



eltic-Plus⁺

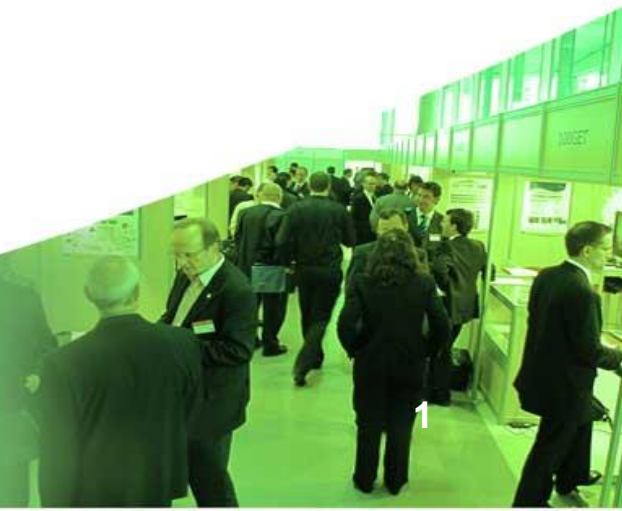
Smart Connected World



Celtic-Plus Event
27-28 May 2015, Vienna

Celtic-Plus Award winning projects present their results CIER

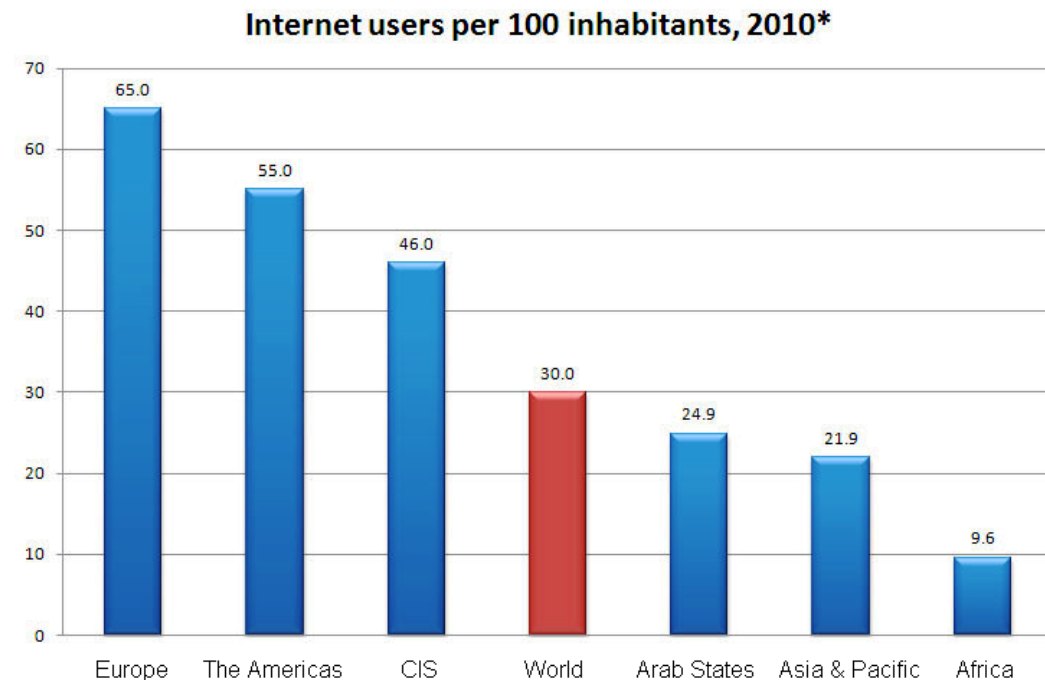
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- Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V., Germany
- Ericsson, Finland
- Orange, France
- LinkNet, Zambia (participated till end of 2012)
- Magister Solutions, Finland
- Media Broadcast, Germany (participated till end of 2013)
- PPO-Yhtiöt Oy, Finland (acquired by operator Elisa, but participated till original end date March 2014)
- University Kaiserslautern, Germany
- VTT, Finland
- Living Lab of clinics and schools at Bunda, Tanzania (replaced LinkNet since early 2013)

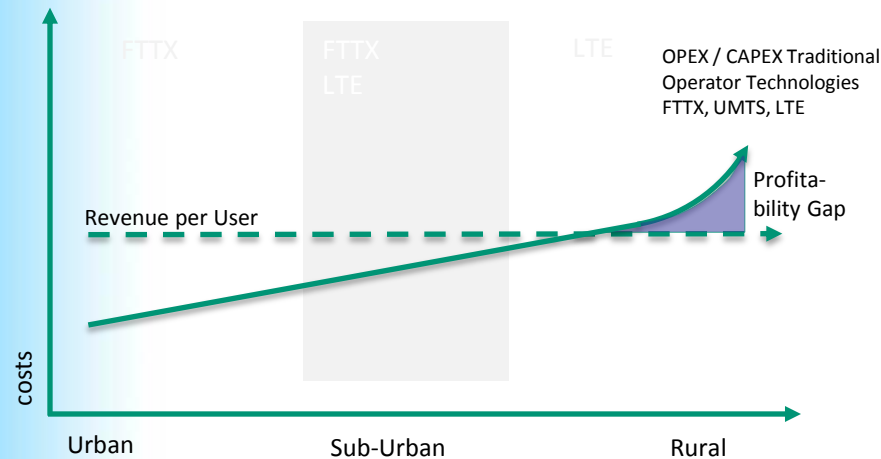


- **Connecting the Unconnected** is a key requirement for sustainable development in rural areas
- Sub-Saharan Africa is the most digitally isolated region in the world
 - a bandwidth per capita that is only 1% of the world average and 0.2% of that in the USA
 - highest connectivity costs in the world (50x)
 - 70% of the population lives in isolated rural areas
- Today, access to Internet and to services is important
 - Economically, socially, and for well-being
 - Not only for developed countries but also for developing ones



* Estimate
Source: ITU World Telecommunication /ICT Indicators database

The challenge to rural connectivity



Rural Attributes	Low Population Density	Huge Distances
	Lack of Energy Access	Lack of skilled labor
	Harsh Environment	High OPEX/CAPEX

New Business Models

Public Funding

New Technical Solutions

- Typical attributes of rural regions lead to **high CAPEX and OPEX per connection**
- Costs exceed potential income completely, or revenue potential is too small for big carriers to address market
- Traditional operator equipment tailored to developed / dense areas
- Competition in dense urban areas lead to increasing bandwidth availability.
- Similar issues in developed and emerging countries – at a different scale
- ✗ **Rural areas are left behind to due lack of sound business case**
- ✗ **Operators are left without viable business case or users with unequal prices**
- ▶ Gap needs to be closed alternatively

▶ “Inclusive Innovation” Approach

Our vision is that communication infrastructure in emerging regions (Africa and parts of Europe) will be based on heterogeneous wireless mesh networks to connect geographically very large areas in an extremely harsh environment.

Typical landscape in rural South Africa



In our vision, **connecting the unconnected** in the rural regions of the world requires **exceptionally efficient and energy aware** and **predominantly self managing** and **low cost wireless backhails** that can utilize **heterogeneous link layer technologies** of **integrated network providers** as necessary.

- Current communication technologies are not appropriate for deployment in emerging regions, due to
 - Lack of wired infrastructures
 - Huge distances between localities
 - Lack of reliable energy supply
 - Lack of well-trained service personnel
 - Limitations to OPEX and CAPEX due to limited financial capabilities
 - Challenging socioeconomic and political conditions
- For long-distance backhauling, standard WLAN is not feasible and cellular technologies are too costly





A Low CAPEX/OPEX Solution



- **Self-Configuring**

Designed to perform a self-configuration of its nodes, no expert knowledge required. Failed nodes can easily replace and will automatically configured.

- **Self-Optimizing**

Nodes communicate with neighbouring nodes and also scan the radio spectrum to determine the best (interference free) channels.

- **Self-Healing**

In event of power failure or malicious damage to a node, its self-healing feature prompts the topology management function to create new connections circumventing the failed node.

- **Energy-Efficiency**

Nodes are designed taking into consideration little or no infrastructure for stable power supply. Their reduced energy footprint allows for powering via alternative sources (solar, wind).

- **Use of IEEE 802 (WLAN / WiFi / ZigBee) Hardware**

Cost-effective, low power off-the-shelf equipment. Requires some 'hand-tuning'.

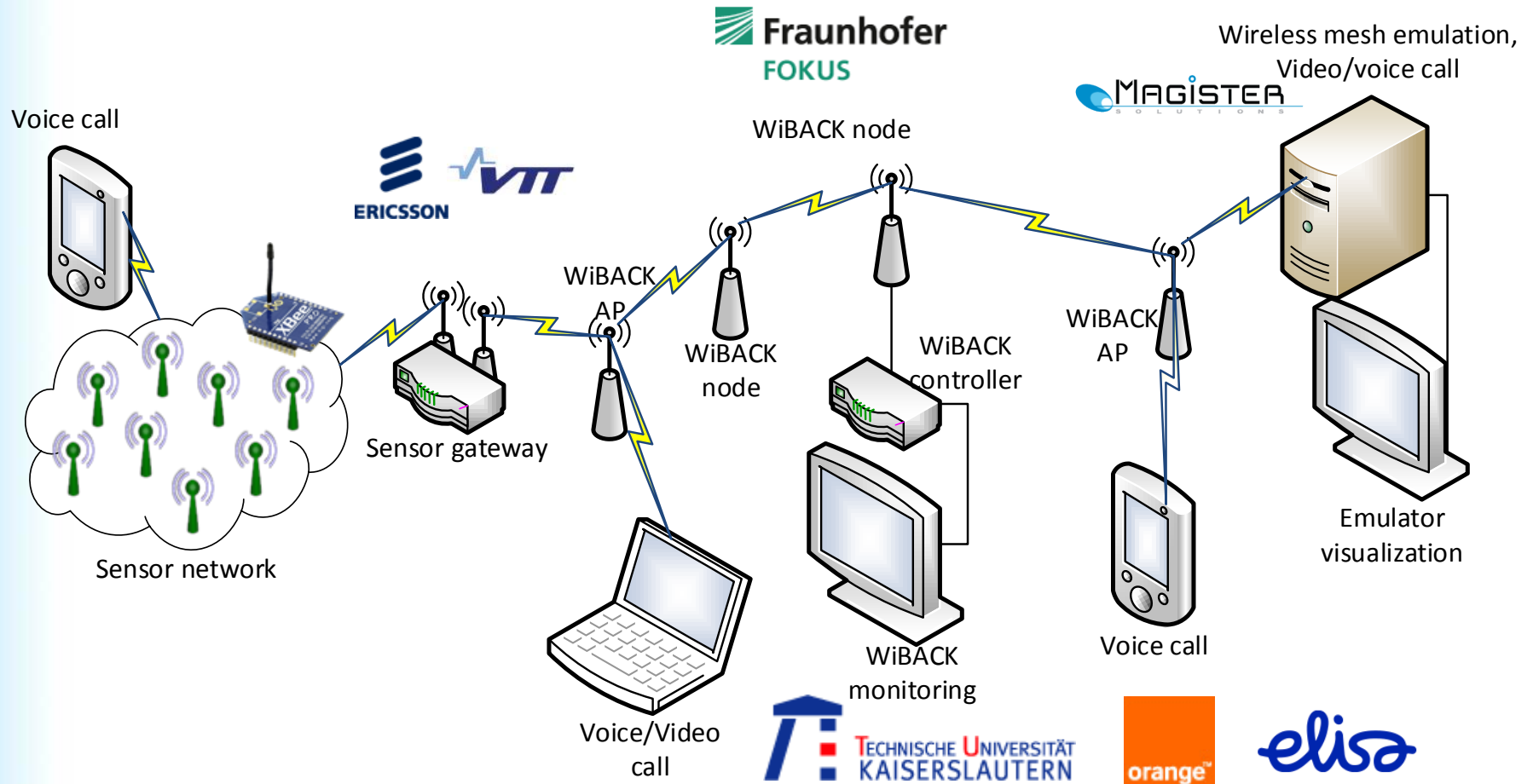
- **Proven Protocols from the Operator World adapted to Self-x**

Enforce service differentiation for Voice, Video and Data traffic and provide predictable behavior under (over)-load situations.

➔ Solution Enables “Carrier-Grade Service Delivery by Non-Specialists” at Low Costs

Integrated network scenario

To design and implement energy-efficient, robust, reliable and affordable wide area heterogeneous wireless mesh networks to connect geographically very large areas in a challenged environment.



- **Development of business models based on thorough technical, social, political, environmental and business requirements analysis** in order to avoid the potential pitfalls that might lead to failed investments.
- **Development of network monitoring based on self-configuration/self-management techniques deployed in a large multi-radio meshed converged infrastructure** to cope with the lack of human resources and wired infrastructure.
- **Design of cross-layer architecture to support message forwarding mechanisms** in order to optimise power consumption and content delivery.
- **Development of prototype testbeds in rural parts of Africa and Europe** to consolidate overall system concepts and full scope of the gained research results while yet raise interest of both industry and end users.

Typical landscape in rural South Africa



Serengeti Broadband Network (SBN) Extension Connection of Schools and Government Offices

8 hops bridging 90km with 100 Mbps end-to-end

