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WiMAX Global Congress, Amsterdam, 16th-17th June 2010

**WiMAX Solutions to enable
the Italian Coast Guard to better
patrol their territorial waters**

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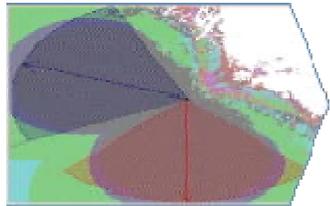
Agenda

- Introduction
- Italian Coast Guard
 - Fleet
- WiMAX Architecture
 - Base Stations and Antennas
- WiMAX Performance
- Services
 - Voice
 - Video
 - Data

The Italian Coast Guard (ITCG) needed a wireless broadband network to help them with their patrolling activities



ITCG has 325 vessels employed in patrol and rescue activities. Accessing intranet services, applications and the internet while out at sea is a real challenge.



WiMAX network will cover Italian territorial waters (up to 12 miles) of 15 Maritime Directorates spread over entire Italian coastline



Operability must be assured on mobile devices and under adverse marine weather conditions



Interconnection to the Public Administration Network and databases must be provided

Accenture's offerings cover a complete turn-key network rollout



Deployment of a proprietary WiMAX network (base stations, mobile antennas, ad-hoc configurations for marine environment)



Deployment of a centralized service center for distribution of "remote office" communication services (voice, video, data)



Supplying Italian Coast Guard fleet (325 boats) with WiMAX antennas and customized multimedia devices (laptops and smartphones)



Joint start-up of the system in order to guarantee service continuity and facilitate ITCG personnel training

Our solution's technology architecture leverages ready-to-use assets and reference frameworks that are aligned to international standards, boosting its scalability and reliability



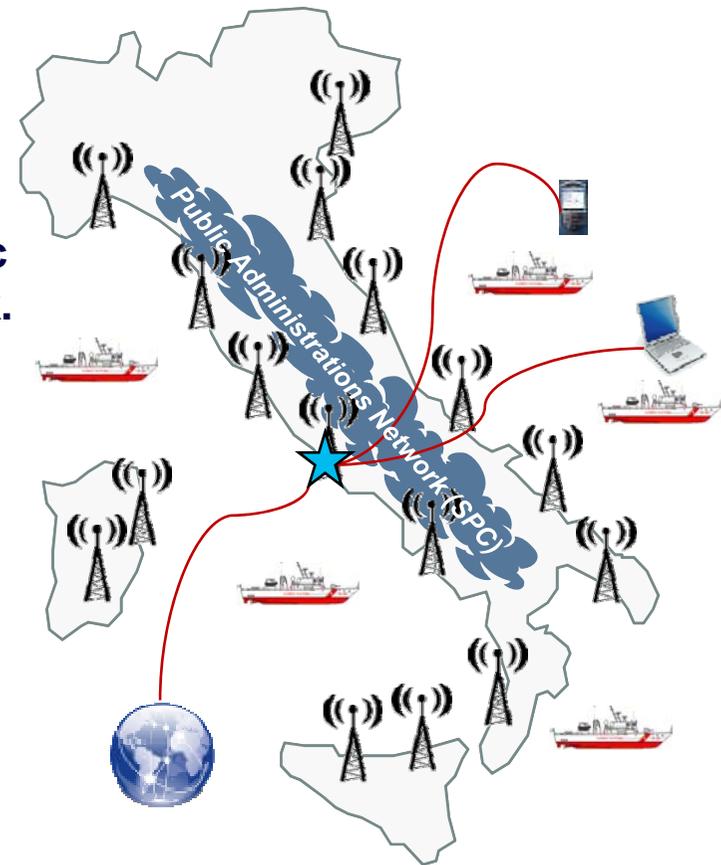
The Service Center is located in Rome in the Italian Coast Guard General Command office.



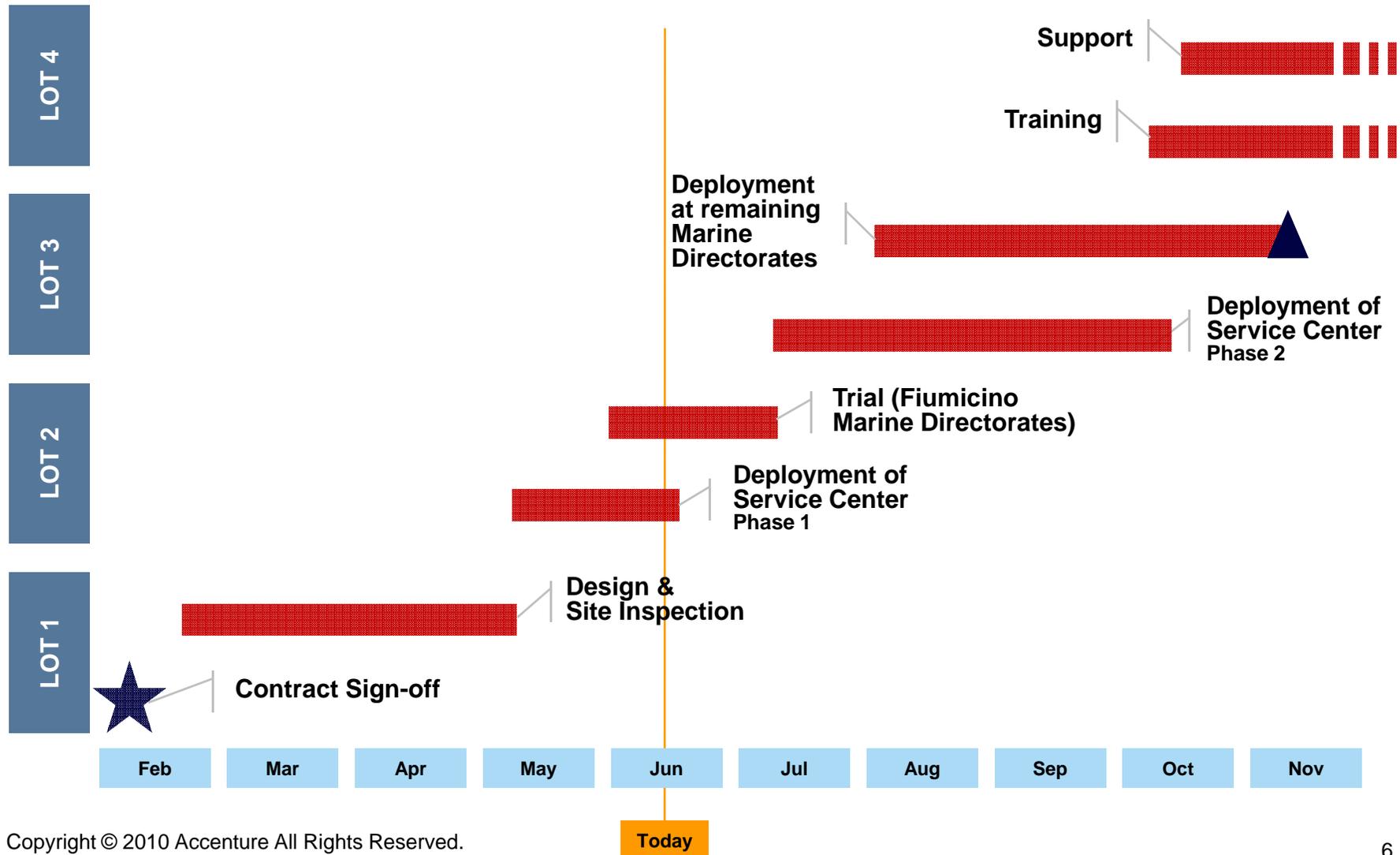
All Maritime Directorates are interconnected through the Public Administration backbone network.



The Service Center is the single point of contact (2nd & 3rd level) for trouble diagnosis and resolution, and for third-party vendor coordination.

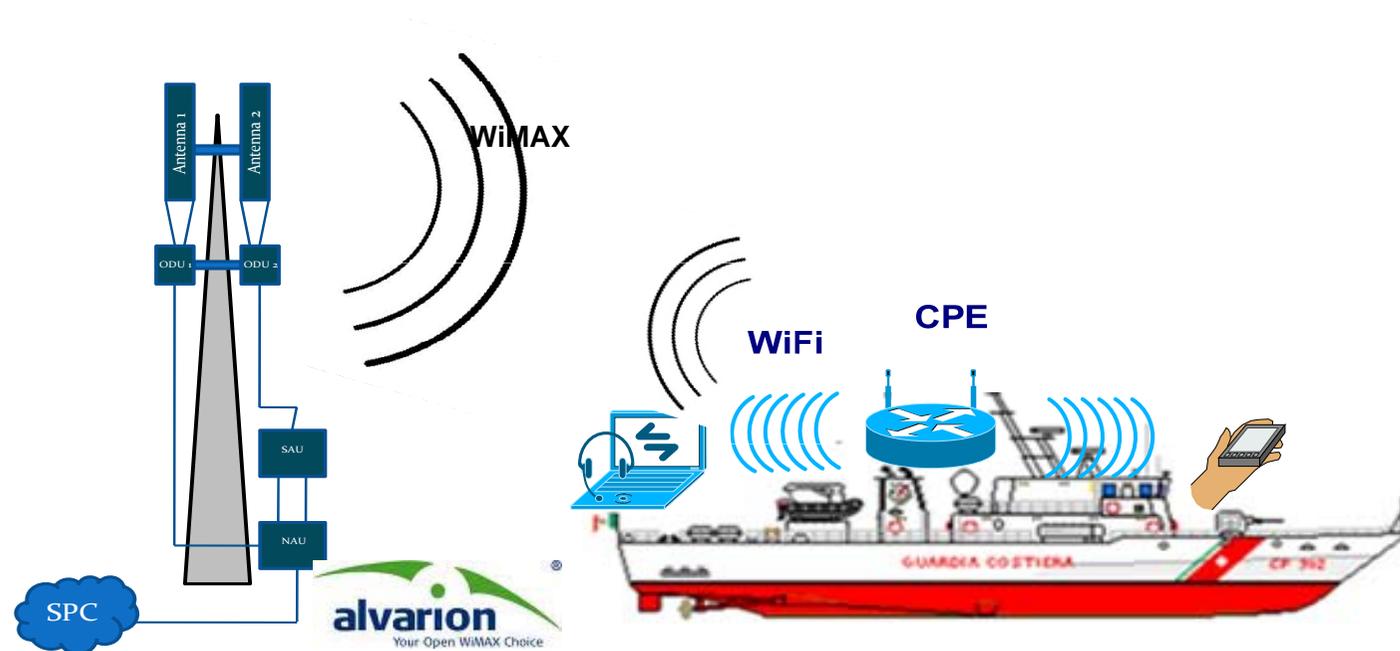


The project will require 11 months and is broken up into four parts



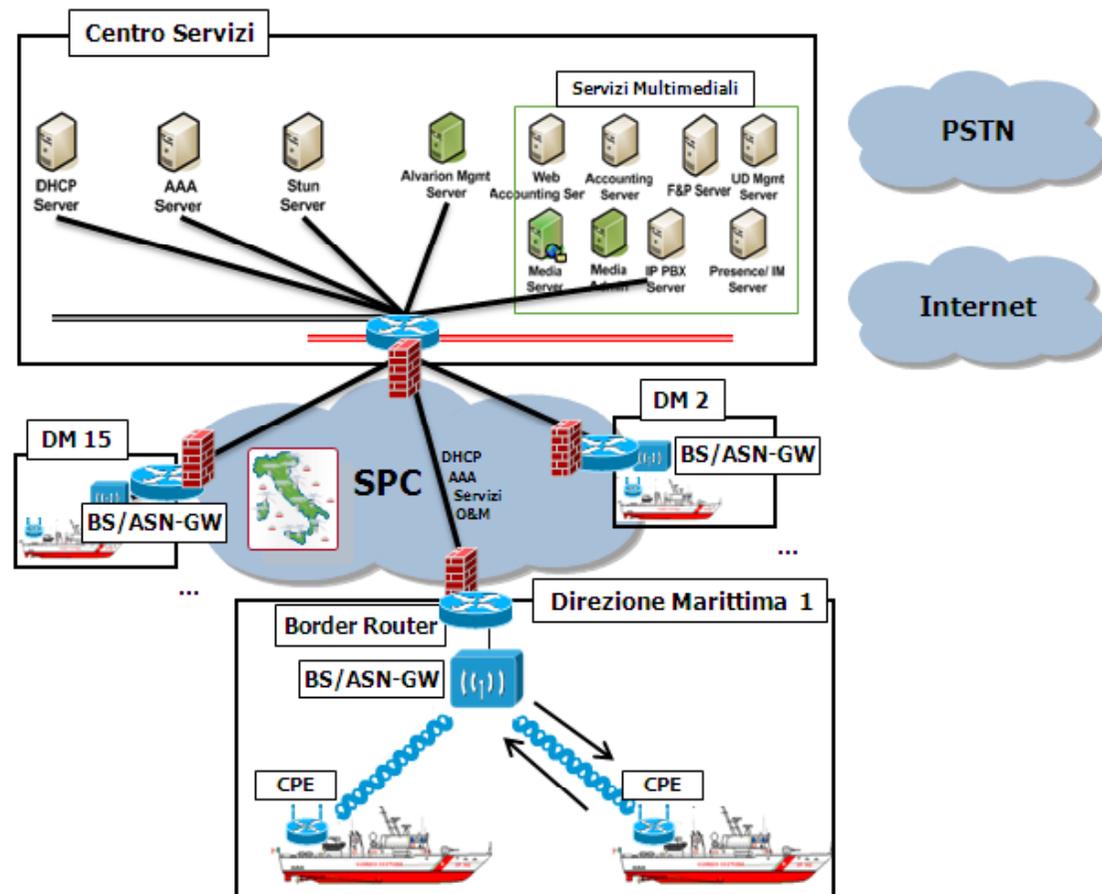
Two wireless technologies will be used to guarantee onboard access to services

- Communication from base station to the vessel will be via **WiMAX**.
- Communication on board will be via **Wi-Fi** and ethernet cable.
- WiMAX BSs, ASN-GW and CPEs will be provided by Alvarion.



The Service Center is located in Rome, in the Italian Coast Guard General Command office

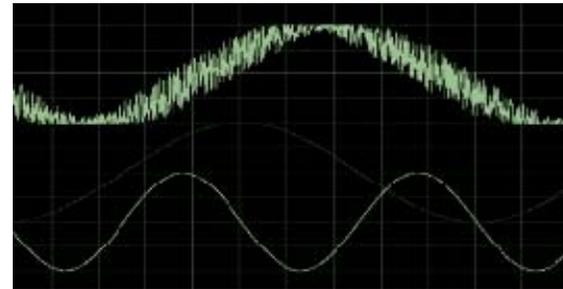
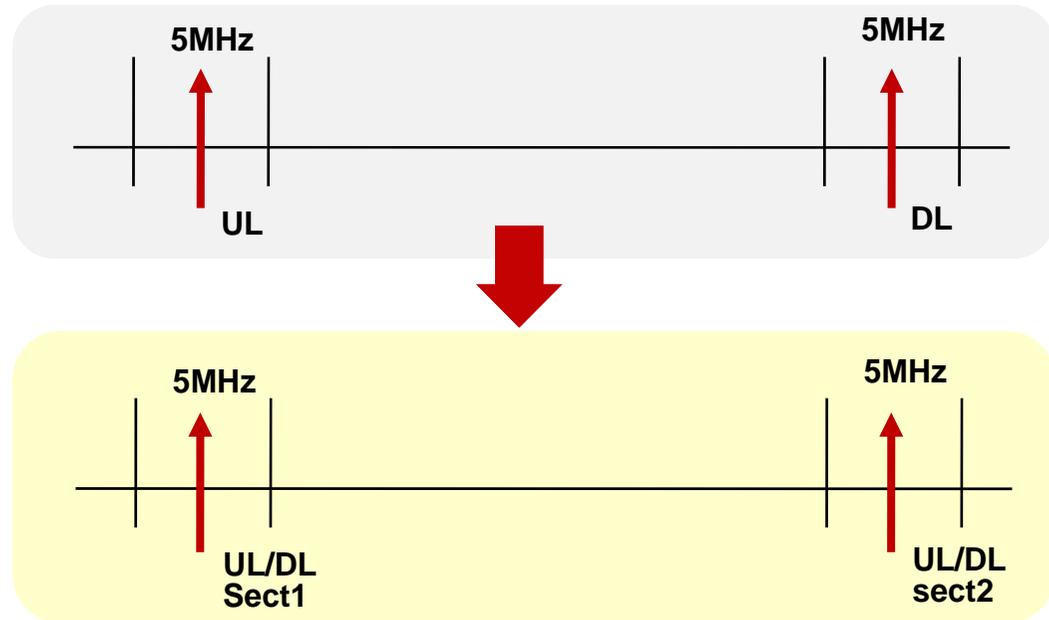
The existing high-speed backbone will connect the
15 base stations in Italy.



Spectrum allocation is based on the specific needs of the Fishing Control Project

ITCG has obtained a specific military frequency from MIRFA (Italian radio frequency management military agency) in 3,5 GHz band, which allows to them use commercial WiMAX equipment and pursue economies of scale.

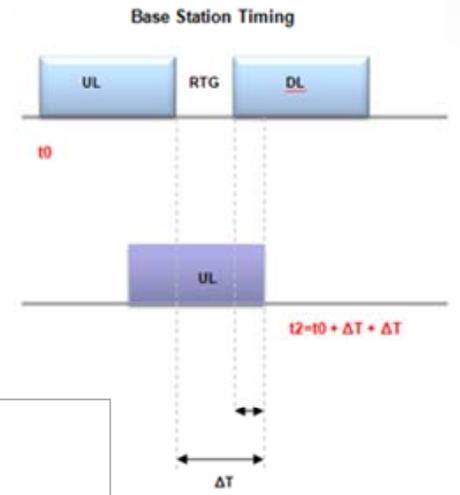
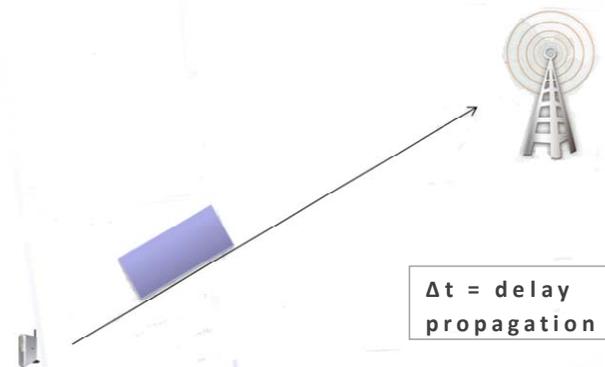
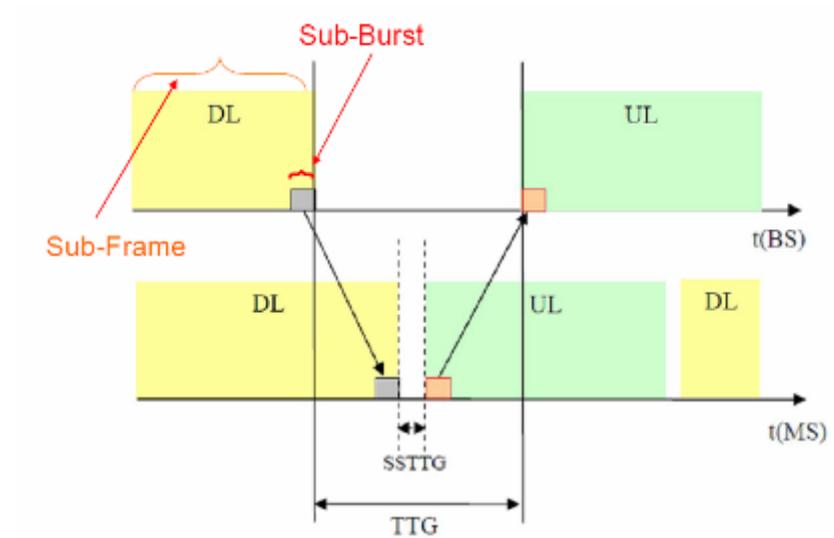
ITCG uses FDD Spectrum to communicate in TDD mode.



Impact on maximum coverage

Coverage is limited by attenuation, TTG (Transmission Time Guard) and RTG.

An MS cannot transmit before it has received all the sub-frame from the BS, and vice-versa.



MAX Coverage = $\min(\text{RTG}, \text{RTT}) * c / 2$
 Where c = speed of light (299.792.458 m / s)

Coverage simulation

Tools simulate the propagation of the WiMAX signal over the sea, measuring:

- Received power
- Average and maximum speed
- SNIR

...for both upload and download links.

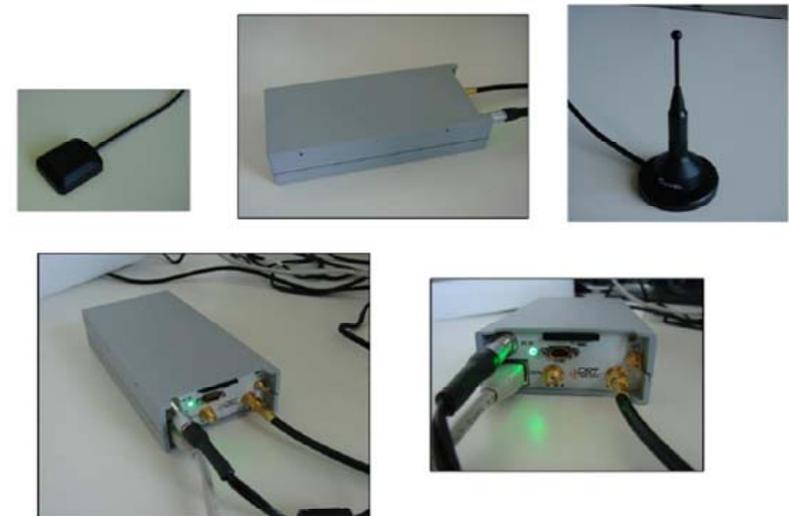
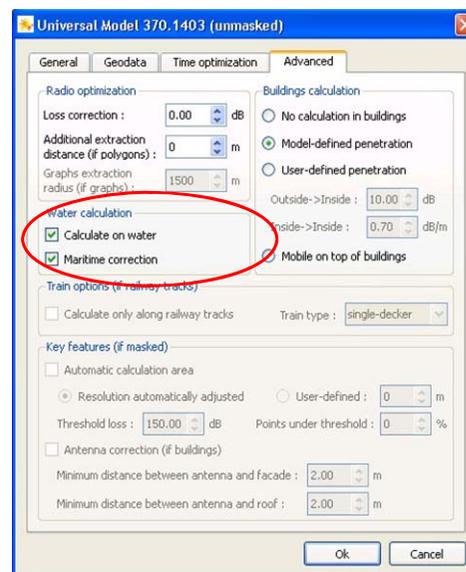
Simulations provide insight about the theoretical maximum reach and the effects of the orography of Italian coasts.



Simulation tools and tuning campaign

Simulations have been performed using commercial radio planning tools customized on sea propagation environment based on a theoretical Link Budget.

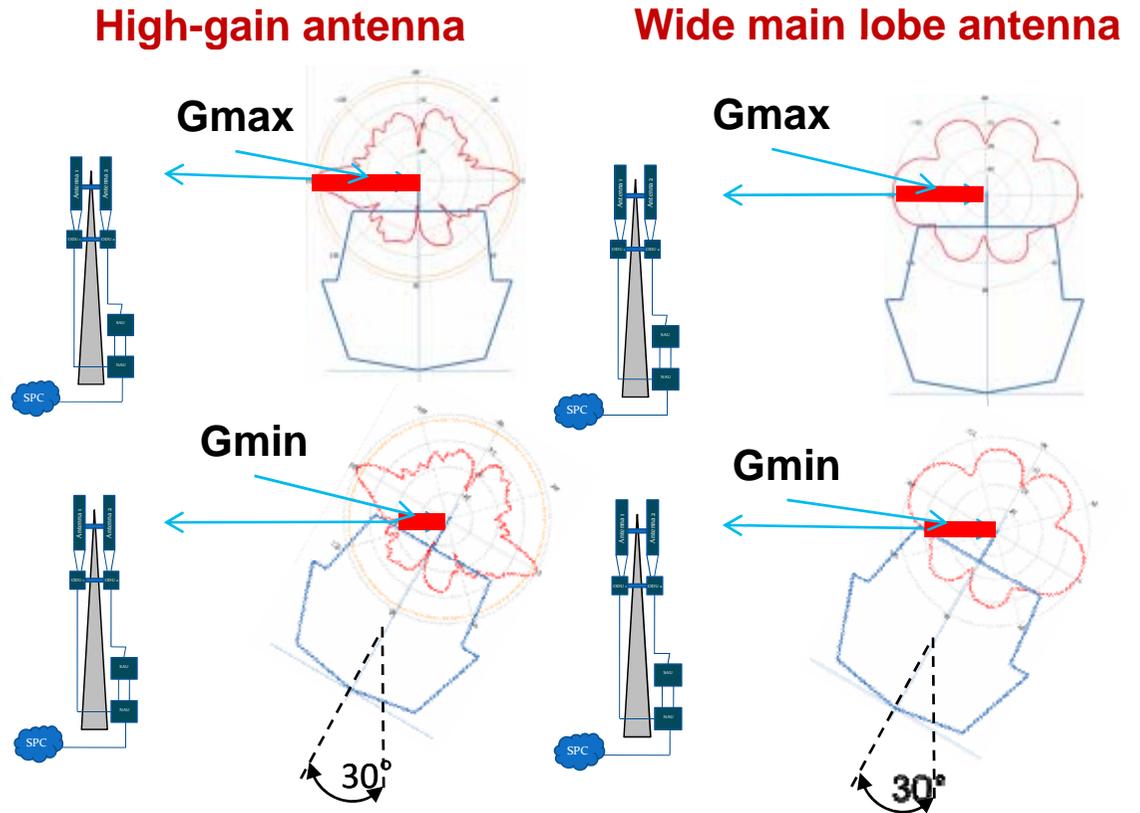
A tuning campaign is required, as simulation over the sea may not be accurate, even if a specific model has been employed.



Antenna prototypes

A high-gain antenna is required to operate while at sea. Boat movements (rolling) may have an impact on performance. Different types of antennas respond differently to sea conditions.

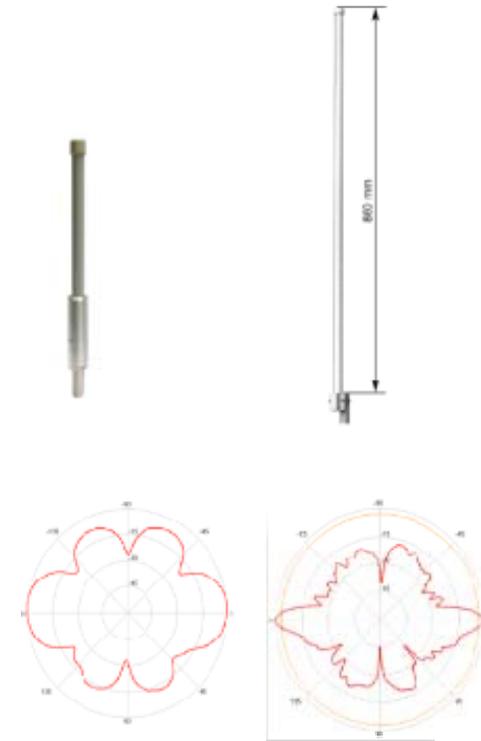
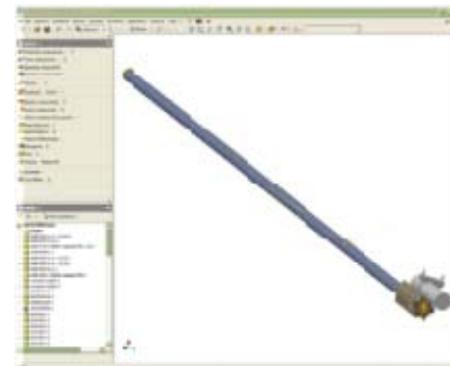
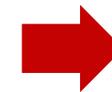
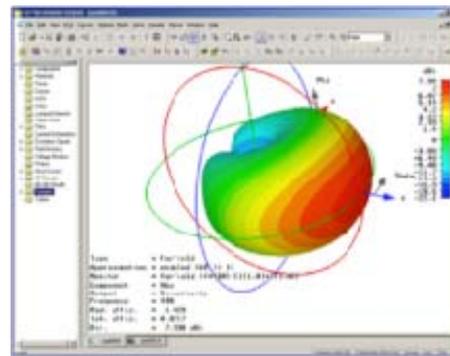
Wide main lobe antennas have sturdier construction and can be more resilient to boat movements, but the maximum gain is reduced.



Accenture & SIRA have specially design antenna prototypes to meet the challenging sea environment and the electrical propagation issues

Trials will determine which combination of antennas will produce the best results.

The data will be used to tune and correct the simulations.



Dual slant versus vertical over the sea

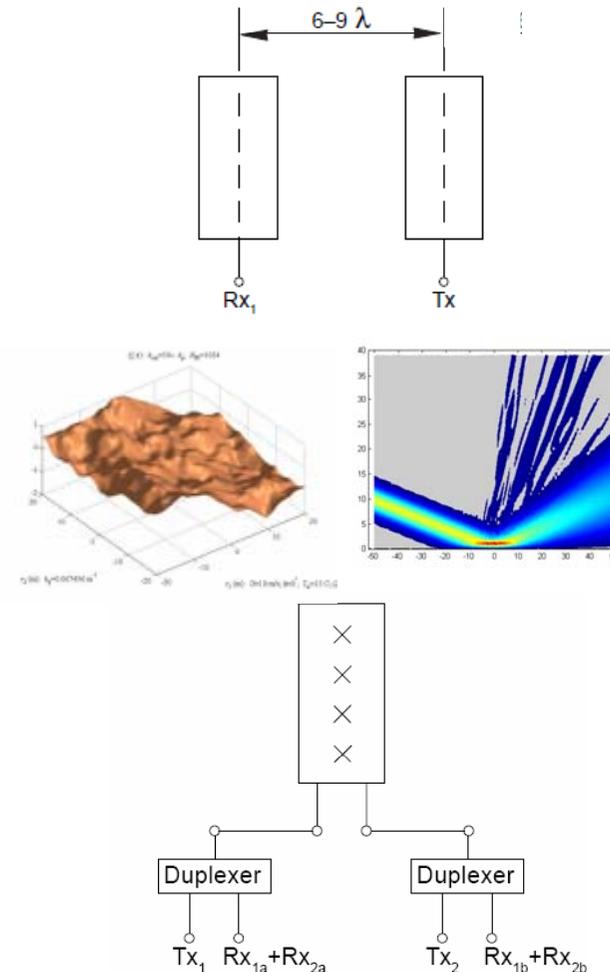
Vertical antennas are expected to perform well

- The typical polarization of transmissions will be vertical (omni-directional antennas on the vessels)

But transmission over the sea is subject to multipath, scattering by the waves and depolarization

Advantages of dual slant antennas:

- Polarization diversity transmission and reception
- Multipath effect mitigation
- Same lobe shape on azimuth plane
- High front-to-side and front-to-back ratio that optimizes coverage
- Potential for better performance than single polarization
- Better resistance to wind and reduced installation costs

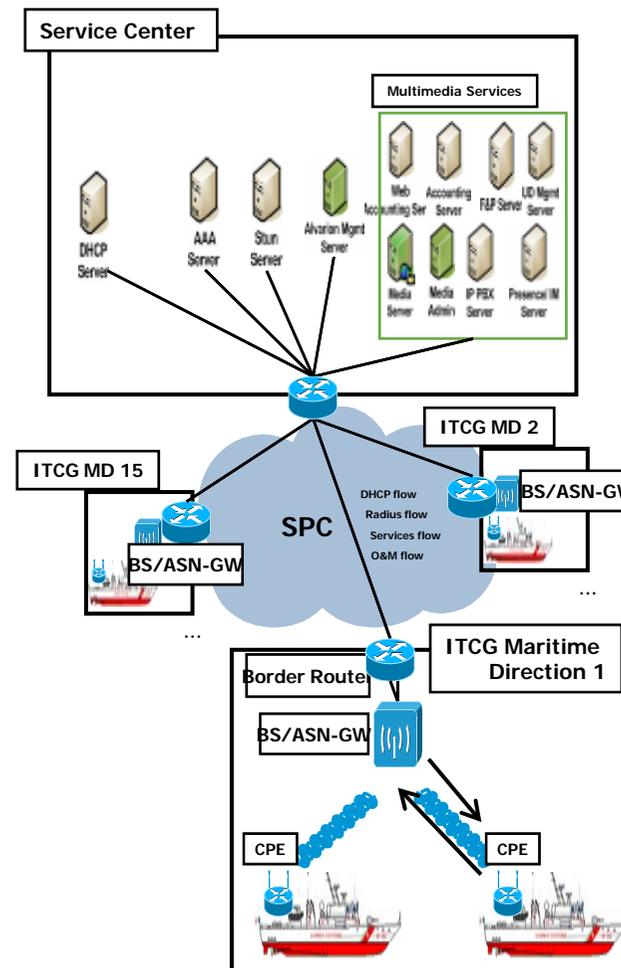


ASN-GW deployment scenario

ITCG's selected scenario for ASN-GW deployment is the **Full Distribution** configuration.

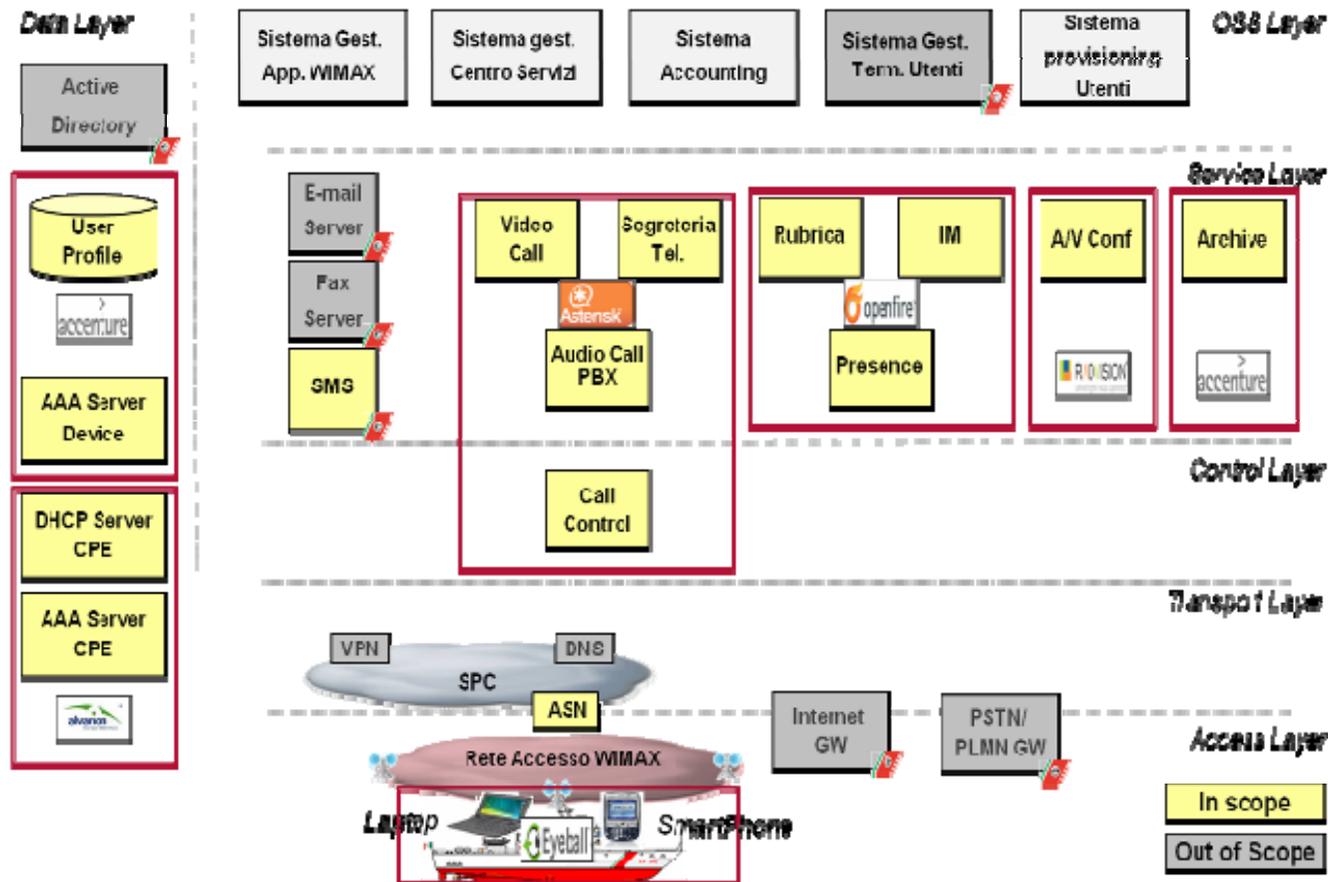
Each ITCG Maritime Directorate, where a Base Station is installed, is equipped with an ASN-GW module.

- **IP Addressing scheme:** The ASN-GW acts as a Relay Agent and uses an IP address which belongs to the specific network subnet reserved for the Maritime Directorate where it is installed.
- **Reliability:** Reduction of ASN-GW domains dimension minimizes the impact of a system/network failure.
- **Performance:** The system uses a dedicated channel for the network delivery of data streams for each Maritime Directorate.



The final architecture will consist of ITCG's existing systems and new systems provided by Accenture and third-party vendors

A large amount of the effort will be spent integrating the various systems



System integration

The system will be integrated with existing ITCG systems:

- Active directory
- Email server
- Internet proxy
- PABX
- Remote management of laptops and mobile phones

The Operation and Support System (OSS) includes:

- WiMAX administration systems
- Service Center administration systems
- Accounting for voice calls
- Provisioning of users on the various systems



The Service Center allows the ITCG fleet to have access to office services, helping to optimize patrol operations



Audio Services

Audio Communication
Conferences
Voice Mail
PBX Services



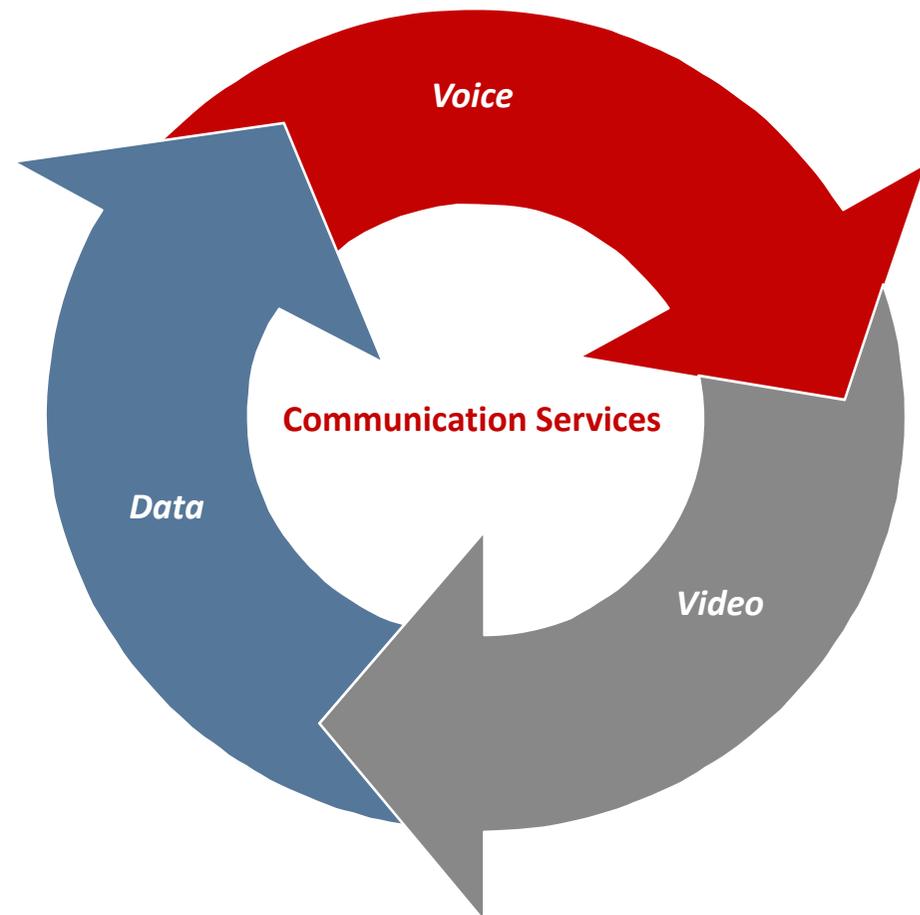
Video Services

Video Communication
Conferences



Data Services

Instant Messaging
File Transfer
Extranet/Internet Access



Audio Services

The Service Center offers advanced audio services for remote office access

- Audio call
- Audio conference
- Voice mail
- Centralized address book
- PBX services (e.g. call hold, call waiting, ...)
- Audio streaming recording



Video Services

The Service Center offers advanced video services for an enhanced communication experience

- Video call
- Video conference
- Video streaming recording

Virtual room capability is provided to ITCG to set-up and manage point-to-point and point-to-multipoint video conferences

Data Services

The Service Center offers advanced data exchange services for the delivery of office capabilities to the patrolling boats

- Instant messaging
- File transfer
- Interconnection to data network and internet
- National and international data base access
- Integration with ITCG email server
- Integration with ITCG fax server



A single client application is available on both laptop and mobile devices

Services

- Audio calls
- Video communication
- Video conferencing
- Instant messaging
- File transfer

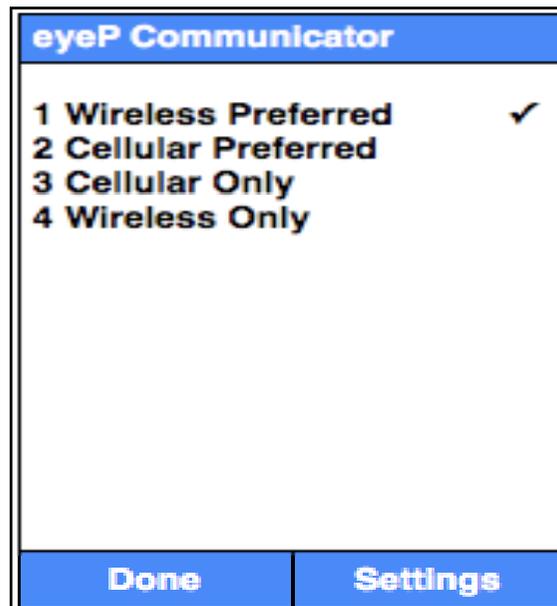


An automatic network switching tool will provide access to a back-up network when WiMAX is not available

Services

- Wi-Fi connection from WiMAX CPE
- Cellular connection (A data plan will be needed)

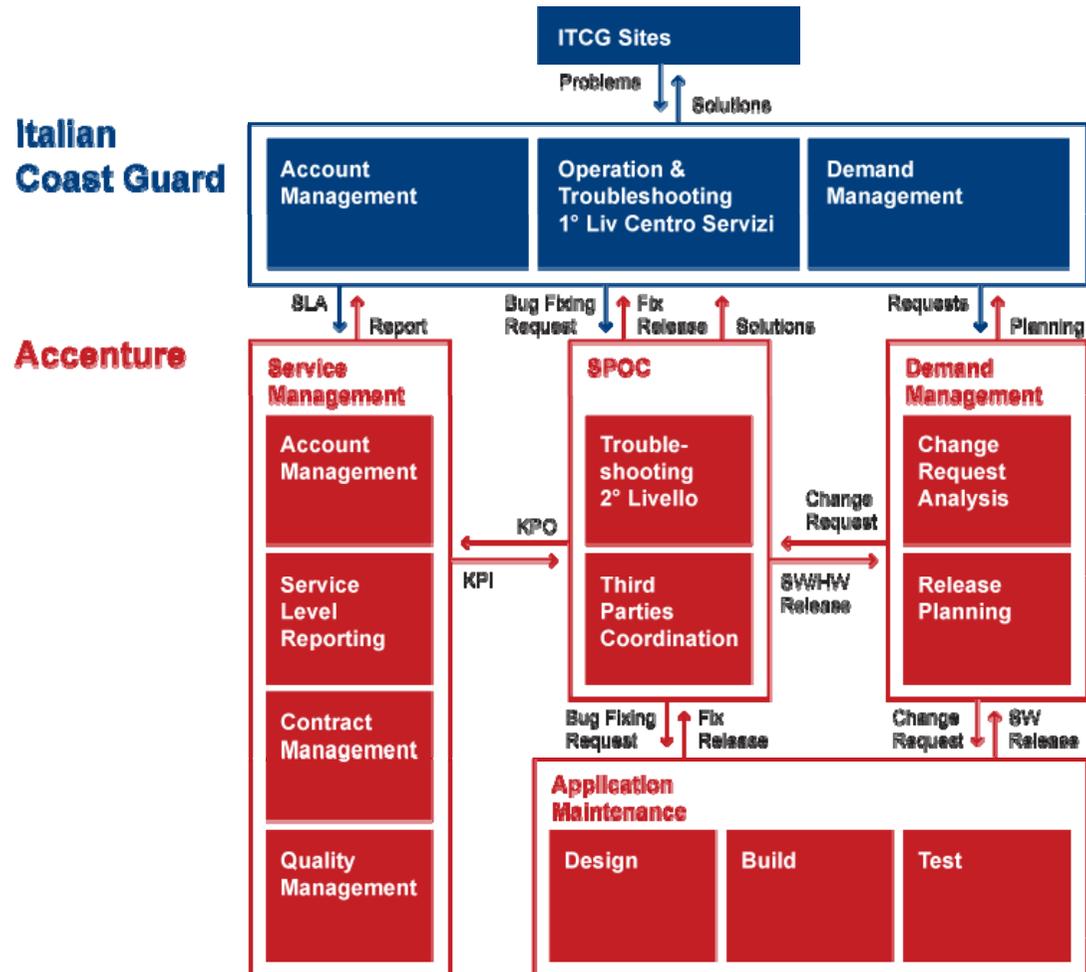
Other options include satellite or proprietary military networks.



Accenture will help ITCG launch and maintain the WiMAX network and services

Accenture acts as a single point of contact for the maintenance phase, which will last for two years following deployment.

Interaction procedures with ITCG have been thoroughly defined.



Conclusion

- WiMAX technology enables ITCG to extend on patrol boats land-office environment improving operation efficiency.
- WiMAX commercial equipment satisfies needs of public bodies in terms of cost efficiency.
- Band availability for public service is a key factor to cope with traffic and quality requirement.
- Flexibility in RF operation band on equipment side will speed up WiMAX adoption by public bodies.