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Regulations and Advanced Wireless Broadband

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InnoWave joins Alvarion

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Disclaimer

This presentation is based on a personal view and does not reflect ETSI BRAN, ETSI HiperMAN or IEEE 802.16 position.

BWA Application Map

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WDSL

Fixed
Licensed and Unlicensed DSL and T1/ T3 Level Services

Portable
Licensed and Unlicensed Wireless DSL Services

Mobile
Licensed Broadband and Wideband Services

SMB Access Backhaul	Residential Access	Destination Based	Nomadic	Broadband	Cellular Wideband
WiMAX 802.16d	WiMAX 802.16d	WiFi 802.11	WiMAX 802.16d,e	WiMAX 802.16e	2.5G, 3G

Source: WiMAX Forum

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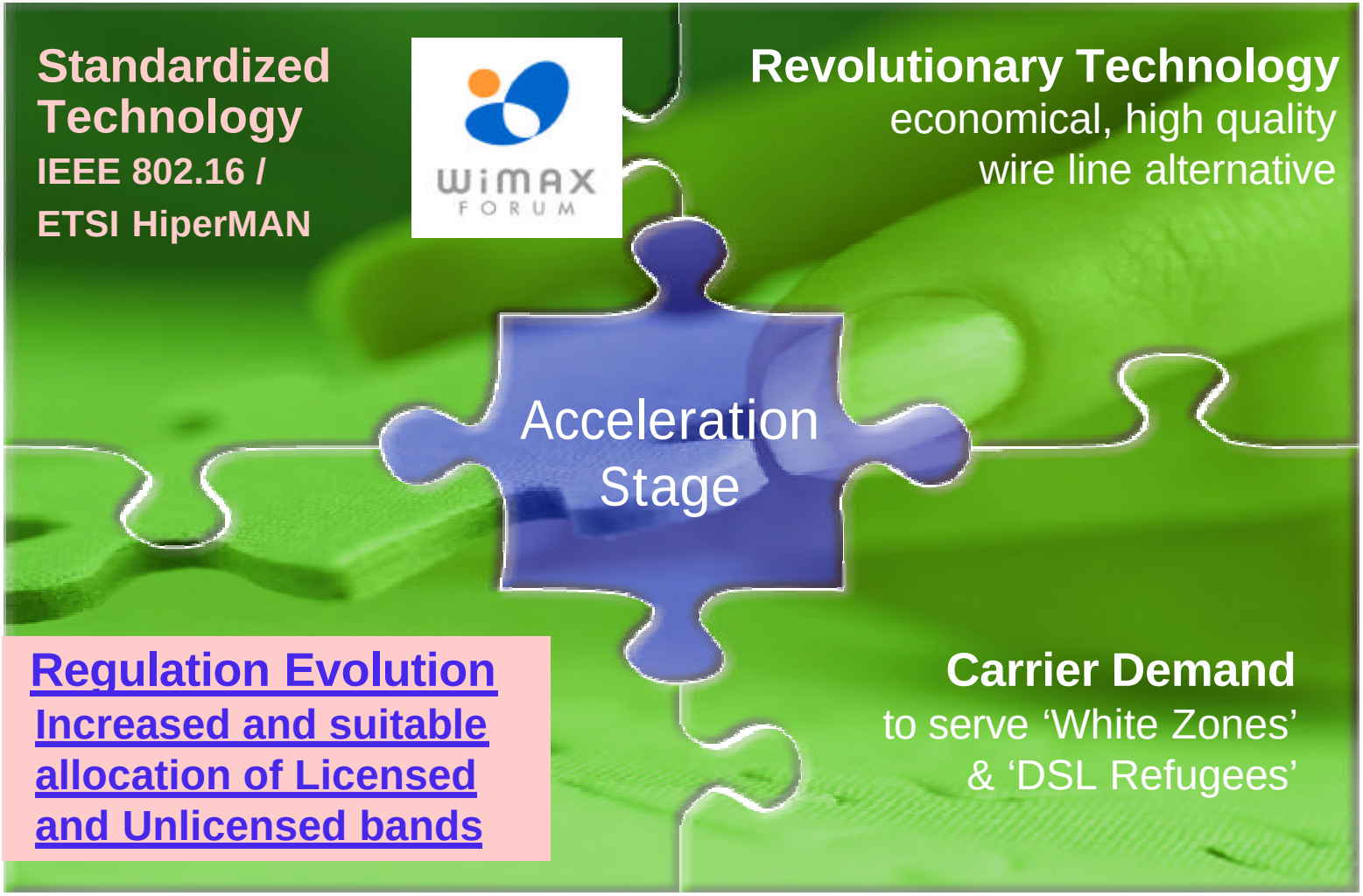
WDSL - Key Success Drivers



Source: WiMAX Forum

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Regulatory BWA Enablers

- **Enough capacity for broadband**
  - Allocation – spectrum amount
- **High coverage for positive business case**
  - Operating frequency (lowest-the best)
  - High allowed power and antenna gain
  - Spectrum quality (interference level)
- **Spectrum cost**
  - At ARPU=$30 /month, the spectrum has to be for free to achieve a positive Business Case
- **Service bundling**
  - Fixed Service
  - Nomadic Service
  - Video on Demand (VoD)

Allocation Size Requirements – Example

- Services
  - Data DL
    - 2Mb/s peak, 100kb/s average – residential only
    - High range, low density area
- Active data users/sector: 100
- Average spectral efficiency: 1.5b/s/Hz
- Band/sector:
  - Data only: 100*0.100/1.5 = 7MHz DL
  - 2*7MHz FDD or 14MHz TDD
- Band / allocation (4 sector deployment)
  - Data only: **28MHz*2 FDD or 56MHz TDD**; add supplementary guard bands

Downlink Power – Example - 802.16/HiperMAN

- Starting point: Subscriber Terminal
  - Tx=23dBm (electrical power)
  - Up-link OFDMA, gain 12dB.
- Base Station
  - Double traffic, compared with the up-link: 5.5dB higher power
    - See FDD/TDD slide
  - Compensate the OFDMA gain: 12dB
  - Compensate the Noise figure: (delta_NF): 2dB
  - Control losses: 2dB margin.
- The Base Station electrical power should be:
- Tx_bs=Tx_st + OFDMA_st + delta_NF + delta_rate + margin
- Tx_bs = 23.5+12+2+5.5+2 = **45dBm**
  - **10dB higher than allowed by EN301021**
- The total transmitted power, for 17dB antenna: will be:
  - Tx_bs = 45+17 = **62dBm** e.i.r.p / antenna
- Beam forming:
  - **Add 12dB for 4 antennae**!

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TDD and FDD

- FDD
  - Better coexistence, eliminates BS-BS and SS-SS interference
  - In spite of marketing stories, allows for asymmetric data rates
    - **By increasing the modulation order**
    - QPSKrate1/2 to QPSKrate3/4
      - 50% increased data rate
      - 2.5dB higher transmitted power
    - QPSKrate1/2 to QAM16rate1/2
      - **100% increased data rate**
      - 5.5dB higher transmitted power
- TDD
  - Better for beam-forming and MIMO
- FDD/TDD use in the same area:
  - 2 Guard Channels, each side of the allocation, with the channel width according to the highest
  - Guard-bands outside the allocated band
  - Without suitable spectrum engineering (guard bands) the systems will kill each-other!

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Coexistence in Licensed Bands

- **The problem**
  - BS-BS and ST-ST interference in TDD
  - BS-ST interference in both FDD and TDD
  - 50% waste of spectrum due to guard bands, for the "technology neutral" approach (2 spare channels)
- **The solution**
  - Controlled sharing of the guard bands
    - **Coexistence –protocol**
      - Systems to talk to each others
      - Resource reservation

Spectrum "Competitiveness" and Operator Budgetary Figures

- Site Installation Costs: ~$100K
- Base Station Equipment Costs Including Backhaul: $60K – $120K
- Maintenance and OPEX: variable
- License Costs: $400K and up…
- Number of CPE's reachable by a base station in rural areas: 50-100.
- → Operator's price per line exceeds $500 which may not be worth to deploy
- Reduce costs via:
  - **Lower/ NO license costs.**
  - **More spectrum in low frequencies to increase coverage and reduce the price per line**
  - **High power allowance and low interference to increase coverage**

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Does 3.5GHz respond to requirements ?

- European Licenses are allocated only for FWA
  - Nomadic Services are considered “mobile”
  - **Low Base Station power allowance**
- Most of licensed blocks are 14MHz
  - **Not really enough for broadband Internet access**
  - Absolutely not enough for VoD
- Latin America
  - 25*2 MHz blocks
  - Mobile data allowed?
- Asia
  - China, etc.: **not enough spectrum in 3.5GHz**
  - Other Asian countries: **inexistent 3.5GHz band for FWA**

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Portable Data Cost Structure

Mobile Data – 2003

- GPRS
  - Effective rate: ~20Kbps
  - Cost: €€€
- Wi-Fi
  - Broadband
  - Cost: €40/mo; € 10/2hrs
- Fragmented services
- **Total Cost: High**

Mobile Data – 2005

- Single mobile service
  - Bearer independent
- Transparent roaming
- Single sign-on
- Auto link selection
- VPN support
- **Total Cost: €40/mo ?**

Target: Single Broadband Mobile Data Service

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Will Mobile Operators Use Their Bands for "Mobile Data" ?

- Generally extremely high license cost
  - No Return of Investment, if one user is given 1Mb/s for $40/month
- "Hot Spot" solution
  - LE bands use
  - Very limited coverage
  - No QoS
- Portable Internet allocation needed
  - **2.3GHz in Korea – example to be followed!**

Fix / Nomadic BWA - License Exempt Spectrum

- Bands:
  - 2.4GHz (80MHz) and 5.8GHz (up to 150MHz)
  - Asia-Pacific – around 5GHz
- Importance
  - May be used by Wireless ISPs (US experience) to cover large areas
  - May be used in Nomadic Access
  - May supplement the lack of Licensed Spectrum
- Open problems
  - 2.4GHz is crowded in many areas;
  - 2.4GHz, 5.8GHz is low power – not usable in NLOS
  - 4.9GHz, 5.xGHz – attenuated propagation in foliage
- Operators avoid to use LE spectrum
  - QoS problem
    - **Lack of a Spectrum Sharing protocol, to allow some QoS in BWA**

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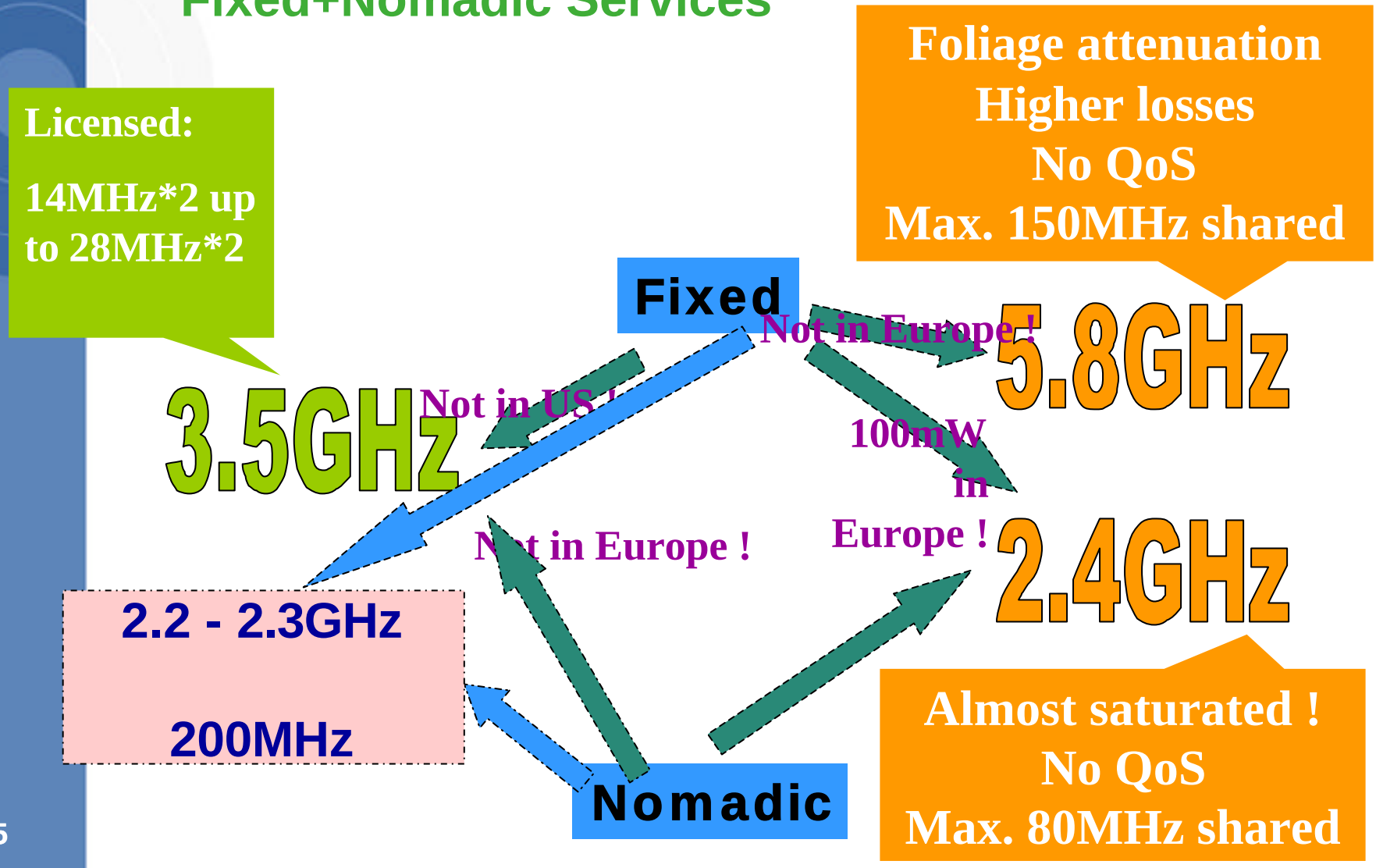
Spectrum for Converged Last Mile
Fixed+Nomadic Services



Conclusion: Regulatory Wish-List

- Licensed spectrum
  - More spectrum in lower frequencies
  - Higher allowance for Base Station power
  - Allow “Portable Internet” and VoD services together with FWA
  - Suitable guard bands for lower interference
- More LE spectrum in lower frequencies
  - Higher power
  - Regulatory imposed coexistence - protocol
- Allocate the 90% not used spectrum
  - Cognitive Radio / Light licensing
  - Data bases to register the licensed users
  - Receivers to indicate their presence
    - Cognitive approach
- Harmonized Spectrum
    - Cost reduction by “factor of scale” effect

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Thank You!