The Emerging WiMAX Ecosystem

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SENZA FILI CONSULTING

About Senza Fili Consulting

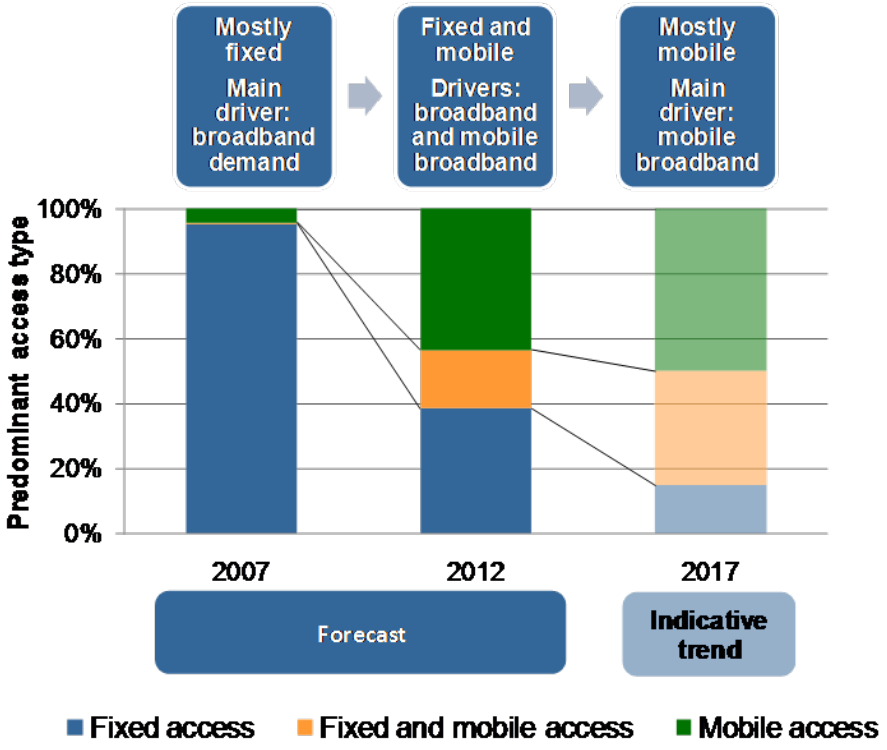
Technology focus	• Mobile and fixed wireless broadband technologies • VoIP, convergence, mobile broadband applications • Network infrastructure and devices
Approach	• Bridge between technologies and services • Quantitative analysis • International perspective
Services	• Business development and strategy • Business plans and financial modeling • RFP and due diligence • Market analysis and forecast

Senza Fili Consulting latest report and forecast on the global WiMAX market

WiMAX: Ambitions and reality.

A detailed market assessment and forecast at the global, regional and country level (2006-2012)

- **Regions:** Asia Pacific, North America, Western Europe, Eastern Europe, Latin America, Middle East/North Africa, Sub-Saharan Africa
- **Countries:** Argentina, Australia, Brazil, Canada, China, France, Germany, India, Italy, Japan, Korea, Mexico, Spain, Russia, UK, USA
- **Forecast data for each country and region**
  - Fixed and mobile broadband subscribers
  - Fixed and mobile WiMAX subscribers
  - Data and VoIP service revenues
  - Device types in use and sale volume
  - Equipment revenues for network infrastructure and subscriber devices



Source: WiMAX: Ambitions and Reality. Senza Fili Consulting, 2007

Why a sudden interest in the WiMAX ecosystem?

Status	Mobile WiMAX (802.16e-2005)
✓	Standards
✓	Trials
In progress	Certification
Starting	Commercial availability
In progress	Network planning and deployment
Soon	Commercial launch of fixed/nomadic services

WiMAX operators have started to plan for commercial launch of new services

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Under development	**New services development** **Full mobility support** **Subscriber management** **Traffic management** **Applications and content** **Roaming and internetworking**

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Operators need a solid WiMAX ecosystem to launch innovative service offerings

What does the WiMAX ecosystem include?

Content and applications	Services and market segments	Core network	Radio access network	Devices	Subscribers
• Mobile search • Location-based applications • Mobile applications • Mobile TV • Online games • Video/music sharing and downloads • TV channels • Movies • Corporate applications • Location-based advertising	• Internet access • VoIP • VPN access • Corporate email • Vertical markets • Redundant connections	• IP servers • VoIP gateways • AAA servers • Interconnect-ion • IMS • Billing • Provisioning • Roaming • Settlement	• Multi-sector base stations • Single-sector base stations • Pico-cells • Femto-cells • Multi-mode base stations • ASN Gateway	• Laptops • PDAs • Multi-mode phones • Desktop modems • Outdoor antenna modems • Multimedia players • Tablets • Video consoles • Cameras	• Business mobile users • Consumer mobile users • Residential personal broadband users • Small and medium businesses • Vertical markets (education, health, transportation)

Why does WiMAX need a new ecosystem?

- First wide use of an all-IP core for a mobile broadband technology
- Flatter architecture
  - Fewer components
  - Less hierarchical structure
- Interoperability of all key elements
  - Definition of open interfaces
  - Certification
- Easier integration in networks with multiple access technologies
  - Wireless
  - Wireline

What will the WiMAX ecosystem support?

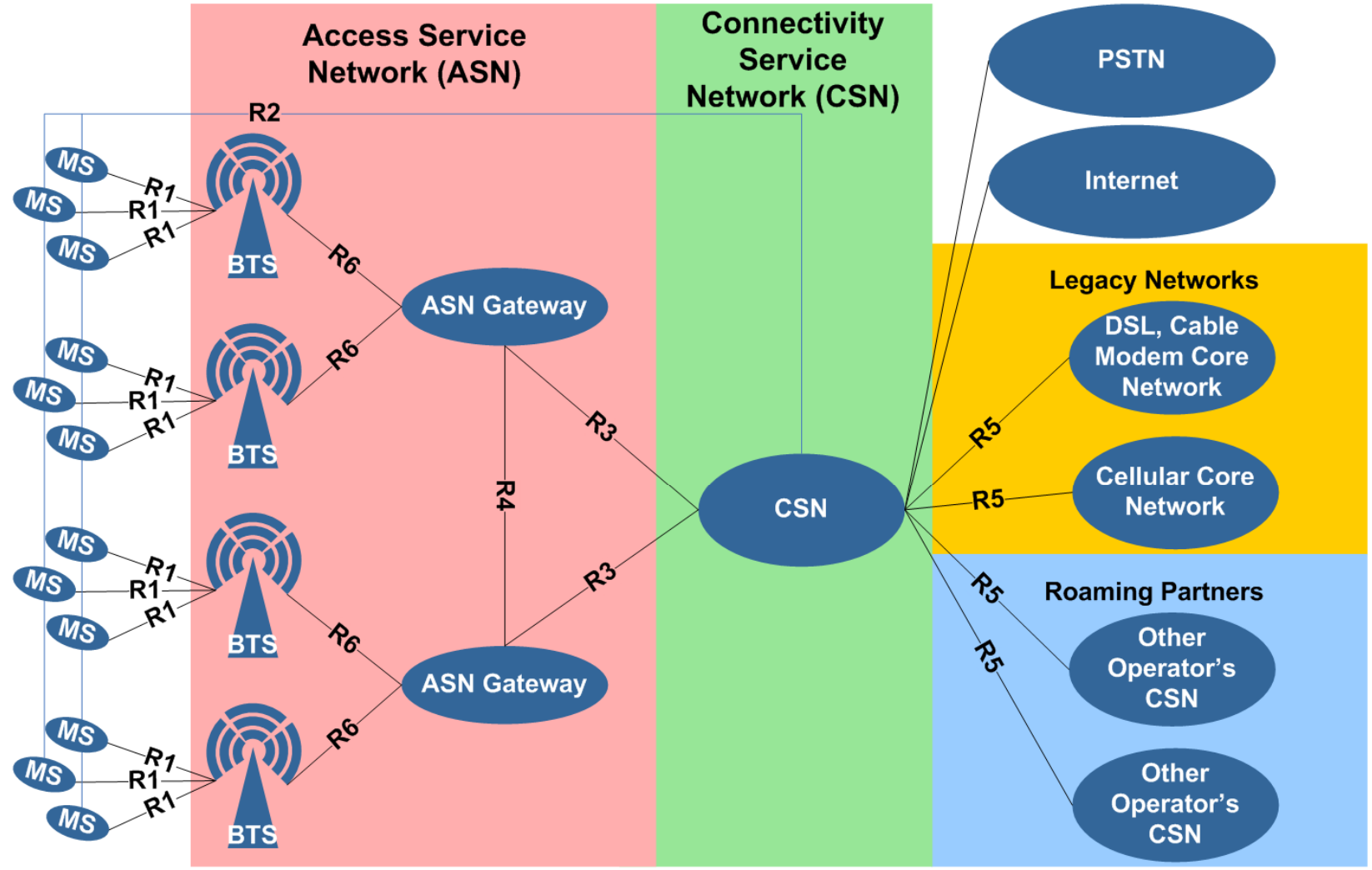
- First data-centric mobile broadband technology
  - Voice supported as a data application
- End of one subscriber = one device = one ARPU model
  - Subscribers have multiple devices
  - Operators may follow no contract, no subsidies model
  - Open access means more applications, more freedom for subscriber, but less control for operator
- Expansion in services and applications driven by mobility
  - Space: location based (e.g. directories, directions)
  - Time: real-time (e.g. social networking, traffic updates)
- Support for high levels of traffic required
  - Smart management of spectrum resources
  - Multiple-level network topology, from macro, to pico and femto cells

A solid ecosystem unlocks the potential for innovative IP-based, next-gen services

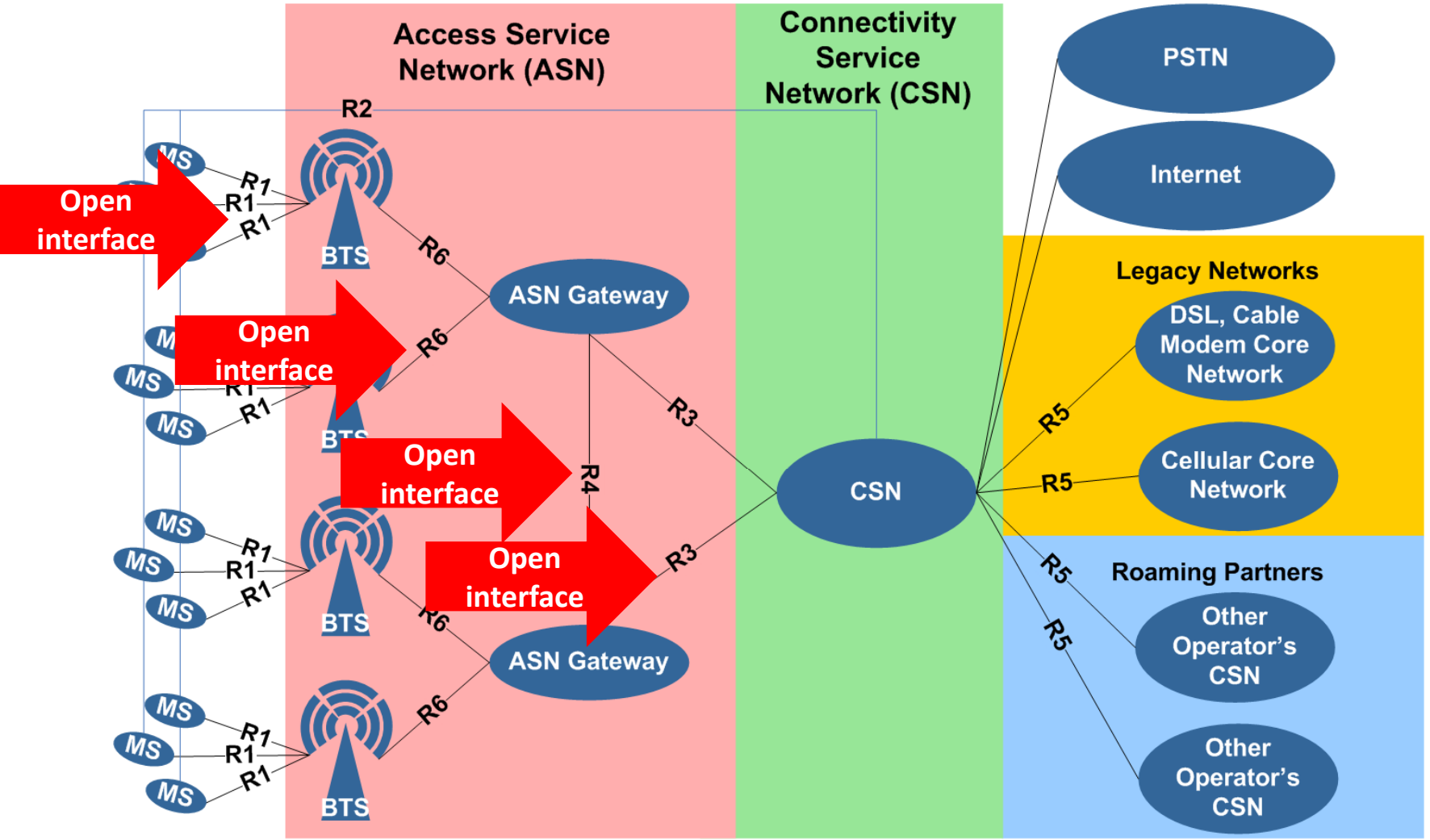
WiMAX represents a move away from closed, proprietary networks

- Wider interoperability
- Multiple vendors can be selected
  - Best-of-breed
  - Different solutions
- More flexibility
- Increased functionality
  - More choices
  - More risks
- Less control on devices and applications
- More complexity
  - Trying to achieve more
  - Computer and telecom industry model combined

WiMAX network architecture



Open interfaces enable interoperability and flexibility



Reference network model interfaces

Reference network model interfaces	
R1	Interface between the MS and the ASN. Functionality: air interface.
R2	Interface between the MS and the CSN. Functionality: AAA, IP host configuration, mobility management.
R3	Interface between the ASN and CSN. Functionality: AAA, policy enforcement, mobility management.
R4	Interface between ASNs. Functionality: mobility management.
R5	Interface between CSNs. Functionality: internetworking, roaming.
R6	Interface between BTS and ASN gateway. Functionality: IP tunnel management to establish and release MS connection.
R8	Interface between BTSs. Functionality: handoffs.

The ASN gateway: a core component where many ecosystem functions converge

- Traffic management
  - Spectrum efficiency
  - Load management
  - Interference management
- Subscriber management
  - AAA
  - QoS
  - Multiple devices
  - Advanced billing
  - Bundled services
- Mobility support
  - Handoffs
- Security
- Content and applications management
  - Application support
  - Partnerships with content and application providers
  - Advertisement

Selection of ASN functionality is crucial for WiMAX operators

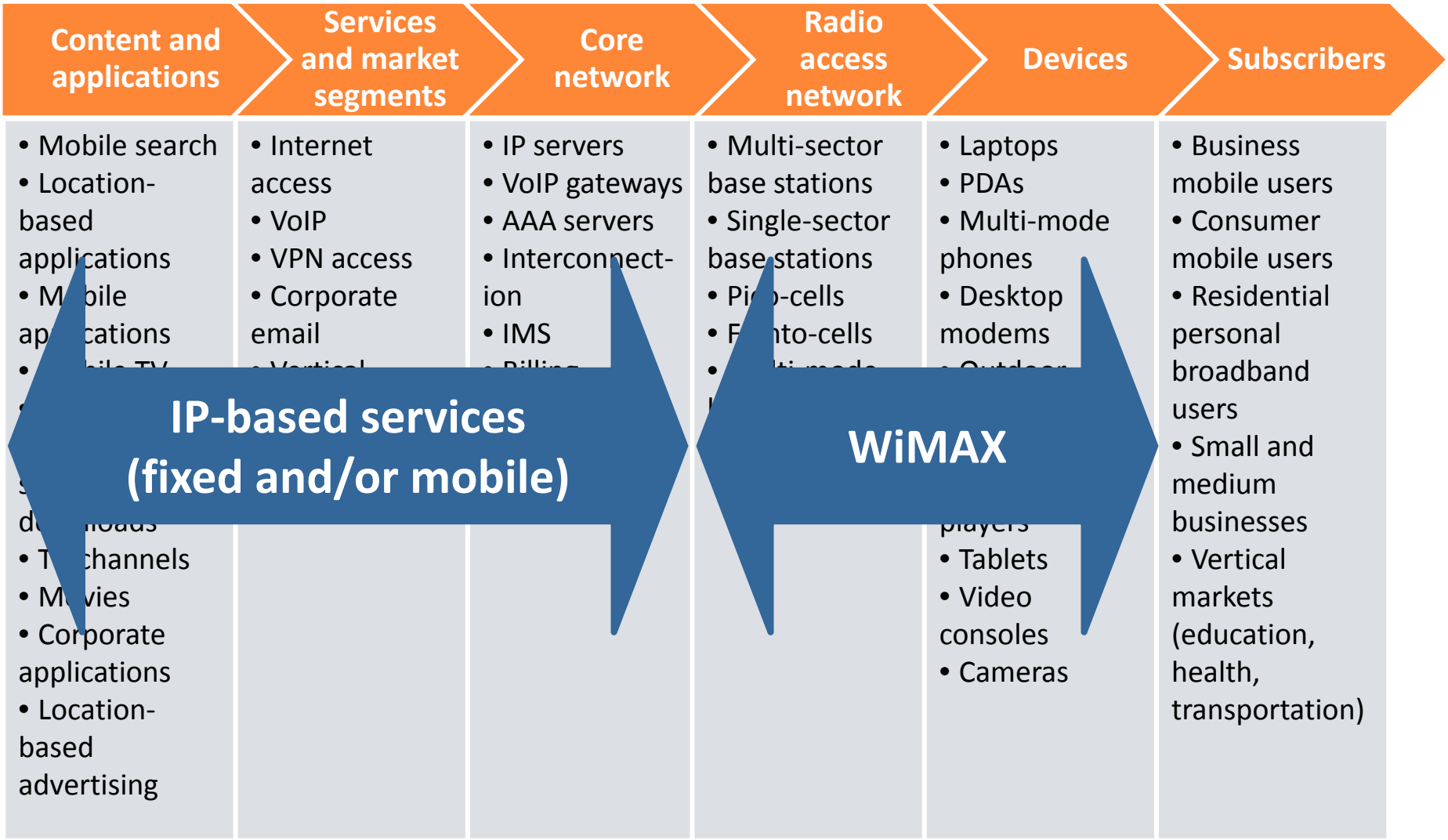
ASN Gateway profiles: Industry is converging on profile C

Profile	Key features
A	Hierarchical model, with more intelligence located at the ASN gateway. The ASN gateway is involved in the Radio Resource Management (RRM) and hosts the Radio Resource Controller (RRC). It also handles handoffs between BTSs. Open interfaces: R1, R3, R4, R6.
B	Flat, distributed model, with BTSs playing a more substantial role in managing traffic and mobility. The ASN network acts as a black box, with R6 being a closed interface. Open interfaces: R1, R3, R4.
C	Centralized model similar to A, but BTSs are responsible for all the RRM, including the RRC and Radio Resource Agent (RRA), and the handoffs between BTSs. Open interfaces: R1, R3, R4, R6.

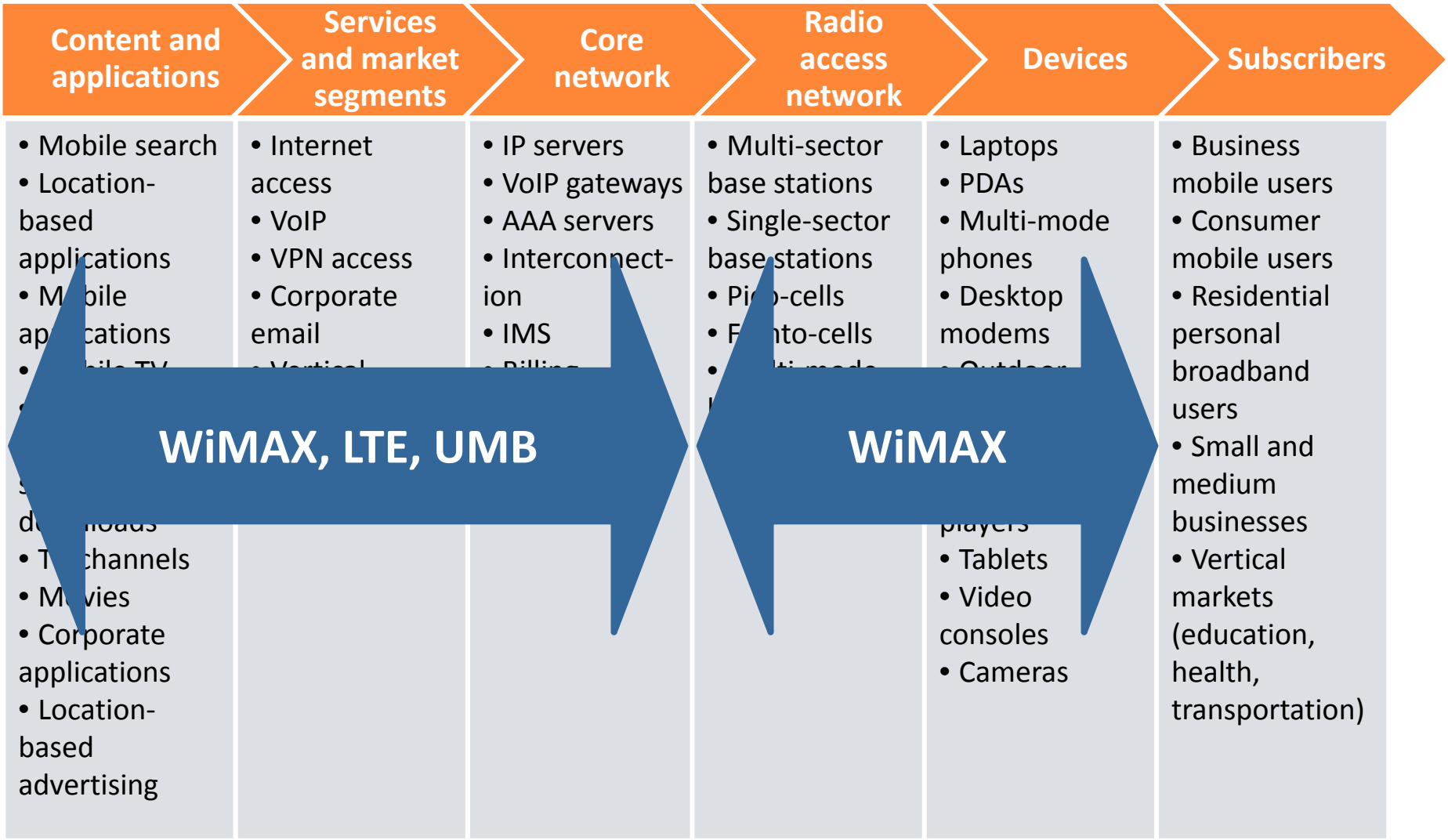
Participation to the WiMAX ecosystem is growing

- Confidence in WiMAX adoption is growing beyond system vendors
  - Device vendors
  - ASN gateway and core network vendors
  - OSS and BSS vendors
- Content and application providers are less active
  - Involvement expected to grow as devices become commercially available
  - Already a strong focus on facilitating mobile access
    - Still in early stages
    - More important than developing new applications

The good news: all-IP core means synergy with other technologies



The bad news: not only WiMAX will benefit from the IP ecosystem



Concluding remarks

- Growth in the ecosystem is crucial to ensure WiMAX success
  - Operators need support from a wide range of players to offer innovative, compelling services
- New ecosystem needed to support all-IP architecture
  - Wider interoperability, increased flexibility
  - But also more risks, higher complexity, less control
- Open interfaces and ASN gateway are the key enablers
- High levels of activity within the growing WiMAX community
  - But other technologies will benefit from WiMAX ecosystem as well

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