Towards an Unified Wireless Architecture

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Do we need a new wireless architecture?

The situation now

- *Too many wireless standards*. UMTS, LTE, WiMax, WiFi, Bluetooth, RFID, ZigBee, Packed Radio solutions, etc…
- *Overlapping spheres of application*. Leads to the necessity in one device to be installed hardware for several different wireless interfaces.
- *Parallel service development.* Parallel investment in one and the same application services, in one and same functionalities for the different standards.

Do we need a new wireless architecture?

The situation now…

- Territorial saturation. Parallel infrastructures and dense deployments of access points in one and the same locations delivering one and the same services. In some locations infrastructure density is even higher than device density.
- Throughput limit. In many places the existing architectures have reached the throughput limit (“Throughput wall”). Interference and EM compatibility problems.
- Strong dependence of users on service providers. Practically a service is available only if the user pays ”tax” for the infrastructure, which means that if an access to two services is required, which are offered via two different independent infrastructures, the user has to pay two “taxes infrastructure”.

Do we need a new wireless architecture?

Pressure to change

- *Device and applications*

  Manufacturers release smarter user devices and new apps and application-driven platforms. Multimedia traffic in the wireless network is increasing, new communicating devices and machines are on the way to be introduced in the network, resulting in greater demands and new requirements on the infrastructure.

- *Users*

  Use of mobile applications and mobile social networking have surpassed voice. There are problems with the ability to process the volume of data transmitted by end users, especially in larger urban areas. Broadband mobile users are expected to reach 3.4 billion by 2014, 60b in 2020.

- *“Green” issues*

  Not only power consumption, electromagnetic “Smog” and health issues are very much under consideration.

Do we need a new wireless architecture?

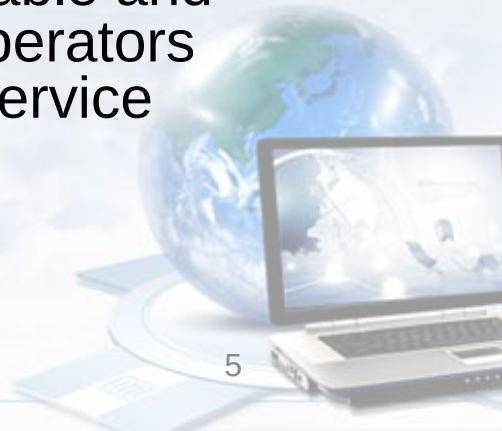
Pressure to change…

- *Service providers*

  Service providers move towards a data-only network, carrying VoIP. The dominant SPs are offering voice-only services for “free” as part of bundled data packages. The requirements towards secure and efficient data transmission, data management and QoS are growing as this is a prerequisite for their domination on the market.

- *Operation, administration, maintenance*

  Good and efficient OAM requires more reliable and easier for maintenance infrastructure. Mobile operators outsource OAM and focus on becoming pure service providers.



Do we need a new wireless architecture?

Pressure to change…

- *Complexity.*

  Traffic and QoS issues are becoming more complex. Multimedia services require a new way of traffic engineering, differentiated treatment of data flows based on traffic type, QoS, customer SLA, user activity and user preferences.

  Implementation of scenarios for dynamic resource management, advanced carrier aggregation, power control, etc., with competing system operators is constrained because of complexity.

- *Costs.*

  The overall pricing and cost model of the network infrastructure is under consideration.

Do we need a new wireless architecture?

What are some of the expectations from a new infrastructure?

- Big range of the access points – from 5m up to 50-100 km;
- Extreme data rates and traffic capacity, to meet future challenges;
- Effective utilization of the infrastructure through the implementation of an unique, shared, flexible and reliable solution;
- Possibility of modular and flexible territorial spread of the access, based on self-organization, self-configuration and self-regulation;
- Unified, efficient and scalable utilization of the frequency spectrum and dynamic spectrum access;
- Cognitive and intelligent architecture adapting to user requirements, new personalized multimedia services and applications, required QoS, etc.;
- “Green” and cost effective, i.e. minimized energy consumption and very-low-cost deployment and maintenance.

Possible solutions

LTE evolution to 4G and beyond

- LTE will continue to evolve and will bring an overall shift to such a new network architecture.
- Cell sites will become smaller thus increasing capacity and less power consuming. LTE will handle the massive increase of users and multimedia traffic.
- The unique air interface of LTE that offers high downlink and uplink speeds will meet the required QoS in the future.
- LTE will become the global and unique technology for future mobile broadband as its underlying architecture is based on IP - fully packet-switched, flexible, with support of cell sizes ranging from tens of meters, spanning femtocells and picocells to macrocells with up to a 100-km cell radius.

Possible solutions

No reason to deviate from LTE track!

Question?

Will all the new applications and scenarios be supported sufficiently well by the LTE evolution?

Very small cells in the LTE architecture means that the infrastructure equipment must support complex wireless Ethernet topologies. Complexity is a problem that will be strongly under consideration. This is also related to the overall efficiency of the architecture.

The same requirements as for Carrier Ethernet in the wireline environment, such as fine-grained OAM&P, precise network timing and synchronization, flexible support of MPLS, etc. will be critical for small cell LTE architectures.

Possible solutions

Convergence or hybrid architectures of access technologies

- Approaches for wireless access, wireline/wireless convergence, etc.
  General target is deployment of a global all-IP wireless/mobile network.

- LTE and Wi-Max or LTE and Wi-Fi hybrid architectures
  "The growing demand for low-cost mobile broadband connectivity is driving the development of heterogeneous networks in which different radio access technologies and Wi-Fi will all co-exist. Some operators view Wi-Fi as an interim solution until small cells are deployed, although we believe Wi-Fi will be an integral part of operator networks for a long time to come."

  [Cellular and Wi-Fi: A Match Made in Heaven? Signals Ahead, March 2012, Vol. 8 No. 4]

Possible solutions

Question?

Convergence will take time and will it bring to a radical change in the network architecture?

There are many challenges and problems to be solved:

- air interface, transmission and protocol convergence of the different technologies;
- convergence of the infrastructure including costly OAM issues to be solved;
- new usage scenarios have to be developed;

…and many of the problems of the current co-existing architectures will also co-exist and not be solved for a longer time…

Possible solutions

New unified wireless architecture?

- To develop a new unique and unified infrastructure for wireless access, which is organized through clear rules for hierarchy, territory, frequency allocation.
- To fully implement the proposed European shared-facilities model of “RAN (radio access network) sharing” with shared infrastructure, shared backhaul, and shared cells.
- To be accessed via one unified interface in the terminal equipments – computers, tablets, smart phones, and why not also industrial controllers, identification tags, etc.
- To be fully IP based, including mobile telephony.

Possible solutions

New unified wireless architecture…?

- To be a self-planning, self-organizing, self-monitoring ,self-regulating architecture in respect of power control, automatic switch-off of zones or groups of access points when no users or requests for service are available and significantly reduced emphasis on manual intervention.
- To be flexible, cognitive, intelligent in order to ensure dynamical development and evolution and employ all the advantages of the cognitive radio.
- To be fully cross-layer designed architecture with the possibility of “virtualizing” different networks and substructures (operators, private networks, etc.) in order to avoid the proliferation of various types of small-cell infrastructure equipment.

What could we gain from a new architecture?

Actually what we gained from cable internet…

- Much more consolidated and cost-effective investments in the quality of the access infrastructure.
- Decrease of prices of access and services. Increase of the overall effectiveness in the industrial segment, due to the lower expenses for OAM&P of the parallel infrastructures.

…and much more…

- Accessibility anytime/anywhere and FOCUS to Services, Applications and Content.
- Incorporating in the architecture D2D and M2M communications and driving the path towards Future Internet.

Challenges

What are some of the challenges?

- R&D of a cognitive, self-optimizing, self-reconfigurable architecture depending on location, user activity and required QoS.
- R&D of a technology for self-organization and self-monitoring, for an energy saving “green” infrastructure.
- R&D of methods for virtualization of the existing technologies and services to be used for different applications (virtual applications) and also for group access to different services (virtual operators).

Challenges

What are some of the challenges…?

- Formulation of new technical conditions and requirements for spectrum usage and allocation.
- New models of ownership and management of resources including, but not limited to, combinations and bundles of spectrum, equipment, processing, storage and energy resources.
- The architecture must be developed in such a way in order to ensure a clear plan for migration from the existing wireless architectures towards an Unified Wireless Network.

Questions to be answered

- Is it really necessary?
- Are the driving forces strong enough?
- Will it happen?
- If yes, will it need a radical approach or this will be a convergence and/or evolution process?
- What about reaction of industry and operators?
- What about market driving forces and competition?
- And many, many other…

Thank You!