



Networking for Communications Challenged Communities:
Architecture, Test Beds and Innovative Alliances
Grant Agreement: 223994

WiMAX Technology

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Albentia Systems

- **Albentia Systems is the first Spanish manufacturer of WiMAX equipment**
- **Founded in 2004 and headquartered in Madrid (Spain)**
- **Member of the WiMAX Forum since 2006**
- **Albentia Systems designs and manufactures complete WiMAX systems, including Base and Subscriber stations, and Backhaul links.**
- **Strongly oriented to delivering solutions for carrier-class services and applications, with stringent QoS requirements such as TDM, Video and VoIP.**
- **Complete in-house development HW+SW**
- **Customers in Europe, Africa and Latin America**



WiMAX Solutions

- WiMAX Base Stations
- WiMAX Subscriber Stations (User terminals)
- Backhauling equipment
- Point-point professional video links
- TDM synchronous transport radio links
- Network management system

**Standard
compliance**



R&D Experience

- **R&D activities: 65% of total budget**
- **Hardware design: Digital, analog, RF, mechanical design...**
- **Software design: Embedded systems, RTOS, MAC layer development, protocol stacks, management systems...**
- **Collaboration with Universities**

- **Participation in several projects related to rural broadband wireless access (mostly financed by the Spanish Government)**
 - **RASWER: Satellite and WiMAX rural access networks**
 - **OPENREACH: Cost-effective WiMAX infrastructure equipment for rural applications**
 - **WIMAR: IPTV applications over WiMAX in rural areas**
 - **Internet access to native communities in Panama (INADEH)**

Introduction to WiMAX

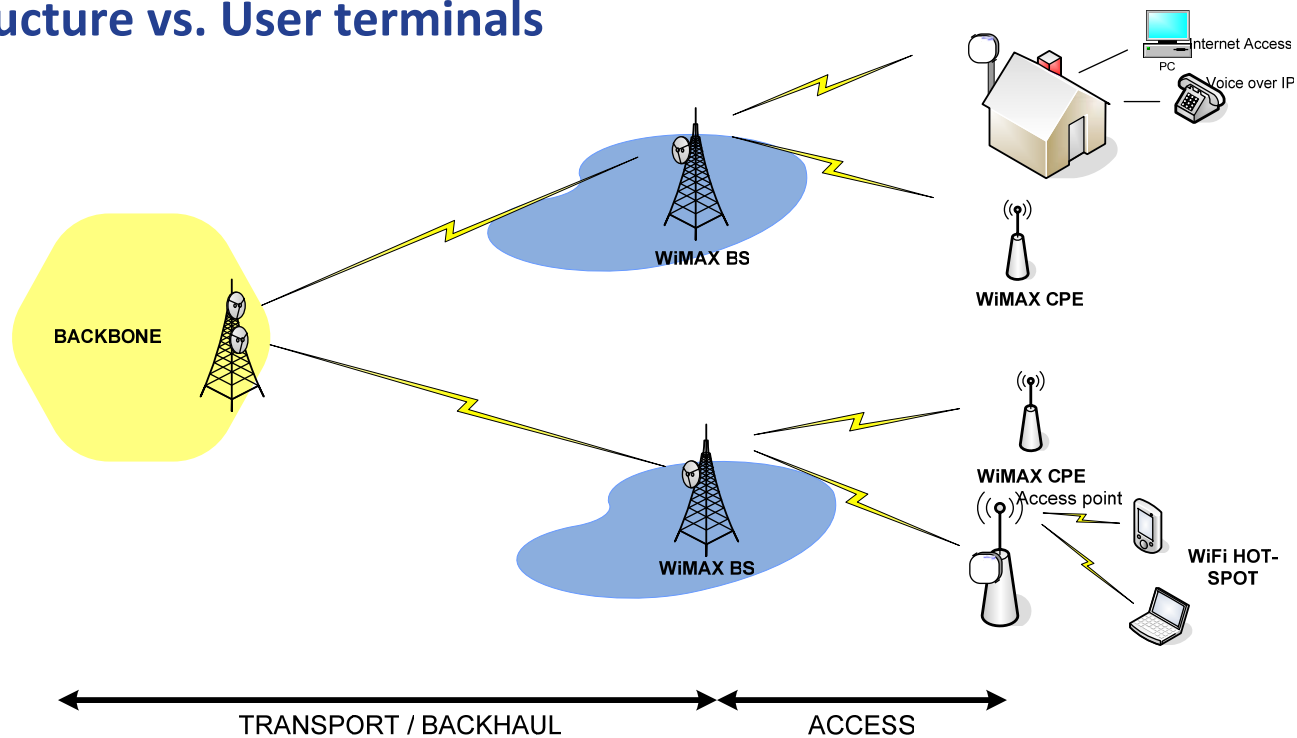
- Broadband Wireless Access technology based on IEEE 802.16 standard
- Point-Multipoint Metropolitan Access Networks
- Outdoor application, 2-20km typical range, 10Mbps total capacity
- Operation in 3.5 and 5.6GHz bands (among others)
- QoS support for voice, video and data (triple play)
- Interoperability – WiMAX Forum



Broadband Wireless Access

Network architecture

- Transport vs. Access network
- Infrastructure vs. User terminals



WiMAX transport networks

- **WiMAX was originally intended for Access Networks**
- **Cost-effective point-point or point-multipoint transport networks can also be based on 802.16 technology**
 - 5-30 Mbps, 10-40km, QoS, low power...
- **Achievable link distance depends on many parameters**
 - Available link budget depends on power, bandwidth, desired data rate, antennas, frequency, equipment...
 - Free-space loss depends on distance
 - Link Margin for special losses: Rain, snow, fading, antenna misalignment...
- **Radio Link Availability is a function of the Link Margin**
 - High availability requires large available link budget and short distances – Higher infrastructure investment

BWA in rural areas

- **Challenging business model**
 - Large areas to cover
 - High investment in infrastructure equipment (transport and BS)
 - Few user terminals per Base Station – Low revenue
- **Cost limited by infrastructure equipment**
 - CAPEX problem: Expensive infrastructure equipment
 - OPEX problem: Expensive transport operators
- **Other aspects make the problem even worse**
 - Power consumption, Temperature, Snow, Visibility, Link distance, Environmental constraints, Security...

BWA in rural areas

- Solution must be based on cost-effective transport and access infrastructure equipment
- Still challenging if 100% coverage and high availability is required
- Reducing availability may help to reduce the problem
- DTN is required

1) Optimized infrastructure equipment

2) Reduced availability

3) Delay Tolerant Networking

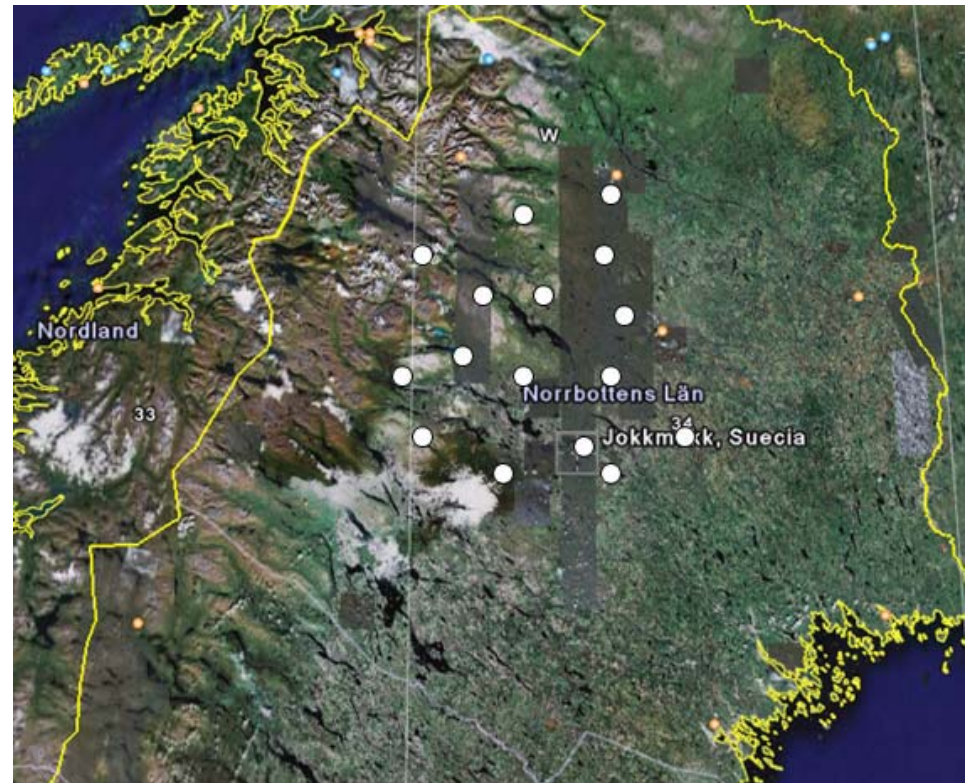


Rural BWA solution?

WiMAX and DTN

- Hybrid equipment (BS/SS) for long distance mesh point-multipoint transport network
- Cost-effective, low power, small form factor equipment
- Several nodes spread across the region (50km distance)
- Long distances at the price of low availability
- Each node switches between BS or SS modes with a defined duty cycle to link with adjacent nodes (unicast or multicast)
- Availability of each PMP link is limited by distance, power, duty cycle, snow, temperature...
- DTN and routing algorithms are required
- Nomadic users may connect to the network using portable terminals (long reach)
- Moving stations (helicopter?)

WiMAX and DTN



Albentia and N4C

What Albentia Systems can do for N4C

- Albentia collaborates with UPM in WP6
- Develop special equipment for DTN applications
- Develop Hybrid BS/SS stations for mesh DTN networking
- Provide a WiMAX platform for DTN layer and protocols
- Provide physical layer for DTN experimentation in a real application scenario

What Albentia would like to learn from N4C

- Experiment new system architectures for rural BWA feasibility
- Understand new deployment scenarios in adverse conditions
- Export DTN-WiMAX concept to other rural scenarios (Panama, New Guinea, Mali, Senegal...)

Thank you!