TOWARDS LTE RAN EVOLUTION

Alcatel-Lucent, Alcatel-Lucent Shanghai Bell

3GPP Workshop on Release 12 and onwards
Ljubljana, Slovenia, 11th – 12th June 2012

Alcatel·Lucent

RWS-120014

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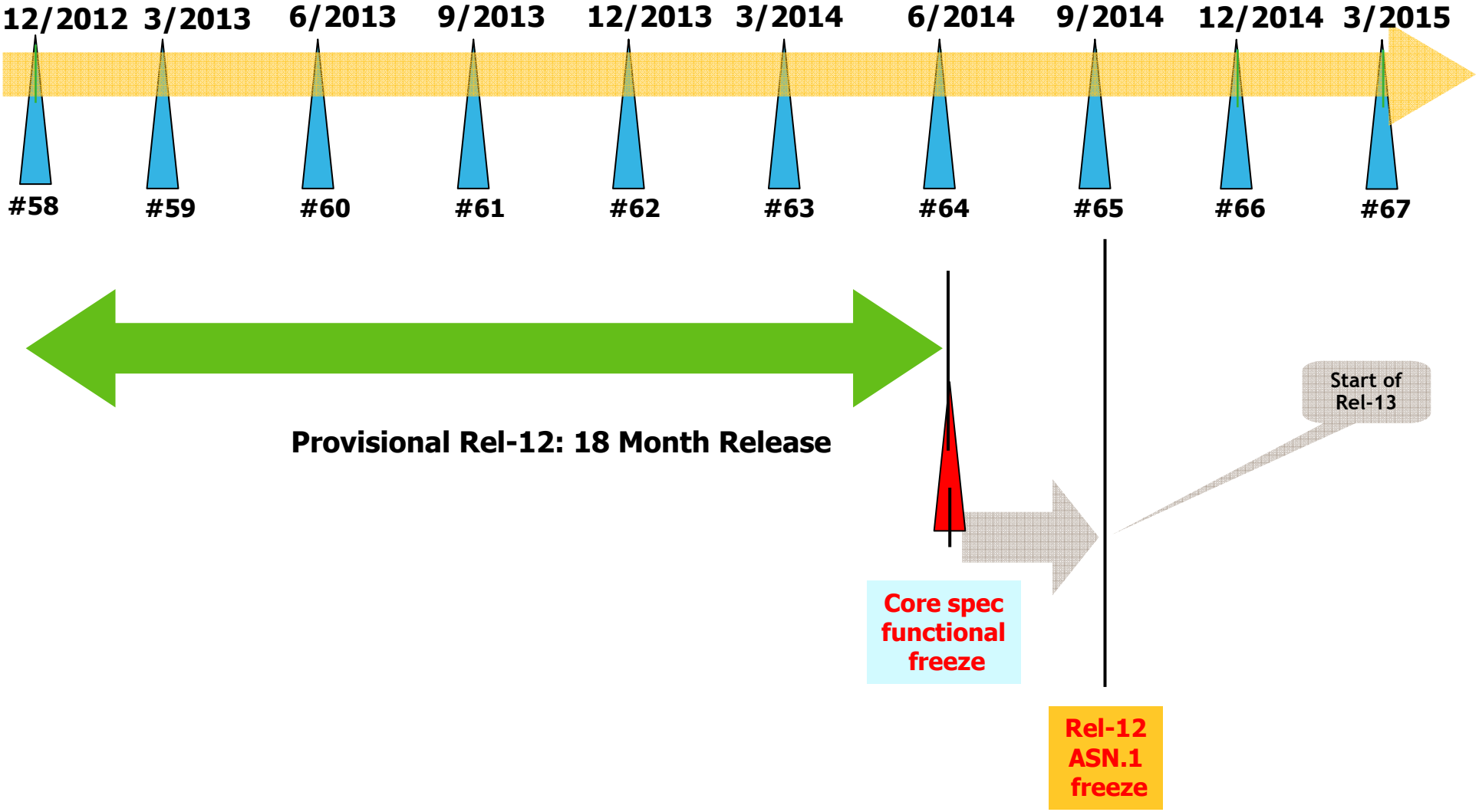
Provisional Schedule for future 3GPP releases



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Industry Trends

MOBILE CONNECTIONS

5.5
Billion

2011

7.3
Billion

+32%

2015

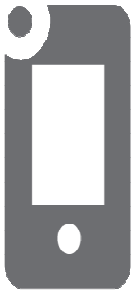
SMARTPHONE SALES

428
Million

2011

1
Billion

+134%



2015

APPLICATION DOWNLOADS

18.2
Billion

2011

41.7
Billion

+129%

2015

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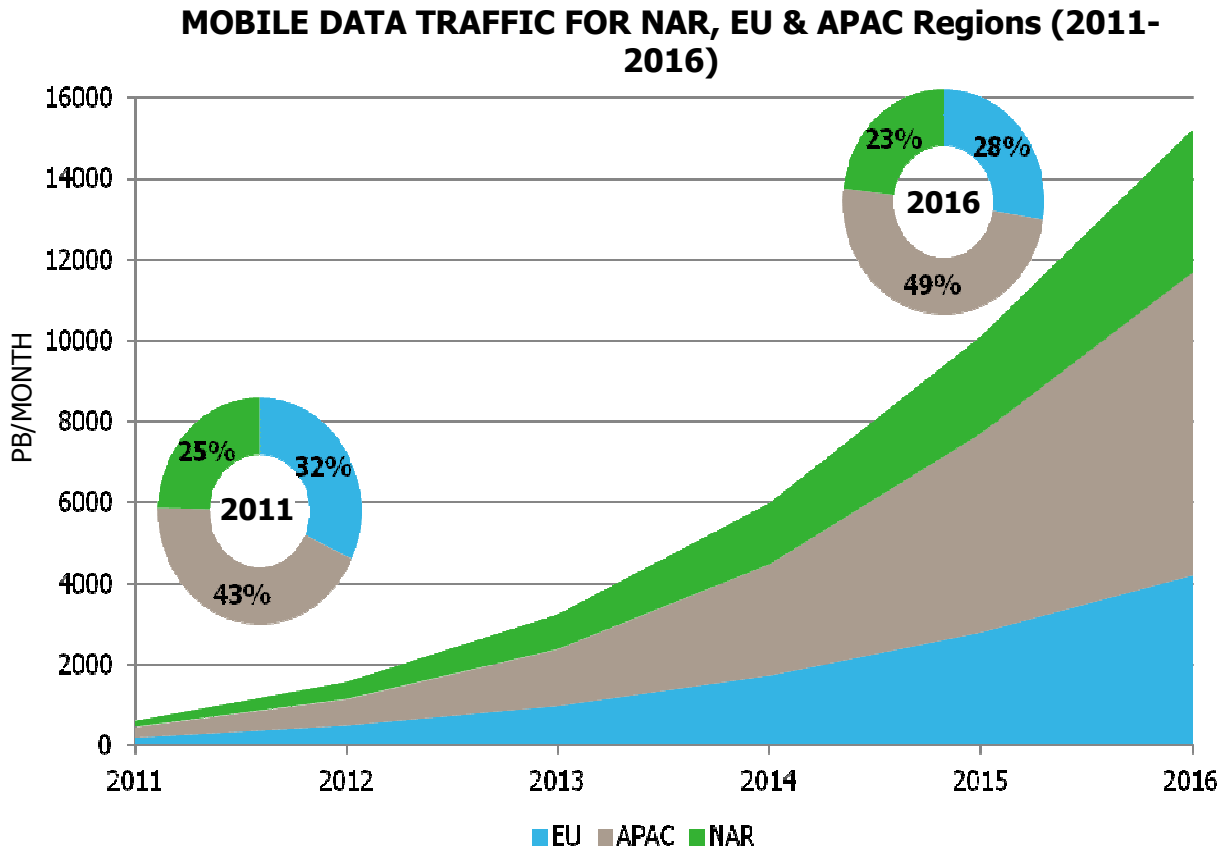
Mobile broadband data is exploding



Source: Traffic Index, 2012 - Bell Labs Modeling

TODAY

DATA is 90% of traffic

BY 2016

MOBILE DATA TRAFFIC WILL GROW >25 TIMES

Mobile broadband data is driving the need for network capacity

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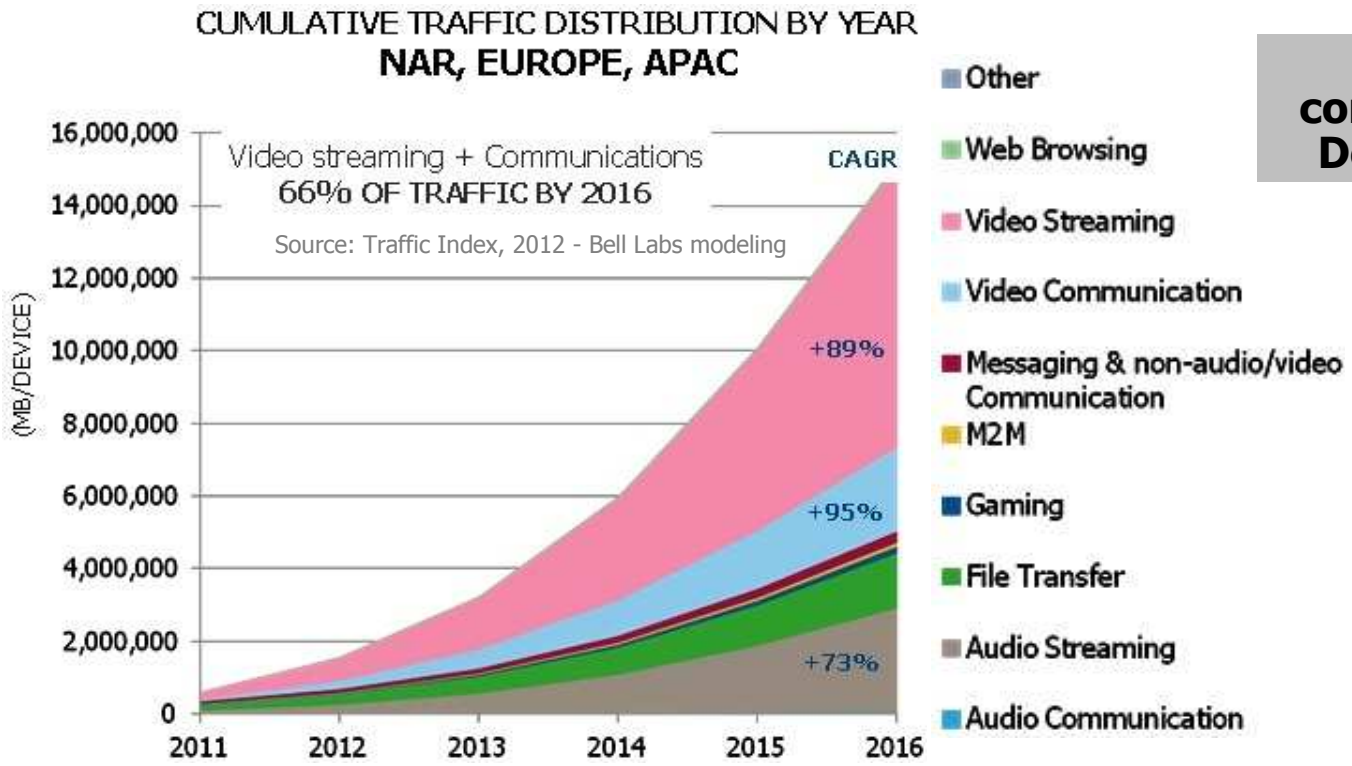
Data traffic is changing

- Smartphones predominating
- Wider range of applications
- New revenue streams for operators



VIDEO

43% of data today
66% by 2016

Most operators considering Content Delivery Networks

Mobile broadband is no longer just downloading: Engaging not just informing

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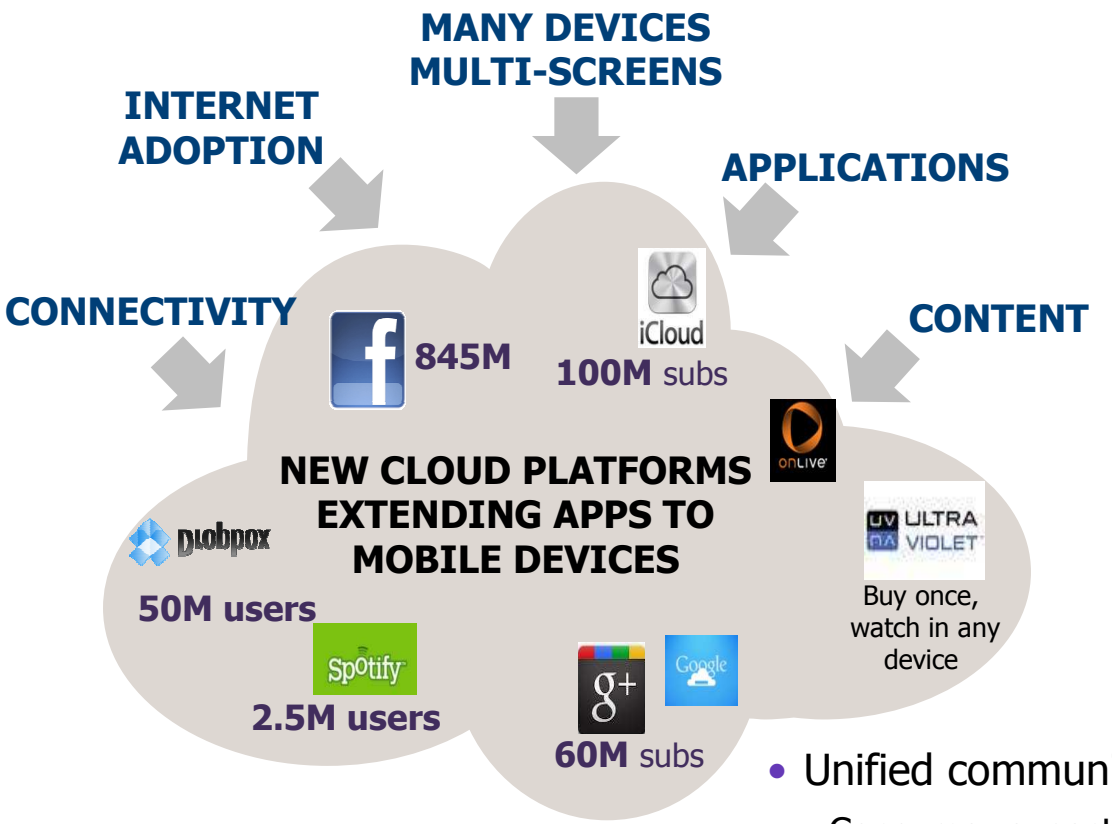
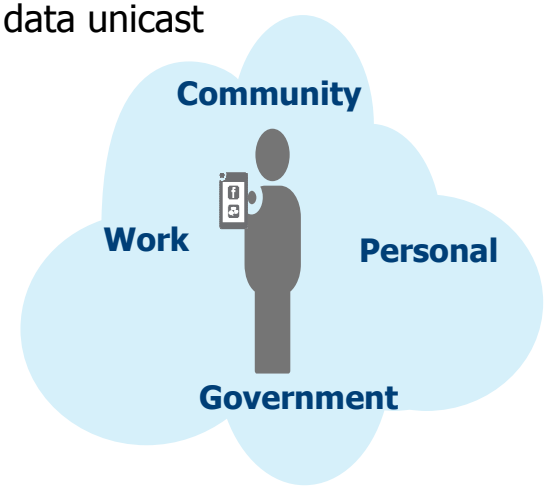
Consumer behaviour is changing



- Personalization
  - My device, my personal environment, my networked community
  - ➢ Real-time, always on
  - ➢ Most data unicast



- Unified communication
  - Consumer expectations are the same whether fixed or mobile
  - Complementary networks with combined data plans:
    - Bundles of fixed broadband, landline, mobile broadband and Wi-Fi
  - ➢ Towards uniformity of service provision

The application cloud requires seamless connectivity for a seamless experience

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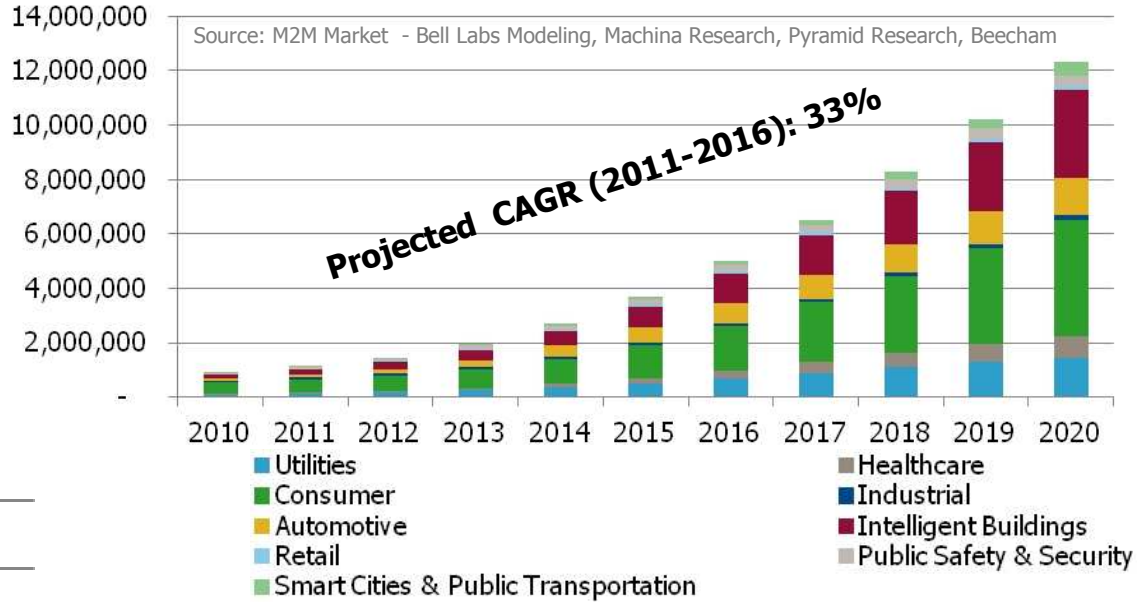
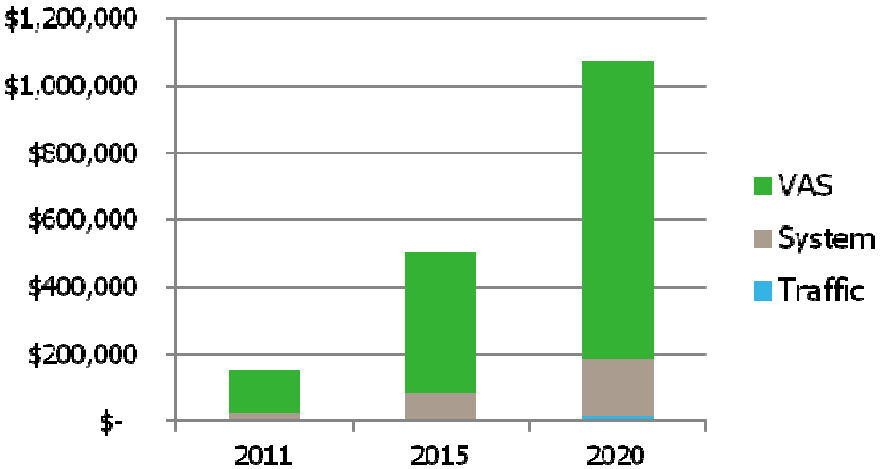
Machine-to-Machine: The Internet of Things

- Everything connected
- Smart cities
- Augmented reality





By 2020:

20 billion M2M devices

500% M2M traffic increase

83% of M2M revenue from value-added services

M2M communication is becoming mainstream, enabling new business models

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Implications for LTE Evolution

- The features needed in LTE in the next 3-4 years will therefore be those that:
  - Increase network capacity
  - Maximize efficiency of spectrum utilisation
  - Improve uniformity of service provision
  - Support personalized data traffic
  - Save energy
  - Support operators in engaging with Over-The-Top players and new revenue opportunities
  - Reduce costs
  - Support newly available spectrum
- Without sacrificing other key strengths of LTE, such as:
  - Low delays – latency and round-trip time
  - Support for mobility
- Potential impacts on other aspects should not be forgotten:
  - Security
  - Prioritisation and traffic management
  - Policy control and Charging Rules Functionality (PCRF)
  - QoS classes

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Evolution or Revolution?

- LTE up to Release 11 already offers great flexibility to support a wide variety of deployment scenarios, including:
  - Homogeneous and heterogeneous networks: Macro, pico, femtocells
  - Single carrier and multi-carrier (including cross-carrier scheduling)
  - FDD and TDD
  - Wide range of carrier bandwidths
  - Coordination in time and frequency domains
  - Single and multipoint transmission and reception
  - Interworking and mobility with other RATs
  - Range of UE categories and capabilities
  - Unicast and broadcast service support
- Much investment has been committed to LTE
  - Technology fragmentation should be avoided, to maximize return on investment and economy of scale

LTE is a very flexible interface, and a radical revolution is not needed or desirable in the timeframe of Releases 12 and 13

LTE development should focus on evolutions of existing features to satisfy more fully the challenges identified on the previous slides

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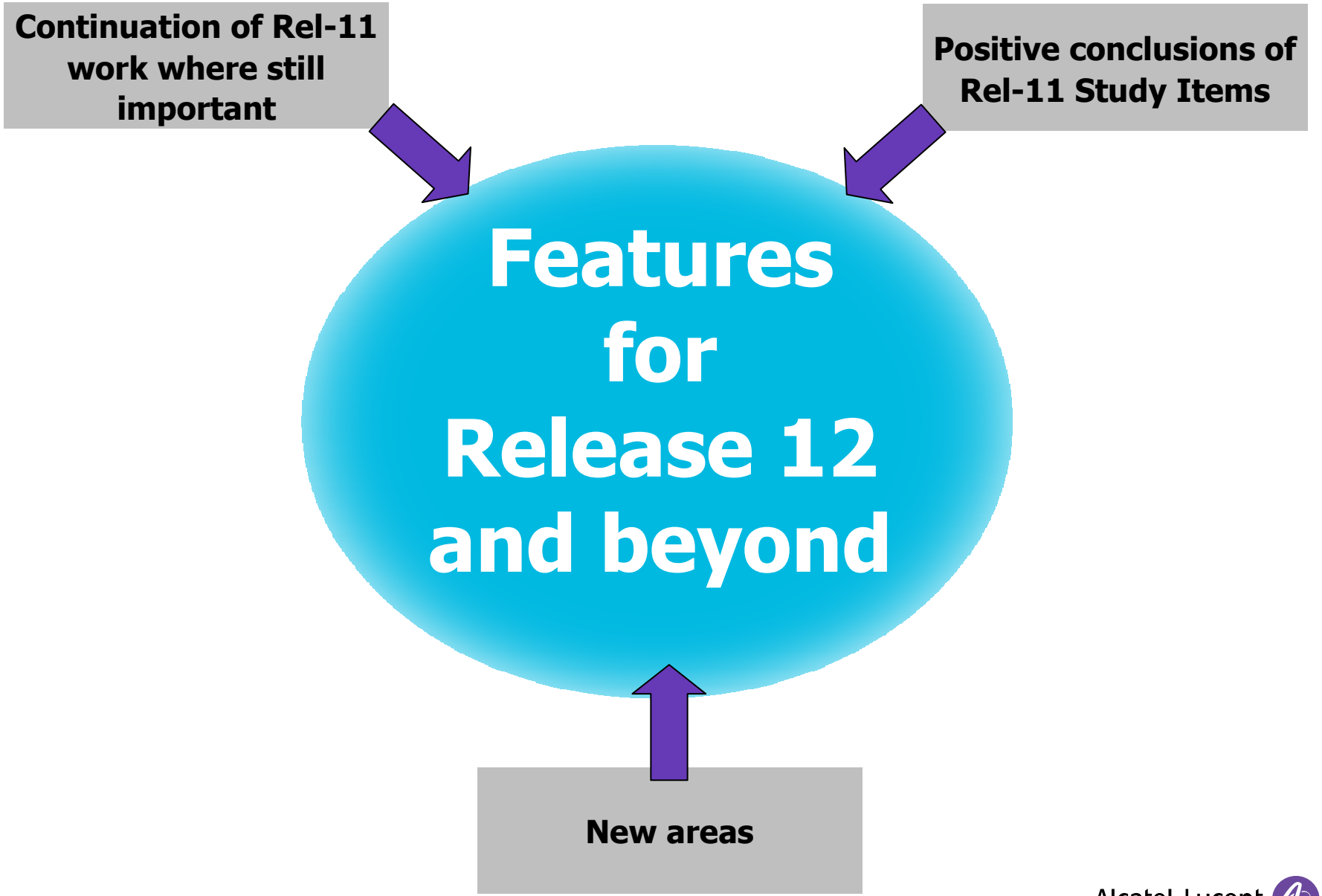

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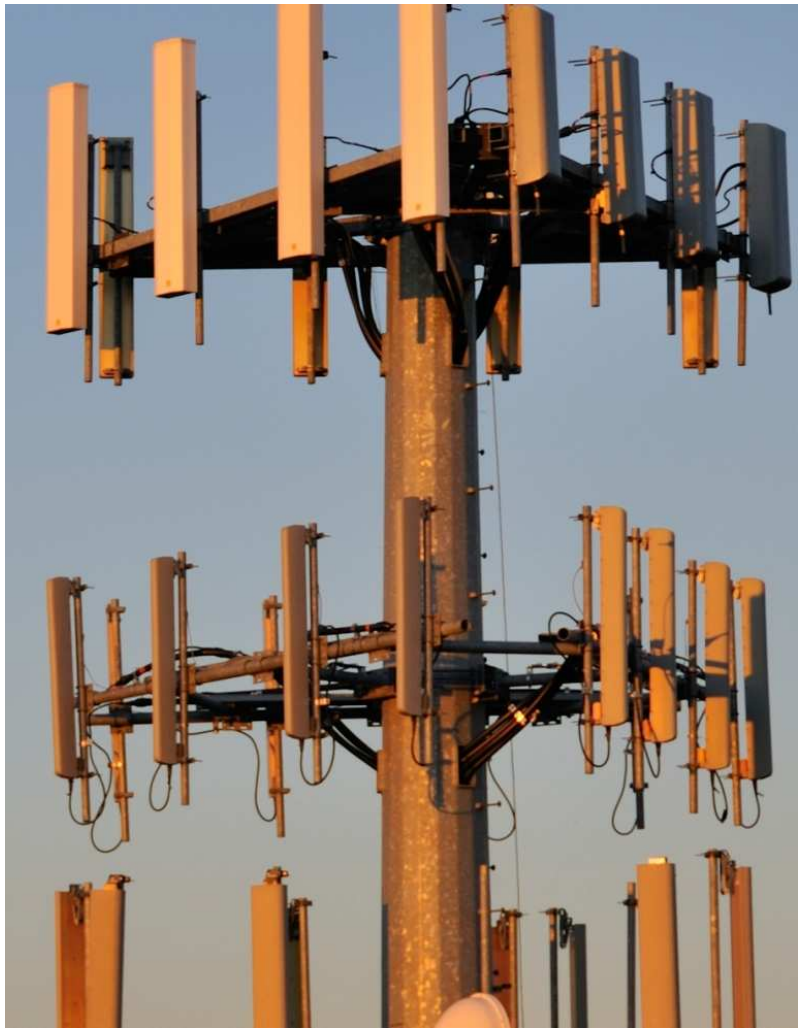
MIMO Enhancements

- The spatial domain is not yet fully exploited
- Multi-user MIMO is key to improved spectral efficiency and uniformity of service provision
- New WI "Further Downlink MIMO Enhancement for LTE-Advanced" primarily addresses currently-deployed antenna configurations
  - Especially 4 tx cross-polarized configurations



Maximise the performance of important antenna configurations

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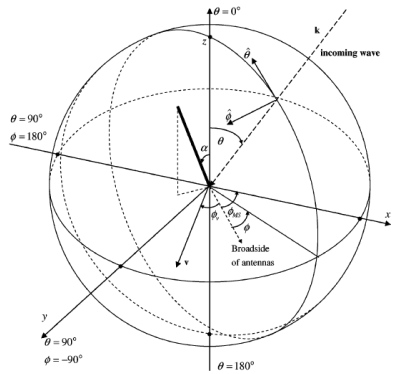
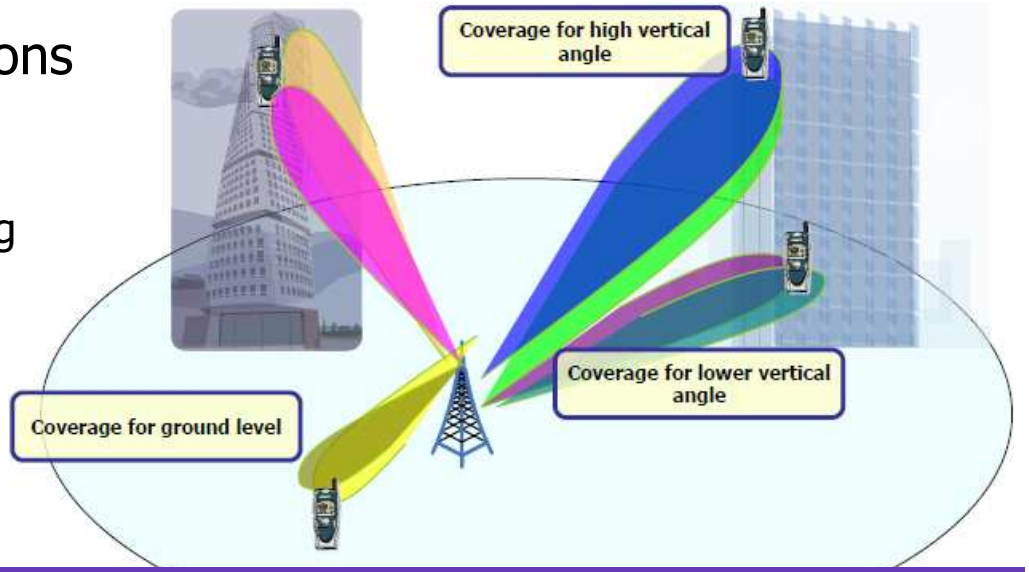
New antenna configurations and 3D MIMO

- Smart active antenna arrays
  - Boost capacity in the urban jungle
    - Increase SINR
    - Support higher user densities
  - Deep indoor penetration



- New antenna configurations
  - 3D MIMO
    - 3D channel modelling study needed
    - Introduce suitable CSI feedback to support 3D MU-MIMO



Study the gains from new smart antenna configurations, including for 3D MIMO

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CoMP Enhancements

- Link level enhancement possibilities are minimal now
- Cooperation is the key to further advances in spectral efficiency
- Improved signalling to support high-resolution coordination
  - Support for multi-vendor coordination, especially in heterogeneous networks
- Support coherent and non-coherent joint transmission
  - The greatest gains in the Study Item were shown by coherent joint transmission
  - Suitable CSI feedback
  - Larger CoMP set sizes
- Support CoMP with typical backhaul properties

Cooperation is key to enhanced spectral efficiency and cell-edge improvements

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Small Cells

- Adding capacity where it is needed
- Facilitate the deployment of a complete LTE small-cell subsystem on top of an existing LTE macro network
  - Improve mobility performance in small cell environment
  - Enable X2-proxy function as an option for the HeNB GW
    - Would constrain the need for IOT, to just between HeNBs and HeNB GW, with no impact on macro network performance
- Optimise performance by smarter LTE small cell interference management
  - Autonomous carrier selection by LTE femto cells
  - Extend carrier-based ICIC techniques to operate between macro eNBs and HeNBs
    - Enable efficient uplink interference management
- Network optimization evolutions linked to SIPTO at Local Network and LIPA mobility at stand-alone gateway

Small cells, both femto and pico, are the key to increased capacity in future LTE deployments

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Energy Saving

- Network energy saving is of high importance
  - LTE already supports many energy saving features
  - Further enhancements that could be considered include:
    - Automatic adaptation depending on traffic demand and global interference levels
    - Improved selection of nodes for activation / deactivation, taking into account:
      - Potential for energy saving
      - Traffic distribution
      - Global interference level

All new features should take into account minimisation of energy consumption

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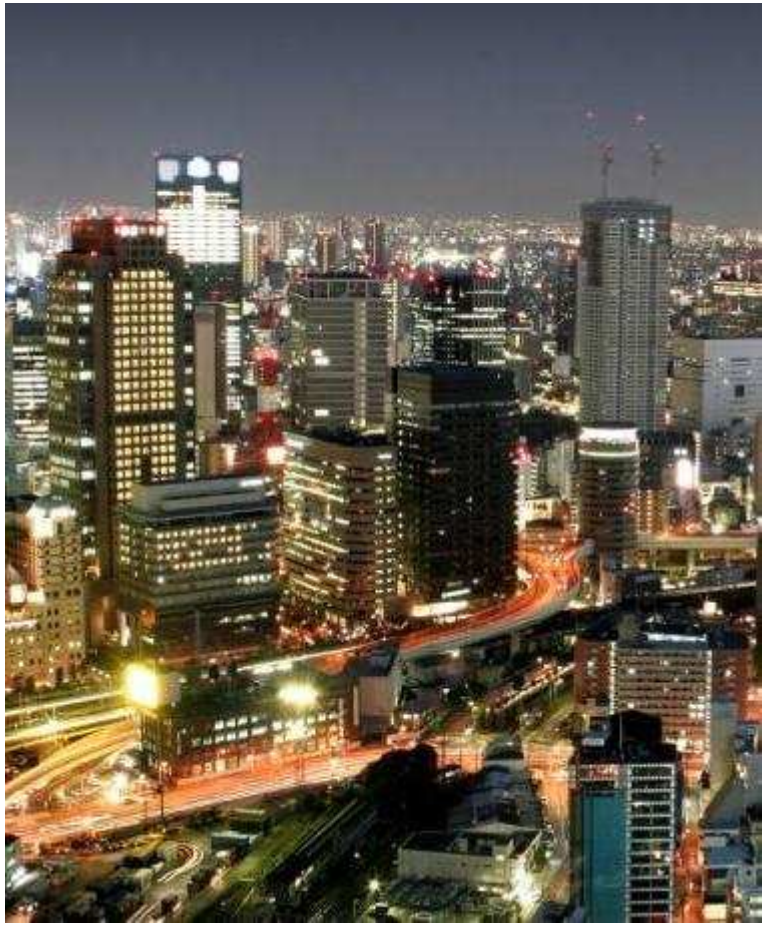
Machine Type Communications: a new ecosystem

- New revenue streams
- Many devices
- Low-cost terminals essential
  - Address conclusions from Rel-11 study
- Support machine-type traffic efficiently
- Handle priority and QoS appropriately



Open new business models via efficient MTC support

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Device-to-Device Communications

- Direct D2D communication solutions can be categorized by the mode of infrastructure control:
  - Preconfiguration by infrastructure:
    - Primarily motivated by public safety scenarios for emergency service use
  - Full infrastructure control:
    - Information sharing between proximate UEs
      - Primarily motivated by social networking applications
    - Data forwarding between proximate UEs
      - Possible benefits (to be evaluated) include increased network capacity, reduced delays, range-extension / dead-spot mitigation, leading to better user experience
- Benefits of full infrastructure control include:
  - Operator control of operation and billing
  - Interference management: a key challenge of D2D in shared spectrum
  - Security aspects
  - Possibility of network assistance for device discovery and link establishment

Benefits and potential design of D2D need careful study in the light of use cases identified in SA1

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Network Self-Optimisation

- Introduce features driven by concrete use cases fulfilling operator needs:
  - Further reduce OPEX and simplify the tasks of operators
    - Automatic updates of network topology changes between LTE network and UTRAN/GERAN neworks
    - Decentralized self-healing mechanisms
  - Optimize the performance of heterogeneous LTE networks
    - Automatic detection and correction of intra-LTE scenarios of short stay in a cell
    - Auto-tuning of mobility parameters according to individual UE mobility and traffic profile in dense hetnet deployments
    - Self-adjustment beween load balancing and mobility robustness algorithms
  - Extend the scope of SON to other RATs
    - Load Balancing, Mobility Robustness and Enhanced ANR between LTE and CDMA2000 networks
  - Extend the scope of SON to other types of nodes
    - SON towards HeNBs

Efficient SON is a key benefit of LTE.
Enhancements should meet clear needs and avoid excess complexity

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TD-LTE

- TD-LTE Status:
  - TD-LTE has been developed in an integrated way with LTE FDD
    - Common feature set
  - TD-LTE enables unpaired spectrum to be utilized efficiently
  - As spectrum becomes more scarce, and capacity demand increases, unpaired spectrum will become increasingly important

- TD-LTE Evolution Principles:

1. Evolve TD-LTE with equal priority to FDD
2. Avoid divergence between TD-LTE and LTE FDD wherever possible
   - Maximize commonality, evolve and enhance features jointly with FDD
   - TD-LTE integrated in the worldwide ecosystem of equipment and terminals can exploit and enhance economies of scale
3. Exploit TDD-specific opportunities
4. Address TDD-specific issues

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TDD-specific aspects

- TD-LTE allows configurable UL-DL ratios
  - New spectrum allocations will result in new interference scenarios
- Faster UL-DL reconfiguration
  - Enhanced adaptation to traffic patterns
    - Short-term fluctuations and long-term trends
    - Adaptation improves exploitation of scarce resources
  - Improved interference management
  - Observed benefits in the SI need to be translated into practice
    - Identify suitable adaptation techniques
- Reciprocity
  - The most significant benefit of TDD operation
  - Channel State Information (CSI) is directly available at the transmitter
    - Possibilities for exploitation:
      - Advanced beamforming
      - Large antenna arrays without high CSI feedback overhead
      - Enhanced CoMP schemes, including coherent joint transmission
  - Challenges to address:
    - Antenna calibration
      - Consider need for standardized antenna calibration techniques

Evolve and enhance TDD with equal priority to FDD.
Exploit TDD-specific opportunities.

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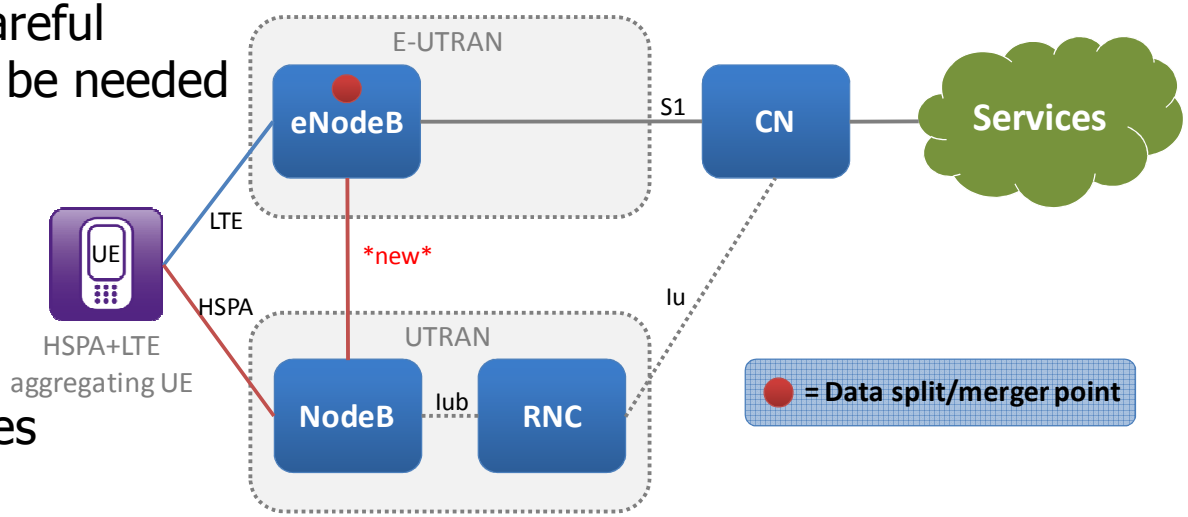
LTE integration with other RATs

- Ensure sufficient interoperability with other key RATs : HSPA, Wi-Fi
  - For LTE-HSPA integration, careful choice of architecture would be needed
  - Benefits are not yet clear, e.g. in terms of capacity, load balancing
  - Analyse implications for latency, complexity, interfaces
  - Analyse potential benefits



- Wi-Fi gives access to additional spectrum
  - Seamless handover between aggregated LTE/Wi-Fi and LTE
- Benefits of new features need to be assessed in the context of existing technologies

An appropriate complexity-benefit trade-off needs to be identified with respect to any possible tighter integration of LTE with other RATs

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Way Forward for LTE in Release 12 and Beyond

- Features should be considered for LTE evolution if they:
  - Increase network capacity
  - Maximize efficiency of spectrum utilisation
  - Improve uniformity of service provision
  - Enable personalized data traffic
  - Save energy
  - Support operators in engaging with Over-The-Top players and new revenue opportunities
  - Reduce costs
  - Support newly available spectrum

- LTE already provides a very flexible interface, and a radical revolution is not needed or desirable in the timeframe of Releases 12 and 13
  - LTE development should focus on evolutions of existing features to satisfy more fully the above challenges
  - Technology fragmentation should be avoided, to maximize return on investment and economy of scale

- Key technology evolutions which should be developed with high priority include:
  - MIMO enhancements to support new antenna configurations and 3D beamforming
  - CoMP enhancements for Network MIMO with improved coordination signalling
  - Enhanced support for small cells and interference management

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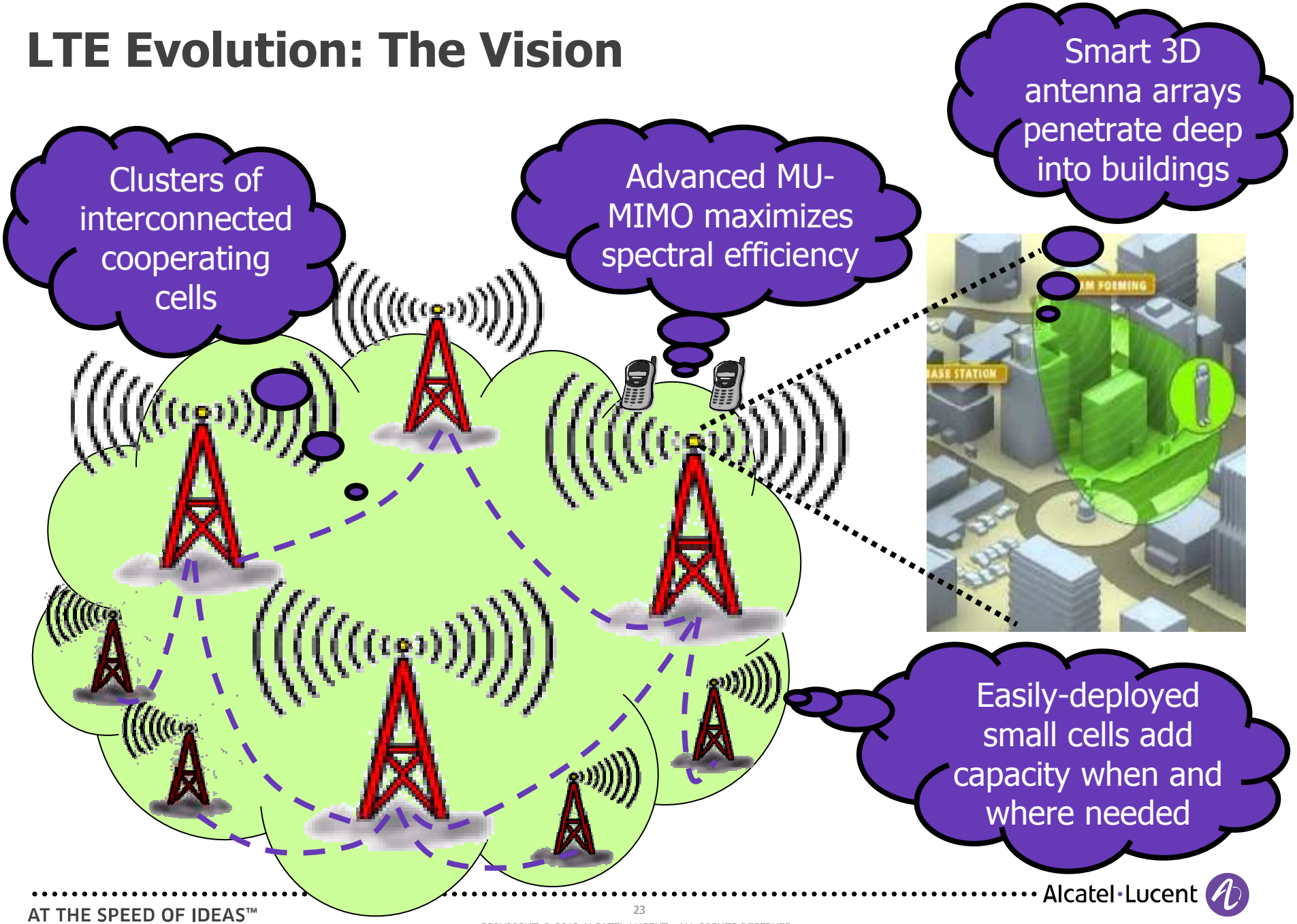
LTE Evolution: The Vision



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