TOWARD THE NEW ERA FOR RADIO USAGE INCLUDING THE WHITE SPACES

Paul Garnett, Director Policy & Regulatory Affairs Microsoft Corp.



THE VISION

A UBIQUITOUSLY NETWORKED WORLD, FOCUSED ON PROVIDING USERS A SEAMLESS AND FULFILLING EXPERIENCE



A WHITE SPACES VISION

- More pervasive and seamless connectivity
- Ubiquitous and affordable Internet access is a key goal
- Facilitating improved access to content and services in the home/office
- White spaces are only part of the answer, but an important part ...





THE THIRST FOR SPECTRUM

- Mobile devices are fuelling massive demand for wireless data capacity and wider coverage
 - Globally, mobile broadband traffic is more than doubling each year.
- But much spectrum lies idle for much of the time – across the world
- To address these needs, regulators can:
 - Make more spectrum available and
 - Make better use of spectrum already allocated



IT'S GOOD TO SHARE

- Not all users need exclusive access to spectrum
- Wi-Fi in U.S. homes generates an estimated value of \$4.3 - 12.6 billion/year
- Sales of license-by-rule devices are set to exceed those of licensed devices
- RFID generates around \$5 billion per year



Source: Perspective Associates



WHITE SPACES ARE A PRIME EXAMPLE

- TV White spaces are underused capacity in a prime part of spectrum
- Significant capacity is available – even more in rural areas
- Significant potential for economic and social benefits





WHAT ARE WHITE SPACES

- White spaces are gaps left between broadcast stations on the same frequency
- They occur in different places on different channels
- They are left either to prevent interference or because coverage is not economic

21	22	23	24	25	26	27	28	29	30	31	32	Channel
33	34	35	36	37	38	39	40	41	42	43	44	
45	46	47	48	49	50	51	52	53	54	55	56	
57	58	59	60	61	62	63	64	65	66	67	68	69
Interleaved Spectrum (DTT) PMSE (radio microphones) Cleared Spectrum												

Example – UHF band plan – UK*

Source: *Ofcom



POTENTIAL BENEFITS TO BUSINESS AND CONSUMERS FROM WHITE SPACES



- White spaces could generate \$100 billion* in value over the next 15 years
 - Internet access adding capacity and coverage
 - Health service efficiency and safety
 - Logistics and retail efficiency
 - Energy conservation
 - Improved land management



NEW TOOLS ENABLE THE SHARING OF WHITE SPACES

- New technology allows more efficient spectrum sharing without disrupting existing applications
 - Geo-location and database access
 - Spectrum sensing
- These tools enable more widespread use of licensing-by-rule
 - Moving the responsibility to the device manufacturer



SPECTRUM SENSING

- A toolkit of techniques is emerging
- Suits remote areas
- However:
 - White space capacity depends on the sensing threshold
 - Low thresholds lead to low spectrum efficiency (due to false positives)



Image source: NXP



GEO-LOCATION

- Coordinating spectrum use through a database brings major benefits
- This deterministic approach provides:
 - Predictable capacity to white space device users
 - Reassurance to licensees
 - Flexibility for regulators to retain control





WHITE SPACES NETWORK TRIALS

- Redmond, USA
 - Research 'White-Fi' network established on Microsoft's campus
 - Mesh topology, exhibits rapid adaptation to changing UHF channel availability
- Claudville, USA
 - Small, deeply rural community now has broadband for the first time
 - White spaces provides cost effective access distribution, from central fibre hub





HOW COULD WE USE WHITE SPACES



A HOST OF POTENTIAL APPLICATIONS

- Home and office networking is likely to be the most prolific application
- Extending Internet access
 - Rural broadband
 - Campus-wide networks
 - City-wide hotspots
- Novel access combined with the favourable propagation should aid innovation





WHITE SPACES OFFER MORE FLEXIBILITY THAN OTHER BANDS

- Favourable propagation characteristics of UHF help reduce wide area coverage costs
- Networks using higher frequencies can selectively reinforce capacity at 'hot spots'





MEDIA-RICH HOME NETWORKS

- UHF enables simpler installation and higher customer satisfaction, offering:
 - Better coverage than networks in higher frequency bands
 - Complementing Wi-Fi
 - Facilitating media discovery, distribution and simplifying network management







WHITE SPACES CAN CHANGE THE ECONOMICS OF COVERAGE

- White spaces provide a cost-effective means of distributing access in sparser communities
- Propagation through walls helps reduce need for installation visits and external equipment
- A license-by-rule access model enables local communities to access spectrum capacity more easily.





COMMUNITY AREA NETWORKING

- Propagation characteristics enable an ad-hoc network to be formed across all or parts of a local community
- This might benefit some types of content which have most value within a local area e.g.:
 - CCTV images
 - Advertising from local businesses
 - Local news







HOT-SPOT VS MESH

- White spaces networks could use hot-spot or mesh configurations
- A mesh architecture may suit campus and residential communities
 - Scalability
 - Potentially better indoor coverage than a central hotspot





AT 5 GHZ



5 GHz

- Bandwidth is good,
- Published 802.11a ranges (Yellow circles) decent
- Measured range (red circle) poor
- Range is not sufficient to bootstrap mesh until installed % is quite high (in this diagram ~50%)



WHITE SPACES (AT 700 MHz)



700 MHz

- Much better range
- Three 2 MHz channels can bootstrap a neighbourhood with ~3-5 Mbps



WHITE SPACES AND 5 GHz



Dual Frequency Network

As more clients come online, links form in highfrequency range and more of the mesh is connected with highbandwidth



CITY-WIDE HOTSPOTS

- Muni Wi-Fi at 2.4 GHz has not proved economical
- A white spaces based network could
 - Provide affordable seamless city-wide access
 - Address sections of society not served by wired broadband





SENSOR NETWORKS

- CitySense is an urban scale sensor network test-bed being developed by researchers at <u>Harvard</u> <u>University</u> and <u>BBN</u> <u>Technologies</u>
- CitySense consists of 100 wireless sensors deployed across a city, such as on light poles and private or public buildings





HEALTHCARE DELIVERY

- A powerful tool in hospitals, potentially supporting:
 - Video links
 - Tracking of patients, staff, equipment
- Useful for remote care delivery and monitoring too ...
- Reliable whole house coverage is a critical factor





SECURITY

- Control and monitoring of access to buildings can benefit from UHF penetration ability
- White space capacity can facilitate tracking and signalling within a building, across a campus
- White spaces could help relieve increasingly the crowded RFID band (in UHF), supporting supply chain management





HOW IS THE U.S. FEDERAL COMMUNICATIONS COMMISSION RESPONDING?



IN THE US, SPECTRUM MANAGEMENT IS A CENTRAL ELEMENT OF INDUSTRIAL POLICY

Our National Broadband Plan will encourage innovative ways of using of spectrum, including what some call "opportunistic" uses, to encourage the development of new technologies and new spectrum policy models.

New ideas such as databases that dynamically enable—or revoke—access to spectrum in particular times and places promise to change the way we think about spectrum."

FCC Chairman Julius Genachowski



FCC DECISION GIVES US THE LEAD

- Two classes of white space device:
 - Portable/personal up to 100 mWatts EIRP,
 - Fixed up to 4 Watts EIRP,
- Geolocation and database access coupled with sensing to protect wireless microphones; the FCC remains open to sensing-only solutions







DEVICES MAY SHARE GEO-LOCATION DATA





MULTIPLE

DATABASE PROVIDERS ARE USEFUL

• US proposals envisage multiple providers



FCC's REMAINING ISSUES

- Designation of white spaces database providers. Nine applications received.
- Resolving the rights and responsibilities of unauthorized wireless microphone operators.
- Responding to requests for elimination or loosening of the sensing requirement for all white spaces devices.



SUMMARY

- Licensing-by rule is emerging as a powerful approach for getting more out of spectrum
- White spaces are a major opportunity, to broaden Internet access and foster innovation
- Their global presence promises an attractive market
- Regulators across the world are now recognising the potential, following the pioneering efforts of the US and UK.





My email: paulgar@microsoft.com