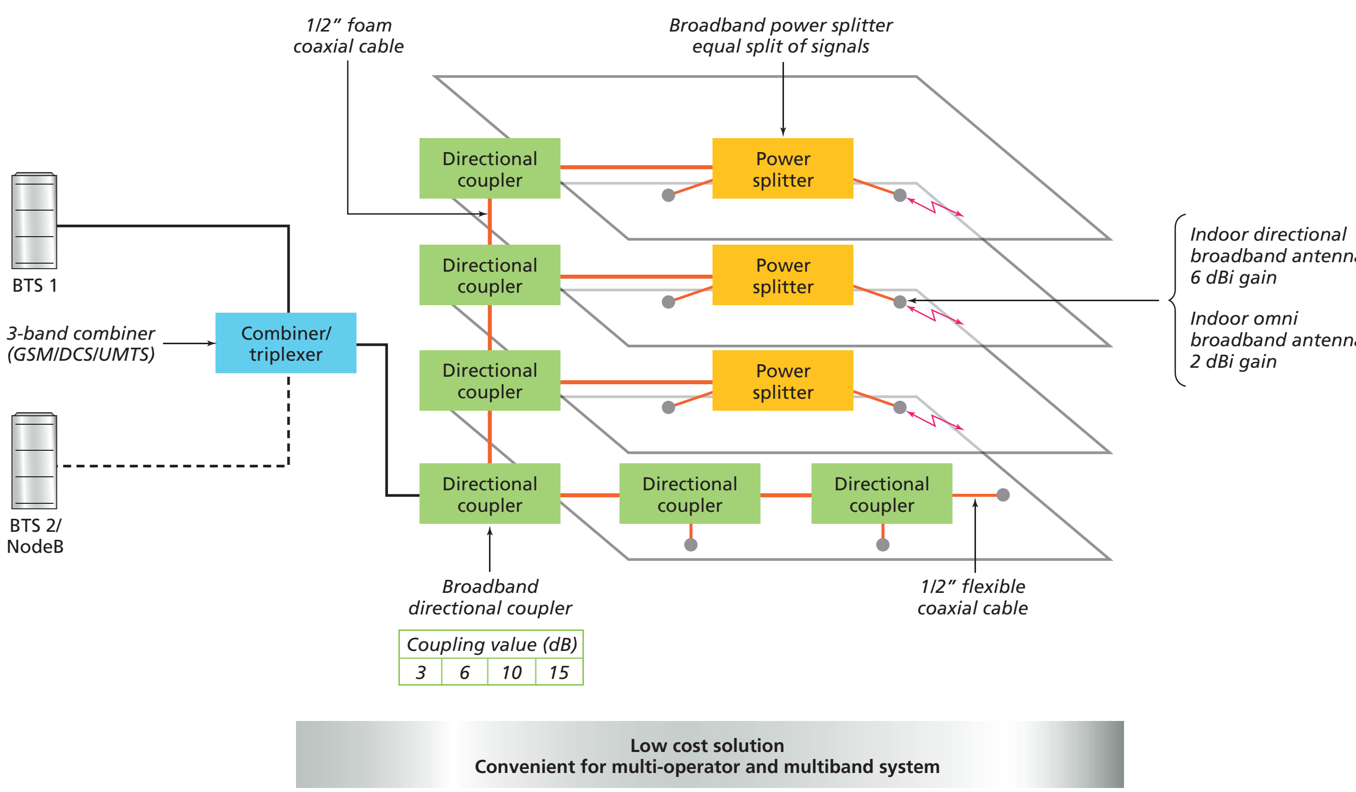
LTE frequency spectrum is not yet fully assigned, although the U.S. market is targeting 700Mhz and Europe is looking for 2.6Ghz. Customers are also looking at alternative solutions, such as reuse of GSM or DCS frequency, or frequency as low as 500Mhz.

The potential impact of frequency is greater on active architectures than on passive. Passive systems are "naturally" broadband, while active require either a dedicated solution for each LTE frequency, or a broadband "costly" solution.

General passive and active architectures are presented in the following sections.

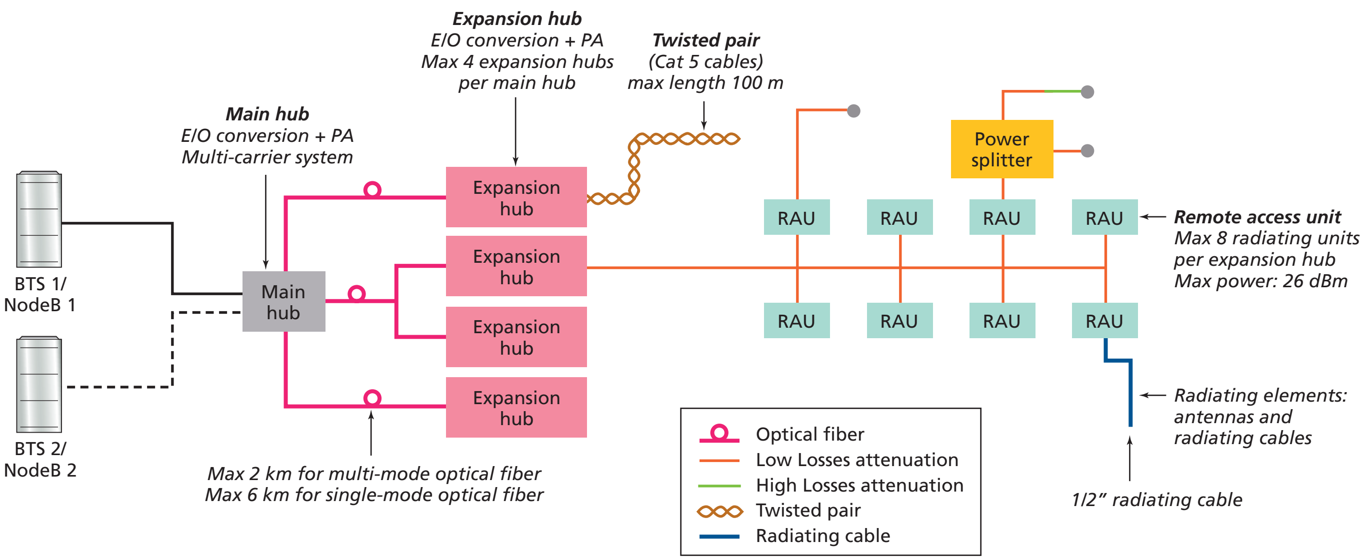
3.2.3 Passive solution

Figure 9. Typical Siso LTE passive distributions include multi-band and multi-operator combining systems. In MiMo, all elements after the combining of systems will be duplicated.



3.2.4 Active solution

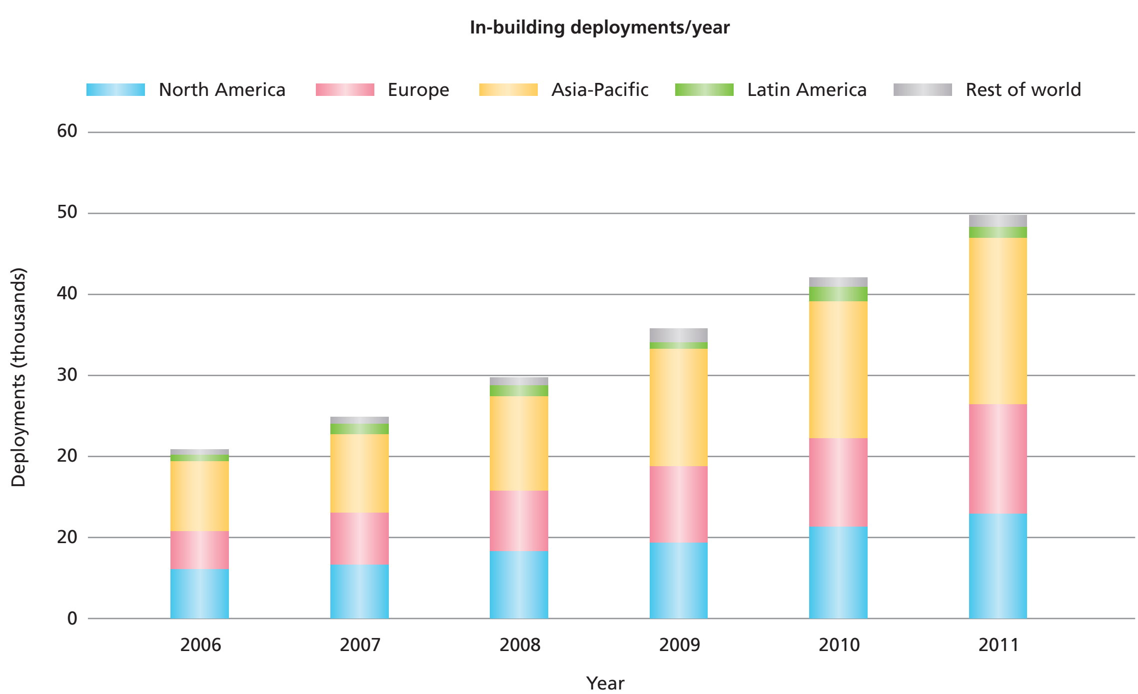
Figure 10. Typical Siso LTE active/hybrid distribution includes multi-band and multi-operator combining systems. For MiMo, all the elements after the remote unit systems will be duplicated.



4. Selecting the right solution: Best practices

Due to the diversity of building environments, a wide range of In-Building Solutions is essential, regardless of RF spectrum. At the same time, the cost of In-Building deployments has to be carefully measured against their expected revenue return (ROI). This has led to moderate growth in enterprise building networks (see Figure 11).

Figure 11. In-Building Deployments Per Year



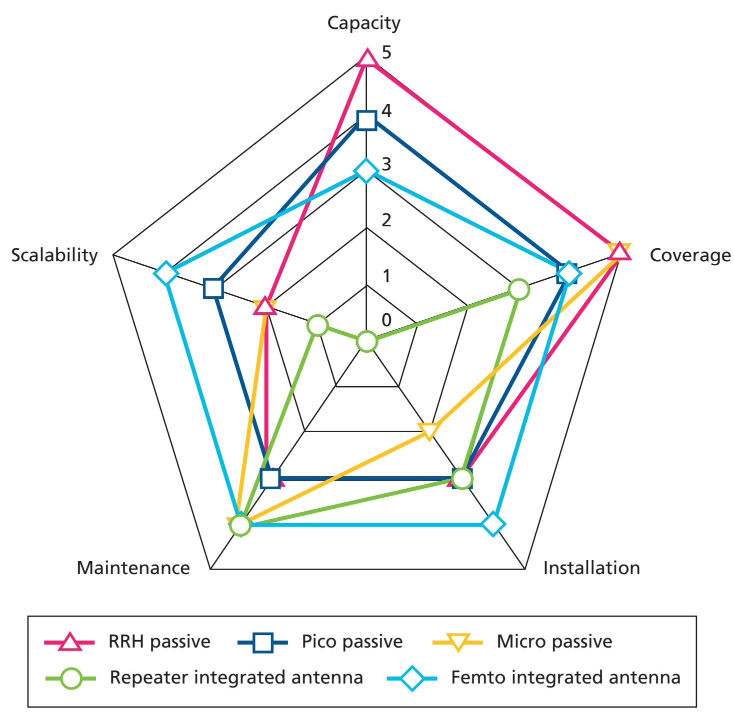
Having identified a location for the deployment of a dedicated indoor coverage solution, the choice of the optimal solution is heavily dependent on the constraints identified for the particular building. Three different technologies need to be considered:

- Feeding technology
- Distribution technology
- Antennas

The choice of these technologies is influenced by how they might be combined, particularly the feeding and distribution technologies.

See Figure 12 for the main criteria that have to be quoted. The weight of each depends on specific customer requirements.

Figure 12. Spider diagram for selecting In-Building Solutions



There are other factors to keep in mind that could have a significant influence on the selection of the indoor solution, including:

- Wireless technologies the system must support (GSM, CDMA, WCDMA, WiFi, WiMAX)
- Number of operators sharing the indoor distribution solution
- Capacity needs for each technology
- Outdoor coverage and needs in term of off-loading the macro network
- Regulatory authority requirements
- Building type (tunnel, metro, office, airport, mall) and the corresponding coverage and capacity requirements
- Building dimensions: number of floors, surface area or tunnel length; this will determine in part the type of DAS solution

A customer case study can help illustrate these considerations. The customer, an airport in North Africa, identified coverage and scalability as its main requirements. Because of the size and complexity of the building, an active solution was selected. Up to three operators would share the indoor distribution solution, so the design would have to meet this requirement. Broadband antennas of 900MHz to 2600MHz were being installed, supporting multi-operator and multi-band systems (GSM, DCS, WCDMA, and LTE).

Several factors were considered in terms of coverage. The airport was new and large-scale, with multiple large floors. At peak hours, an estimated 3,250 people are expected to need coverage. Antenna positioning was a key challenge, because of the airport's architecture: It featured slanted ceilings and many columns, on which no antennas could be installed because of aesthetic concerns.

In terms of scalability, the customer requested a solution easily scalable to LTE. Simulations for LTE design were conducted in the course of completing the solution, and site surveys were performed accordingly. Thus, although other systems are in place, all the components of the new solution are capable of supporting LTE when the customer chooses to install it; that is, it is LTE-ready.

5. Alcatel-Lucent value proposition

When it comes to indoor solutions, "diversity" is the key word: There is a diversity of potential locations, of specific scenarios, and of options for addressing the particular conditions of any given deployment. Alcatel-Lucent's added value lies in its ability to help operators contend with this diversity and overcome the associated challenges, thanks to:

- Extensive indoor experience in 2G, 3G, WiFi and LTE
- A turnkey and "one-stop shopping" approach with strong project management, processes, tools and methodology
- A complete set of solutions adapted to indoor constraints, with a technology-agnostic approach and scalable design
- Deep knowledge of corporate and enterprise needs
- Field-proven expertise and optimized processes
- Commitments on enhanced QoS and QoE

Further, Alcatel-Lucent performs a complete integration between outdoor and indoor design tools to optimize the overall network and ensure CAPEX optimization. The resulting data is then used as input for the backhaul dimensioning.

Customers can also leverage Alctatel-Lucent's leadership in IP Transformation, extensive wireless network planning and migration experience, and comprehensive multi-vendor network integration expertise to de-risk their move to all-IP wireless. Transformation services are not limited to network core or access but extend to the transformation of business processes, operations, applications/services, and security domains.

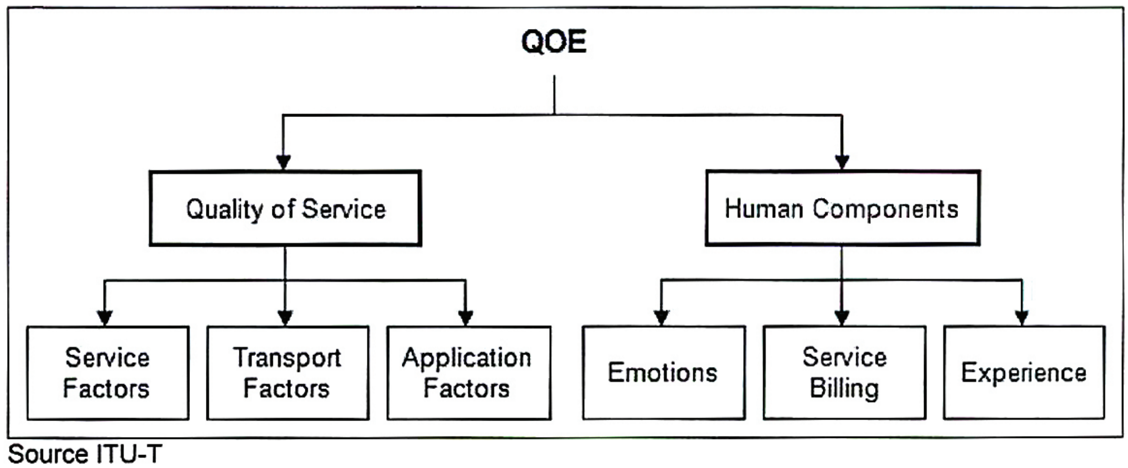
Customers can also rely on Alcatel-Lucent's experience in QoE and QoS.

Quality of Experience (QoE) can be illustrated as the measure of how well a system or an application is meeting the user's expectations. This concept is different from Quality of Service (QoS), which focuses on measuring performance from a network perspective.

A QoE Indicator is an estimated numeric value based on objective measurements. The QoE Indicator predicts the score that human subjects would assign based on indicators' measurements.

As an example, Figure 13 below defines the process of the QoE as performed by Alcatel-Lucent.

Figure 13. QoS-QoE Relationship



The Alcatel-Lucent services portfolio for LTE spans consulting, business modeling, design, architecture, end-to-end planning/integration/testing, managed network operations, maintenance, spares management and knowledge transfer.

6. Conclusion

Mobile data usage trends are driving changes in how mobile providers will handle new capacity demands and speed requirements. To compound the problem, the first deployments of LTE, or Long Term Evolution, the next generation of wireless access, are being planned and rolled-out around the globe. LTE will offer faster access with lower latency and with more efficiency. As such, providers are looking at ways to cope with LTE in high-volume, indoor and near-building public locations that receive a lot of traffic.

This intense in- and near-building mobile data activity can also be viewed through the trend towards small cells, or the move to increasingly smaller cells to handle capacity needs in high-volume high-traffic corridors. The engineering and logistics required for In-Building Solutions are similar to those required for many types of small-cell needs. In-Building Solutions are complex, having many technical characteristics depending on the type of building being fitted and the availability and mix of technology and applications. In-Building Solutions require well-considered design and planning, especially with LTE, since it demands high QoE and increased capacity for growing data usage. This paper described best-practices procedures and methods for designing In-Building Solutions in light of LTE scenarios and current trends in the mobile marketplace.

There is great diversity in indoor locations and in scenarios for which there is value in deploying dedicated indoor solutions. As such, there is a wide range of possible indoor solutions and configurations that can be used to address the requirements of specific indoor environments. Alcatel-Lucent's added value lies in the ability to help operators select and implement the optimal indoor solution for their specific situations, based on:

- Indoor and near-building experience in 2G, 3G, WiFi and LTE, matching indoor specifications with experience. Designs may include one or more of the following feeding technologies: Macro, RRH, Micro and Pico Node-Bs, Femto BSR, distribution solutions.
- In-building processes and methodology that ensure the right number and type of sites and type and configuration of distribution solution are selected, according to the building type and the operators' investment policy.

- A life-cycle solutions approach and service delivery commitments to ensure operators' achievements. Alcatel-Lucent is able to provide operators with:
  - A complete set of solutions adapted to indoor constraints, with a technology agnostic approach and future-proof design, based on flat-IP
  - Deep knowledge of corporate needs to leverage indoor coverage
  - Field-proven expertise and optimized processes
  - Commitments on enhanced QoS
  - A comprehensive "one-stop shopping" approach with strong program management

These services offer an integrated solution, enabling customers to achieve aggressive time-to-market and quality of experience objectives. These unique assets combined with a worldwide presence give Alcatel-Lucent the ability to build partnerships with all stakeholders (service providers, construction companies, site owners, and large enterprises) in the complex ecosystem for in-building services continuity.

7. About the Author

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Hervé Leboime has been the In-Building Solutions Director since 2006. He is responsible for developing indoor solutions for customers and service providers worldwide, offering a fully integrated end-to-end approach to designing, implementing and integrating new services for end-users in public areas, corporate campuses and residential dwellings.

Hervé's career spans more than 20 years. He joined ALU in 1998 and was previously Business Process and IS-IT Tools Director in the Mobile Communications Group. Notable achievements include deployment of a comprehensive set of indoor solutions for the ALU campus in France, in line with business requirements and benefitting from the evolution of access, applications and services technology. He is the author, with R. De Baroce and P. Kelley, of the article "Alcatel Mobile Office" (2003-2004; ISSN 1267-7167, http://cat.inist.fr/?aModele=afficheN&cpsidt=15406734) and has made numerous speaking engagements worldwide.

Hervé is a graduate of the engineering school at Ecole Centrale in France.