LTE/4G Alcatel Lucent Solution
E2E Stuttgart

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LTE-E2E Alcatel Lucent Solution

Agenda

1. Introduction and Overview
2. Core and Access
3. E2E Solution Stuttgart North
4. ngConnect Program and Connected Car
1 Introduction and Overview

LTE 4G
What we see in the market

We looked for killer applications, we found killer devices...
Market evolution towards broadband access

Growing mobile adoption

by 2011 roughly 4 billion people will be carrying mobile phones!

Rise of the millennials

The Millennials generation born and/or raised with Internet (11-25 years old)

Within 5 years, millennials will spread their “early-adopters” life style into their adult lives & enterprises

Fixed broadband life

Massively adopted now and “exportable” to mobile

My life in my handset

New generation of devices and communicating machines

Connected broadband life style soon becomes mainstream...
Alcatel-Lucent Ultimate Wireless Broadband End-to-end LTE solution
Redefining the wireless experience

- **End-to-end LTE network** with next-generation IP service delivery and wireless innovations
- A **comprehensive ecosystem** of device, content and applications partners enabling new business models
- **Broadband IP transformation** leadership: de-risk evolution

The industry’s most comprehensive end-to-end LTE solution, from the trusted leader in broadband IP transformation
IP transformation
The fundamental evolution in long-term evolution

1. End-to-end IP
   - IP access
   - IP transport
   - EPC, IMS
   - Web, IP comms, IP multimedia SDE

2. Flat IP
   - eNodeB
   - 3G NodeB
   - RNC
   - PS
   - CS
   - EPC
Validation of our LTE solution by major operators

Only end-to-end LTE network provider (EUTRAN+EPC+IMS) - First-mover: LTE commercial services to launch in 25-30 cities in 2010. **CONTRACT**

Selected for Shanghai Expo 2010, **first major public trial of TD-LTE** - Showcasing TD-LTE technology to over 70 million predicted visitor

700MHz and AWS testing

Alcatel-Lucent Establishing Clear Market Leadership

Americas trials
8
AWS, 700MHz, PCS, 2.6GHz

APAC trials
12
FDD, TDD, small cells, 1.8MHz, 2.3GHz, 2.6GHz, 2.1GHz

EMEA trials
18
FDD, TDD, small cells, 1.8GHz, 2.6GHz, 800MHz, 2.1GHz

large scale commercial contracts
2

LTE trials worldwide
40

1800MHz testing

700MHz and AWS testing

TD-LTE and LTE FDD testing coexistence in 2010

700MHz and AWS, commercial service in 2011. **CONTRACT**

Verizon
Bouygues Telecom
Etisalat
China Mobile
AT&T
Telefonica
Orange
SingTel
2 LTE Core and Access

LTE 4G
New Services and all-IP LTE require purpose built components
Unleashing the data and control plane in LTE with Alcatel-Lucent EPC

Control plane:
- Highly scalable, secure dynamic mobility and connection management
- Network-wide, real-time policy control

Data plane:
- High aggregate throughput (over 100 Gbps) for high bandwidth on-demand services
- Per-subscriber, per-application, per-session QoS and policy enforcement
Alcatel-Lucent EPC: Forward-looking, purpose-built elements

Control Plane
- ATCA
- Mobility Management Software
- Policy Management Software
- MME
- PCRF
- SGW
- PDN GW

Data (User) Plane
- 7750 SR
- Mobile Services Module*
- Widely deployed WW
- 7750 SR
- Mobile Services Module*
Alcatel-Lucent EPC: Performance

**Control Plane**
- Fully redundant
- 99.999% availability
- Hot swap elements
- Basic chassis: 400k up to 2000k subscribers in 400k subscriber increments
- Extension chassis: 2400k up to 4400k subscribers in 400k subscriber increments

**Data (User) Plane**
- Fully redundant
- 99.999% availability
- Hot swap elements
- 100 Gb/s half duplex per slot
- 1 Tb/s half-duplex switch fabric/control
- 1000k simultaneous attached bearers context
- 220k S1 active bearers
- 16k eNB end-points
- 1280k simultaneous attached bearer contexts
- 4000k simultaneous active SDF contexts
- 4000k hierarchical policers (PCEF rate limiter)
Converged Radio Access key building blocks

Plug-in radio modules

- Dual Techno Modules (WCDMA / LTE)
  - TRDU Single PA
  - TRDU Dual PA
  - 800/2100 MHz

Remote Radio Heads

- RRH Single PA
- RRH Dual PA
- 800/1800/2100/2600 MHz

Common Base Band Unit

- BBU

Triple Techno modules (GSM / WCDMA / LTE)

- MC-TRX
  - GSM
  - WCDMA
  - LTE
  - 900/1800 MHz

- MC-RRH Dual PA
  - GSM
  - WCDMA
  - LTE
  - 900/1800 MHz

Common Base Band + Dual Techno RF + Triple Techno RF
eNodeB - The Architecture
LTE End-to-End Solution Lab Stuttgart

Introduction

- Alcatel-Lucent established an End-to-End solution lab in Stuttgart
  - The lab is setup to perform end-to-end tests of Alcatel-Lucent LTE solutions
  - Local LTE competence team established, supported by all product units
  - Activities supported by Bell Labs Stuttgart, responsible for wireless research of Alcatel-Lucent
- Lab setup consists of several eNodeBs in the lab and over the air for the NW in Stuttgart North
- ePC consisting of MME, PGW, PCRF and SGW
- Worldwide first LTE800 eNodeB enables stable drive testing over the air
- LTE FDD&TDD system in the lab and over the air
- Voice quality testing
- ng Connect initiative testing application in the LTE ecosystem
Stuttgart North
NW Set-Up

- Sides with 800MHz and 2.3GHz/2.6GHz
LTE End-to-End Solution Lab Stuttgart
Lab and NW Setup

Evolved UTRAN (eUTRAN)

LTE 2.6 GHz
RRH & Antenna
9926 BBU

LTE 2.6 GHz
RRH & Antenna
9926 BBU

LTE 800 MHz
Antenna
ALU 9412

Internet

HSS

GSM/UMTS
MSC
HLR
VLR
RAN
SMSC

VANC (VoLGA)
LVI-B
LVI-C

Evolved Packet Core (ePC)
MME
PCRF
S-GW
PDNGW

OA&M
PM Monitoring
XMS
NTP
LTE End-to-End Solution Lab Stuttgart

Test Activities

Test Scope

- Test suite verifying new SW loads
- Verifying generic test for customer projects
- End-to-End testing environment (FDD LTE800, LTE2.1, LTE2.6 and TDD LTE2.3 / LTE2.6)

Test Areas

- Performance
  - Single UE / Multiple UE / e-NodeB
  - Mobility (drive test)
  - Cell Edge Analysis
  - Throughput and Latency assessment
  - Handover Optimization
- Features
  - Self-Optimizing Networks (SON)
  - OA&M

- Stability
  - Long-time duration test (weekend run)
  - Counter evaluation
- Early UE IOT
- Application integration
  - Email, HTTP, Video Streaming
  - Real time Gaming
  - ng Connect Applications
LTE End-to-End Solution Lab Stuttgart
Overview Alcatel-Lucent FDD and TDD system

- **LTE End-to-End FDD System**
  - System supports 800 MHz, 2.1 GHz & 2.6 GHz
  - Worldwide first 800 MHz call over the air
  - SON ANR testing successfully completed
  - First 2.6 GHz / 20 MHz integrated achieving more than 100 MBit/s throughput
  - Integration of voice services into LTE lab

- **LTE End-to-End TDD System**
  - Started with pre-commercial hardware @ 10 MHz
  - Integration of commercial hardware March 2010 @ 20 MHz / 2.3 GHz & 2.6 GHz
  - Add LTE TDD system @ 2.6 GHz in April 2010
ng Connect Program & Connected Car
The ng Connect Program initiated by Alcatel-Lucent

Next Generation Broadband is about more than just speed...

Alcatel-Lucent is bringing together stakeholders from traditional and non-traditional industries to:

- Accelerate deployment of new services and devices
- Drive new sources of revenue with new business models
- Broaden the device landscape to consumer electronics and machine-to-machine

Working with the next generation of applications, content and connected devices providers to make the market for LTE based services in 5 target areas:

- Consumer Media & Entertainment
- Enterprise Collaboration & e-Healthcare
- Automotive Connectivity
- Digital Signage
- Computing Experience (Cloud Computing)
Announcing: The LTE Connected Car Concept Vehicle

Enabling the Next-Generation In-Vehicle User Experience

The LTE Connected Car concept represents the next frontier for mobile connectivity
Alcatel-Lucent developed together with partners the Connected Car concept

- Validate technology and service definition
- Discover and validate potential new business models
- Primary research on consumer experience
- Solidify an end-to-end value chain
- Enable a prospective new world of automotive services and experiences
LTE End-to-End Solution Lab Stuttgart
Connected Car - Architecture

Connected Car Concept Vehicle

- Embedded CPUs
- In-Car Network
- WiFi
- Nomadic Personal Devices

Service Provider and Third-Party Applications
Content Storage
LTE Network
Service Provider IP Network
Private/Public WiFi Network
The Internet
Car G/W

Alcatel-Lucent
Features of the Connected Car Concept

- Each passenger is unique. The four touch screens connect to a personalized in-vehicle experience.
  - **The driver**: Access to driver-centric services such as advanced GPS navigation, vehicle safety and wellness, and hands-free communication.
  - **The front passenger**: Access to applications, including management and control services such as home control, and all others.
  - **Rear passengers**: Free to enjoy a wide range of services, on-demand video, gaming, social networking, and Web-based applications.

- A Wi-Fi modem creates a hotspot inside the car, notebooks, personal media players and smart phones are now connected.

- LTE provides the overall instantaneous network connectivity, for ultra-high bandwidth (both upstream and downstream) content and data delivery.
Entertainment

Video-related services
- On-demand movies (streamed/downloaded from network)
- Kabillion Kids VoD Service (On-Demand Kids content)
- Access to “MyPVR” personally recorded TV via network storage
- Access and remote control of IP camera(s) in home, car-car
- YouTube

Audio-related services
- Pandora Internet radio
- Atlantic Records Fanbase
- On-demand music store
- Access to personal media devices via Wi-Fi/Bluetooth and plug-in.

Gaming services
- Game store: download and play
- In-car and out-of-car: Single and Multi-player

Infotainment

Navigation services
- Local search
- GPS augmented by P.O.I overlay on maps

Vehicle wellness services
- Maintenance tracking and notification
- Virtual mechanic
- Car to Car sharing of road and safety conditions
- Schedule service appointments via Web

Communication and connection services
- Hands-free mobile communication services
- Network-based value-added services, e.g., voice recognition
- Access to widgets and social networking
- In-car broadband Internet access via Wi-Fi
- Home control

http://www.youtube.com/watch?v=wGvujFweS14
Thank you