Enabling Legacy Transitions and New Approaches in the U.S., Japan, and S. Korea

EE-402A Topics in International Technology Management
"Mobile Internet Businesses and Technologies in Asia"

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Disclaimer

The opinions expressed are those of the author and do not necessarily represent the views of the Federal Communications Commission or the United States Government; The Maureen and Mike Mansfield Foundation; or any Japanese Ministry or the Government of Japan.

本人の見解によるものであり、アメリカ合衆国その他の代弁ではないことをご承知下さい

- Pressing Spectrum Needs to Support Mobility
- View of Legacy and New Approaches in Japanese 311 Disaster
- Legacy Transitions Seen Through Broadcast
- New Approaches and New Challenges

Exploding Demand for Mobile Broadband

- Internet-centric vs Mobile-centric Computing
- Dominance of mobile in many markets
- Increase of "smart" mobile devices

Convergence

- Tyeing of a particular kind of content to a particular:
  - Frequency (the allocation of spectrum to particular kinds of use at the ITU and National level),
  - Technology (tyeing of broadcast to NTSC, ATSC or other kind of delivery technology), or
  - Provider (the license category's regulatory restriction)

“Convergence” Evolution of Spectrum

- Technologies
- Business Models
- Consumer Behavior
- Markets
- Regulatory Approaches

Exploding Demand for Mobile Broadband

- Dr. Purdy and others lectures explain the explosion of data on mobile devices
- 450% Increase in data usage 1Q 2009 → 2Q 2010

Exhibit 10. Spectrum Need Forecast - Table of Results

	Year:	0	1	2	3	4	5
Line	Description	2009	2010	2011	2012	2013	2014
1	Data Growth Relative to 2009 - Cisco	100%	242%	598%	1253%	2577%	4722%
2	Data Growth Relative to 2009 - Yankee	100%	266%	631%	1189%	1770%	2332%
3	Data Growth Relative to 2009 - Coda	100%	251%	539%	1154%	2200%	3464%
4	Data Growth Relative to 2009 - Average	100%	253%	589%	1199%	2182%	3506%
5	Cell Sites	245,912	263,126	281,545	301,253	322,340	344,904
6	Absolute Growth	100%	107%	114%	123%	131%	140%
7	CAGR	7%					
8	Traffic per Site - Growth	100%	236%	515%	978%	1665%	2500%
9	Avg. Spectral Efficiency (Mbps/MHz)	0.625	0.75	0.88	1.00	1.13	1.25
10	Absolute Growth	100%	120%	140%	160%	180%	200%
11	Tech-Adjusted Traffic per Site - Growth	100%	197%	368%	612%	925%	1250%
12	Spectrum req'd for data (MHz)	57	112	208	346	524	708
13	Percent allocated for data	33%	50%	65%	75%	82%	86%
14	Spectrum req'd for voice (MHz)	113	113	113	113	113	113
15	Percent allocated for voice	67%	50%	35%	25%	18%	14%
16	Spectrum - In Use (MHz)	170	225	322	460	637	822
17	Spectrum - Currently Allocated (MHz)	547					
18	Surplus/Deficit (MHz)	377	322	225	87	-90	-275

- National Broadband Plan recommendation to make available 500 megahertz (MHz) of new spectrum for wireless broadband, including 300 MHz for mobile flexible use within five years.
- President Obama's June 28, 2010 Executive Memorandum directing 500 MHz of new spectrum for mobile and fixed broadband use.

The Catch? "Opportunity Cost"

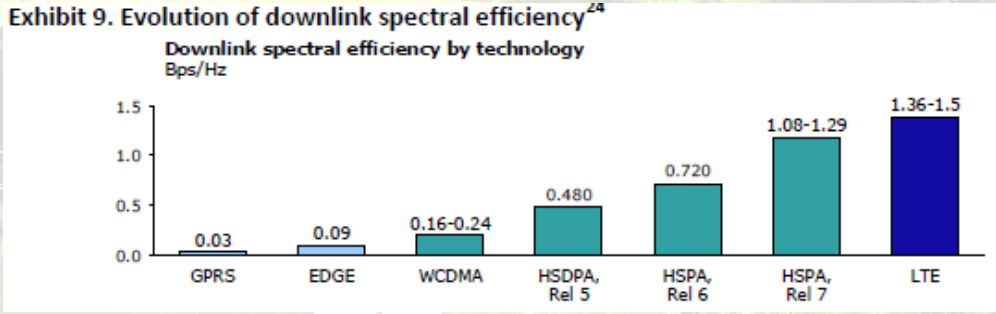
- More users and More Demand Means Congestion on the existing networks
- Different approaches entail different opportunity costs
  - Accommodating more users and more demand by improving existing spectrum use
  - Allocating Additional Spectrum
    - Regulated resource
    - No ownership of spectrum but usage rights entail huge economic significance

Spectrum Physics Constraints

- Fundamental Wireless Engineering Considerations
  - Power – Distance
  - Frequency
  - Power - Digital vs. Analog
- State of Technology Plays Important Role in Defining Practical Confines of Spectrum Use
- Relationship Between Physics Properties and Nature of Spectrum Use
- Balancing of Technology Capabilities with Ix Concerns to Incumbent Users, Complexity for Users, Performance and Battery Life
- Error Correcting Performance Improvements to SNR Benefit for Power Reductions for Analog → Digital

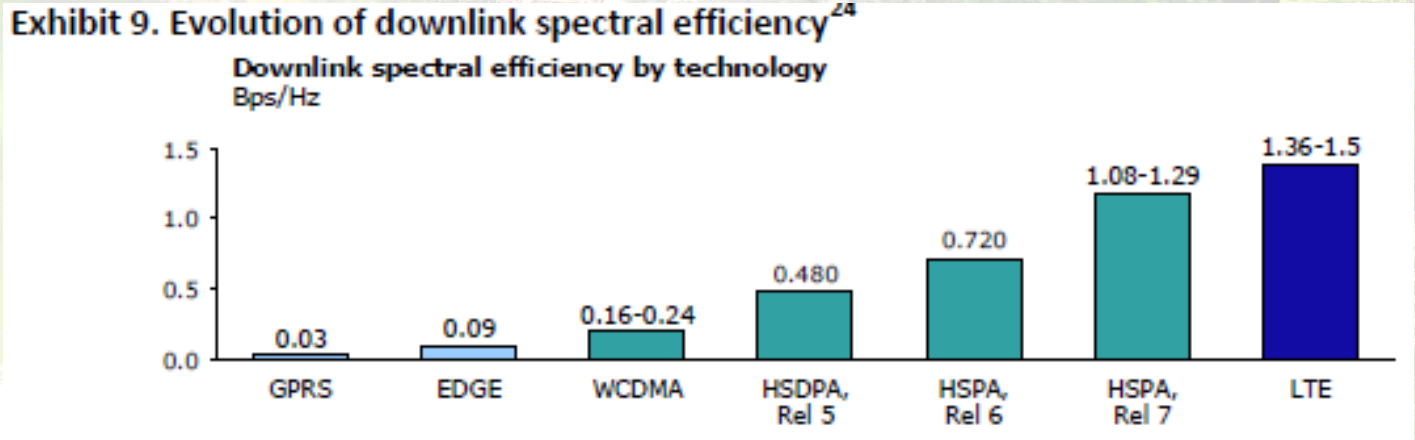
Improving Existing Spectrum Use

- Shrinking the Distance between transmitters and receivers
  - Small Cell / Femtocells
  - Investment and other costs of increasing base stations
- Improving the Efficiency of Access to Communications Channel
  - Analog 1G → 2G → 3G → 4G
    - WiMAX – LTE
  - Analog TV → Digital TV
  - Public Safety Narrowbanding



- Better Processing of the Information (Baseband)
  - Improved audio and video codecs
  - Analog to Digital baseband conversions
  - Changing where data resides, is processed and is used (Cloud, etc.)

- Drivers of network capacity
  - Capacity per cell-site
    - Spectral efficiency of wireless technology
    - Spectrum allocation
  - Numbers of Cell sites



Add Capacity With More Spectrum

- Reallocation of Spectrum
  - Economic incentives
  - Regulatory incentives
- 500 megahertz (MHz) of spectrum available for mobile broadband within the next ten years
  - Including improving the transparency of spectrum allocation and utilization
  - Expanding incentives and mechanisms to reallocate or repurpose spectrum to higher-valued uses
  - Increasing opportunities for unlicensed devices and innovative spectrum access models

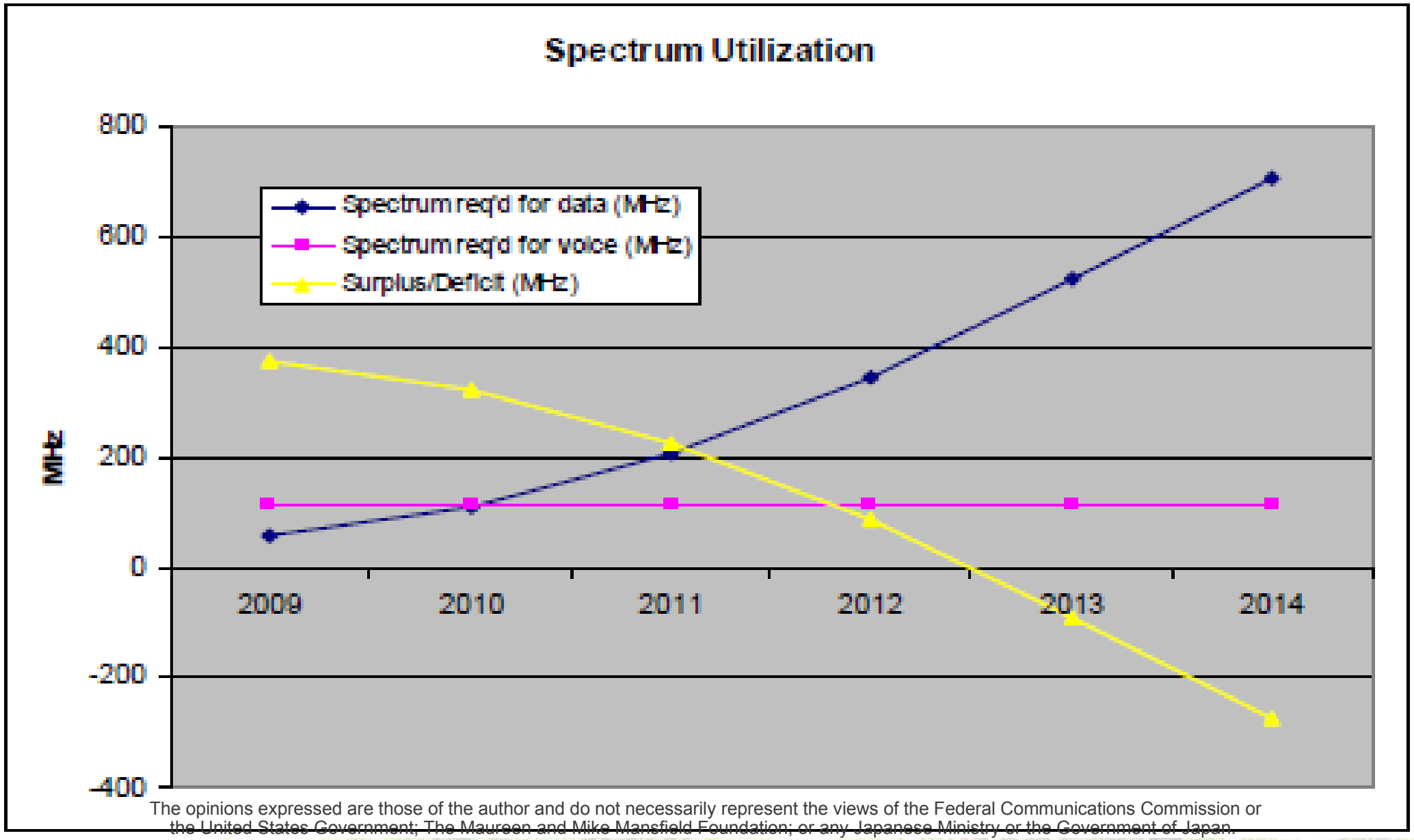


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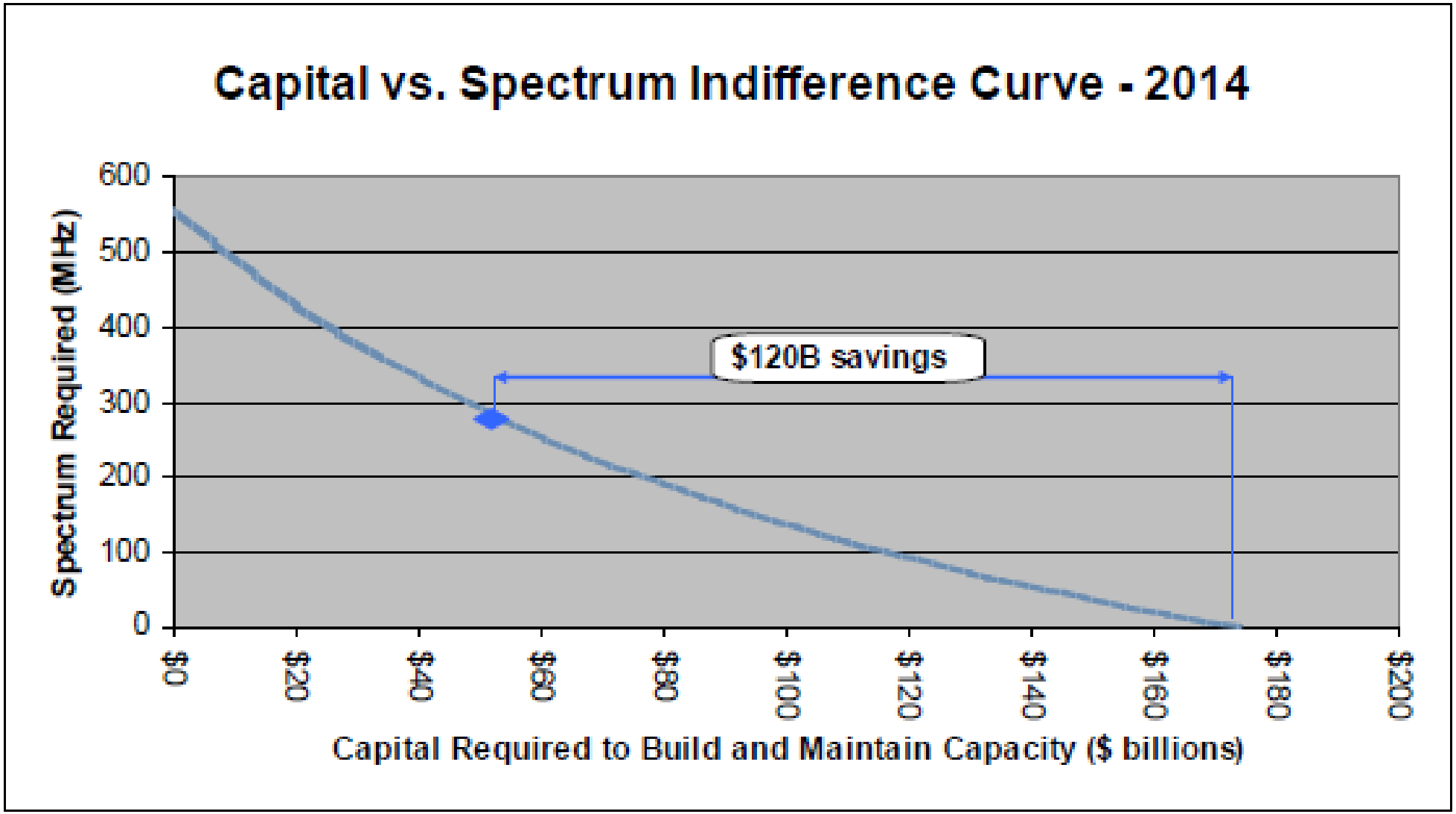
Exhibit 22. Capital vs. Spectrum Indifference Curve for 2014



FCC Technical Papers Conclusion

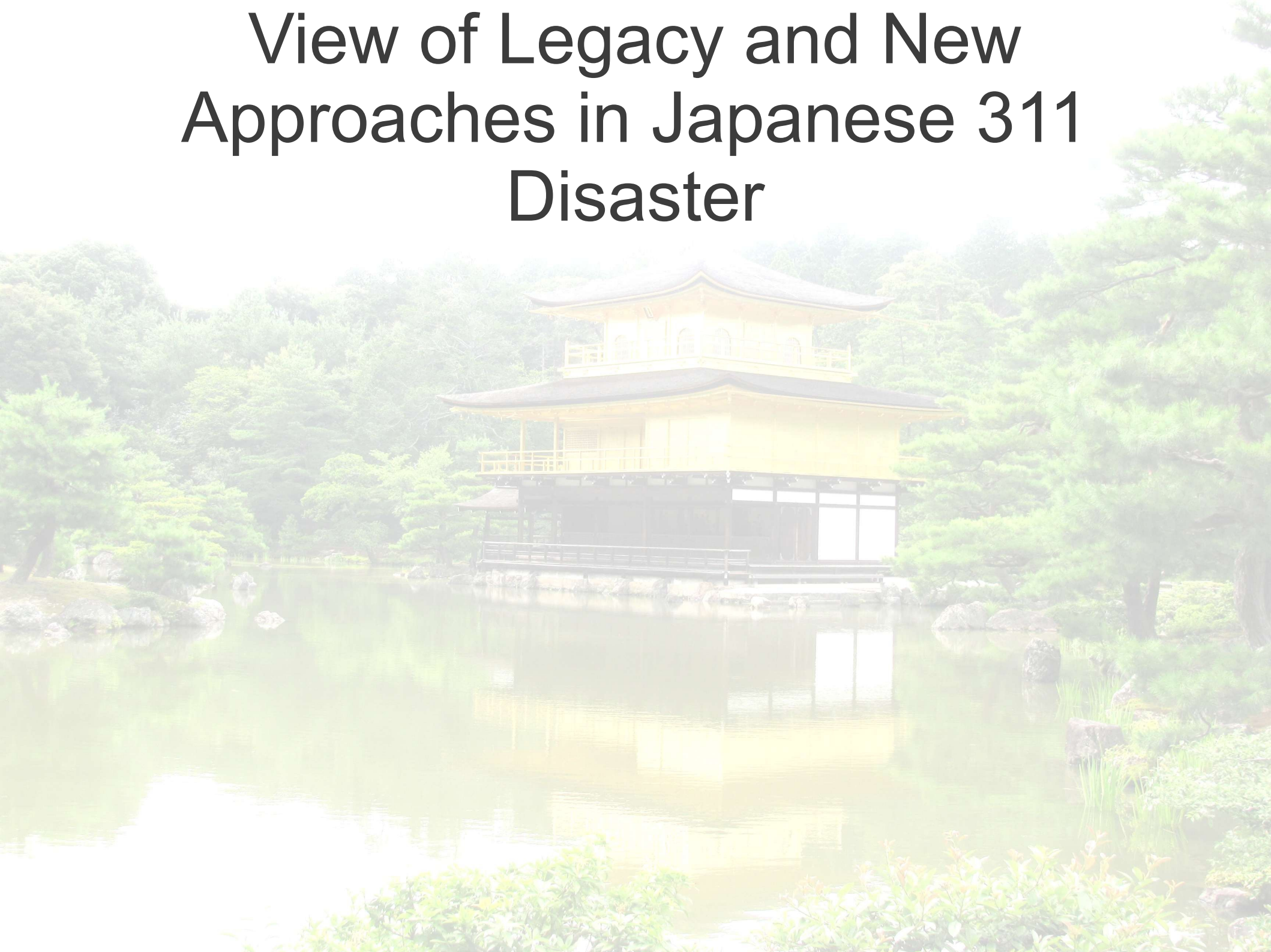
- Broadband spectrum deficit is likely to approach 300 MHz by 2014
- Making available additional spectrum for mobile broadband would create value in excess of $100B in the next five years through avoidance of unnecessary costs.
    - Mobile broadband industry Capital Costs of $54B + 275 MHz of additional spectrum. Against cost to to build enough capacity sites to handle the demand if no addition spectrum made available will be $174B.
    - The difference between these costs represents the value created by additional spectrum in 2014, which is $120B.31

Spectrum's Free Speech not Free Beer

- National Broadband Plans' 500 MHz and 300 MHz for Mobile
- 120MHz proposed from broadcasting

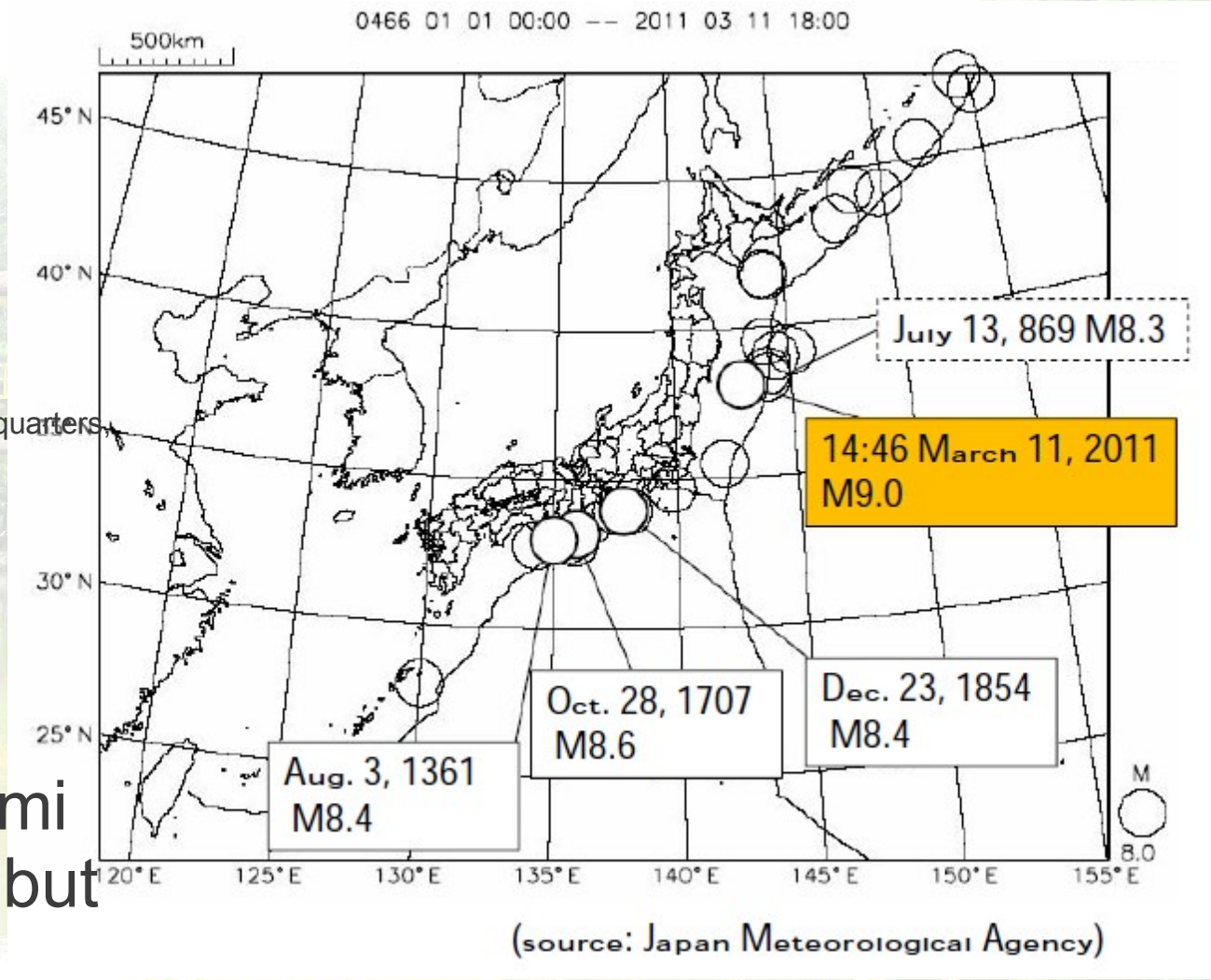
Band	Key Actions and Timing	MHz
WCS	2010—Order	20
AWS 2/32	2010—Order 2011—Auction	60
D Block	2010—Order 2011—Auction	10
Mobile Satellite Services (MSS)	2010—NPRM 2010—L-Band and Big LEO Orders 2011—S-Band Order	90
Broadcast TV3	2010—NPRM 2011—Order 2012/13—Auction 2015—Band transition	120
Total		**300**

View of Legacy and New Approaches in Japanese 311 Disaster



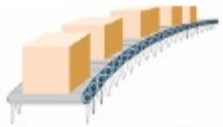
Japan's March 11 Disasters

- Casualties
  - Killed 14,755
  - Missing 10,706
  - Injured 5,279
- Emergency Disaster Countermeasures Headquarters, National Police Agency of Japan, May 3, 2011
- Second Highest Casualties from Natural Disaster
- Magnitude of Tsunami Difficult to Measure but in excess of 30 feet



Examples of Response to an Earthquake Early Warning

Controlling trains



Controlling factory lines
--> To mitigate damage

To prevent
traffic accidents

Controlling elevators
--> To prevent people from
being trapped

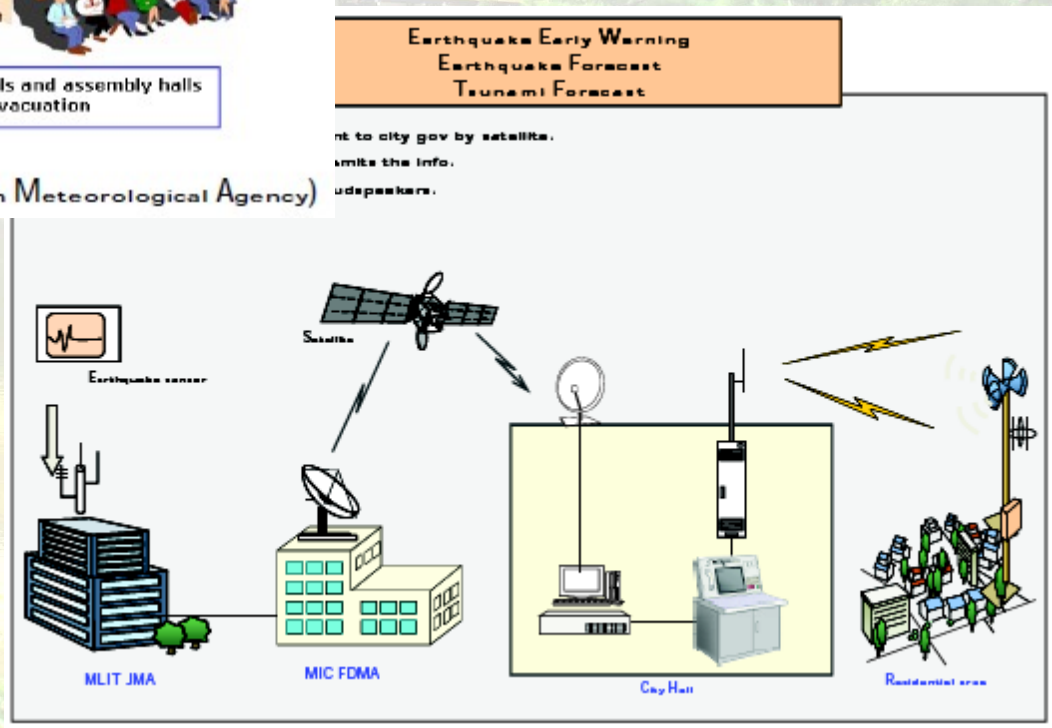
At home
--> To enable personal protection

Workers performing
hazardous tasks
--> To secure safety

Suspending work in progress
--> To avoid mistakes

Alerting schools and assembly halls
--> To guide evacuation

(source: Japan Meteorological Agency)



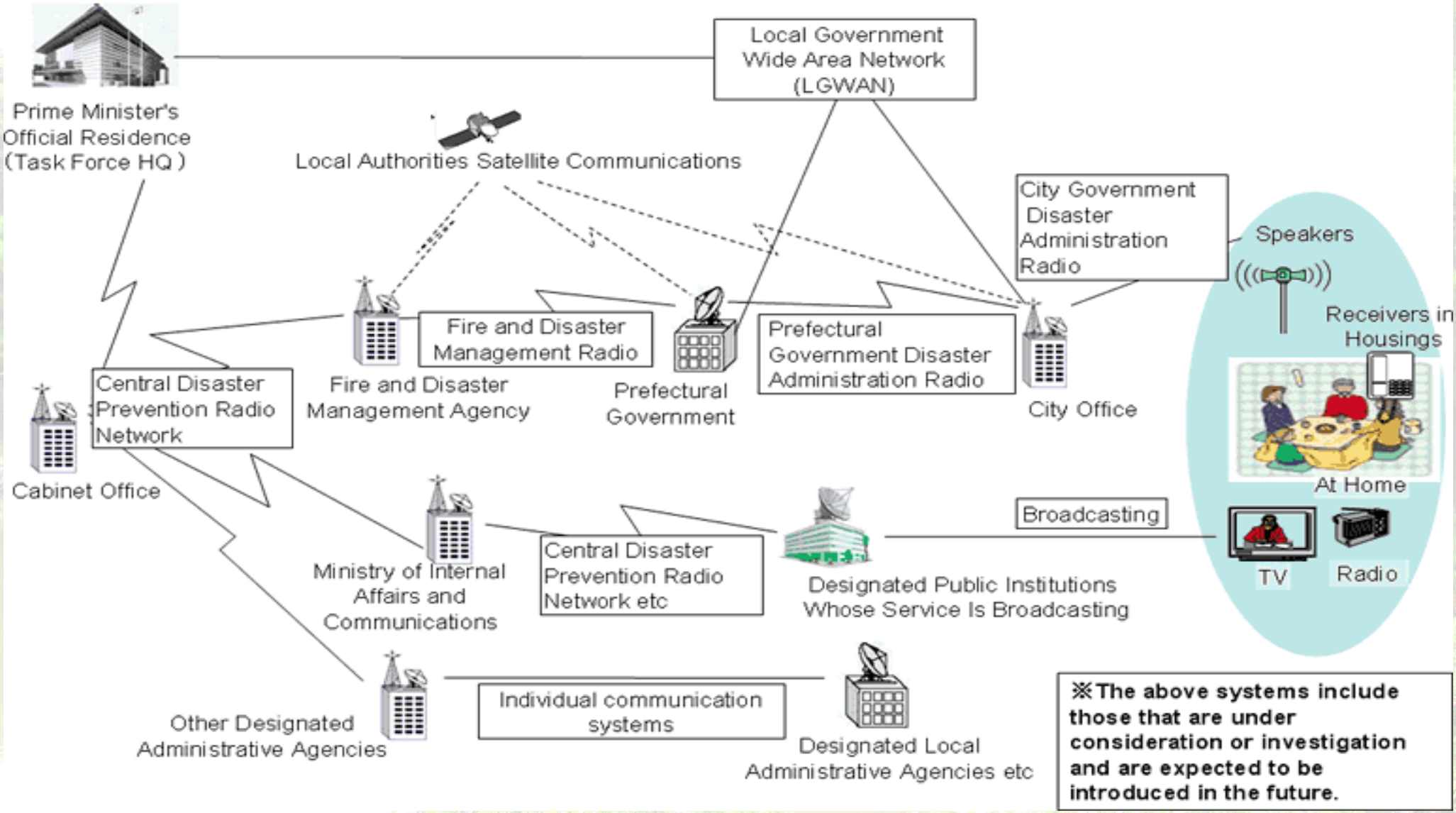
Technology's Role in **Detecting** and Reporting Events

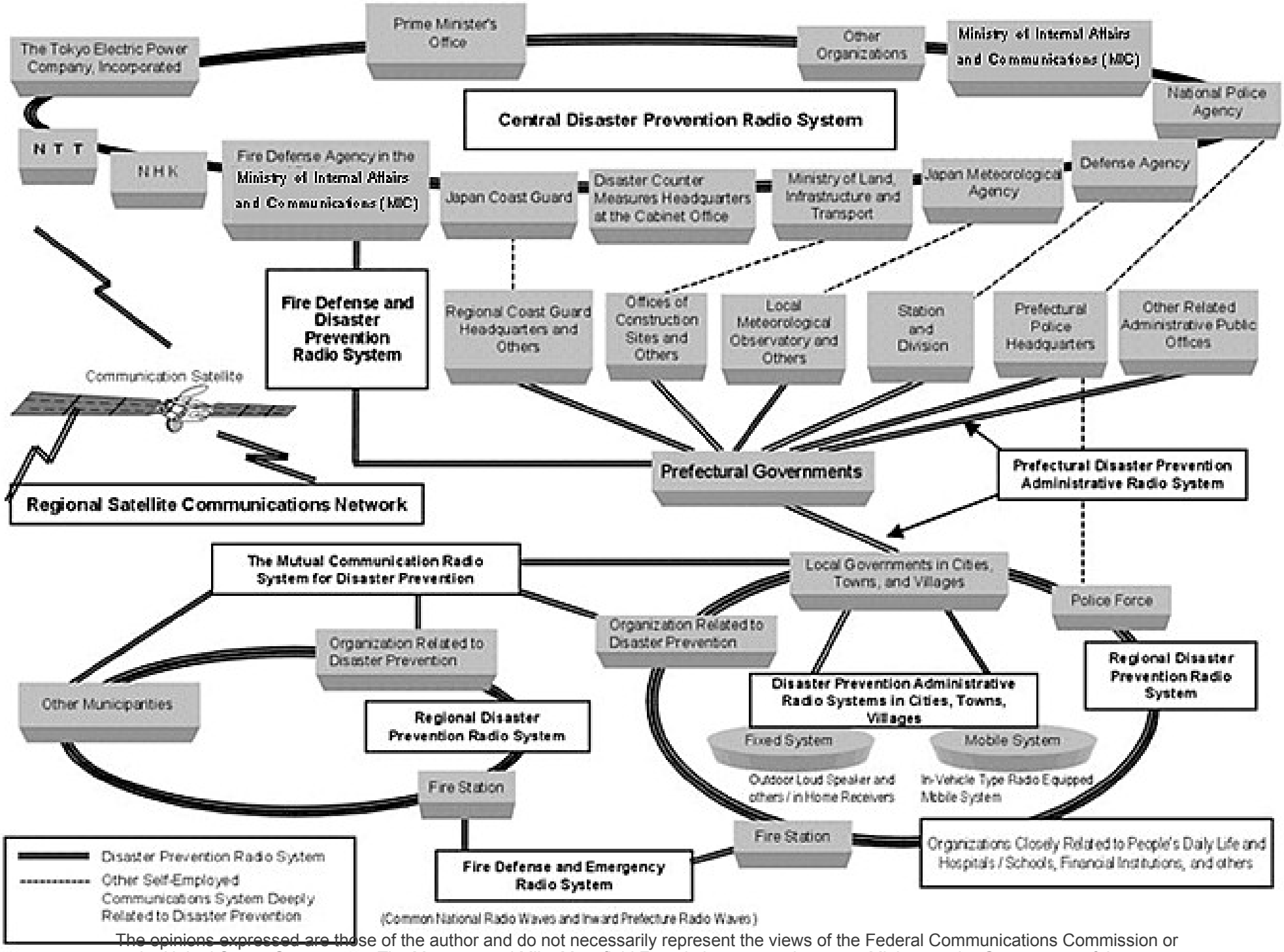
- Diverse Sources
  - Domestic Government Agencies and Research Institutions
  - Private Companies (JR Central UrEDAS and TERRA-S)
  - International Agencies
- Diverse Content
  - Earthquake - EEWS
  - 1000 seismic stations
    4200 seismic intensity stations
  - Tsunami Detection
  - Highly automated systems issues first tsunami warning just six minutes after quake
- Other National Level Concerns
(Missile attacks, Terrorist Bombings, etc.)

Decision Making and Coordinating Responses

- Cabinet Structure and Central Decision Making
  - 1961 Basic Law for Disaster Response (災害対策基本方)
  - Central Disaster Management Council(中央防災会議)
  - Basic Disaster Prevention Plan (防災基本計画)
- Role of Policies and Automating Responses (false positives)
  - Diverse Connectivity
  - Trust and Automation
  - Human Intelligence and Policy and Procedures
- Action and Cooperation (designated public entities – transportation, energy, communications, etc.)

Disaster Network Infrastructures





Provision to the public through:
-TV & Radio
-Cell phone services (NTT DoCoMo, KDDI, SoftBank Mobile)
-Municipal Disaster Management Radio Communication Network (via J-Alert (MIC FDMA))
-Other facilities

-TV (sample display)

(source: NHK)

-Cell phone (sample display)

1 待受画面に緊急地震速報表示
→[○](センターキー)

2 [○](センターキー)

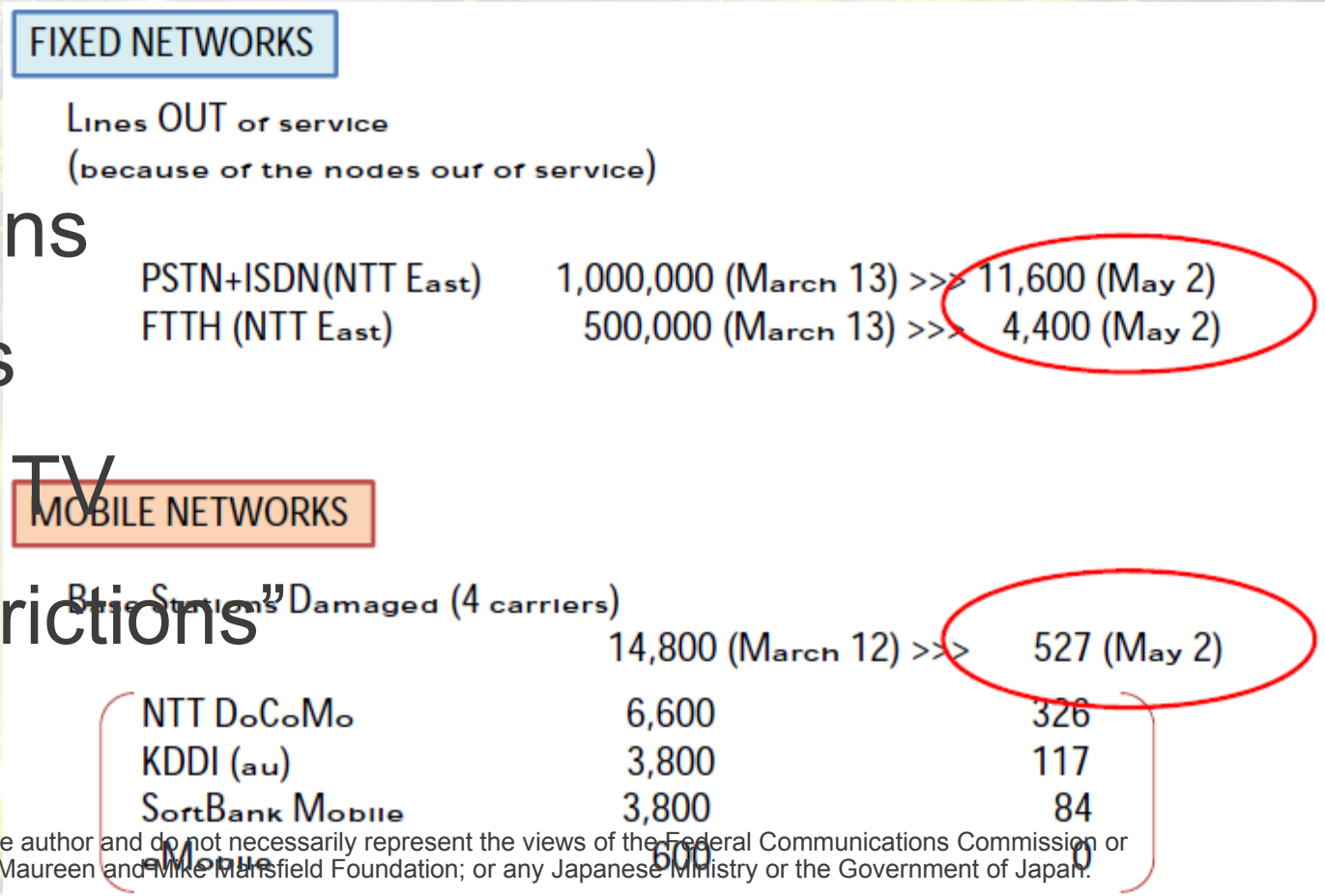
(source: KDDI)

-Speakers for residents
(Municipal Disaster Management
Radio Communication Network)

Disseminating Information and Ensuring Action

- Translating Information and Policies into Action and Operations
- Internet and Mobile Connectivity
  - Em-net e-mail systems
  - Area Mail (cell broadcast)
  - Confirming Status of Loved Ones (Message Boards)
  - Social networking
- Traditional Broadcast Media
- Role of Triggering Disaster Response
  - Train and Plant Safe Shutdown

- Power Charging stations for refugees
- Satellite phones (1251) - SMR Radios (1151)
- Satellite backhaul Internet Stations
- Public Phones
- 40000 radios, TV
- “Capacity restrictions”



FIXED NETWORKS

Lines OUT of service
(because of the nodes out of service)

PSTN+ISDN(NTT East)	1,000,000 (March 13) >>>	11,600 (May 2)
FTTH (NTT East)	500,000 (March 13) >>>	4,400 (May 2)

MOBILE NETWORKS

Base Stations Damaged (4 carriers)

	14,800 (March 12) >>>	527 (May 2)
NTT DoCoMo	6,600	326
KDDI (au)	3,800	117
SoftBank Mobile	3,800	84
eMobile	600	0

- Media Providing First Tsunami Warning
- Upto 6M TV / Over 6M Radio
- Predominantly Radio in Disaster Areas

Media First Accessed After Disaster

51.00%	Radio
21.00%	TV
19.00%	One-seg
7.00%	Internet
1.00%	Newspaper
1.00%	Other

Most Accessed Internet Sites (%)

Yahoo Disaster	48
Local Govt	22
Youtube	22
Google People Finder /Disaster	22
Google/Yahoo	20
Twitter	20
Mixi	16
Blog	16
NHK	13
Newspaper	5
Nikoniko Live	5
Ustream	4
Nikoniko Other than Live	3
Facebook	2

2384 Users of Internet Sources

Nature of Twitter Usage (%)

Lifeline Info / Public Utility	50	25
Safety of Friends Family	32	32
Specifics of Earthquake	32	36
Fukushima Nuclear Plant	23	33
Evacuation Center Info	17	17
Volunteer Info	11	15

被災地調査 (n=472) 準被災地調査 (n=1,643

- 執行文子 東日本大震災･被災者はメディアをどのように 利 用したのか～ネットユーザーに対するオンライングループインタビュー調査から～ , 20 SEPTEMBER 2011, 図 3　地震発生後, 最初に利用したメディ(100 % = スクリーニング調査回答者, 3,152 人

Mix of Services Involved Supporting Japan's Response

- Cellular
- Satellites
- Broadcast
- Public Safety
- WiFi
- Fixed Infrastructure

Technology Blending

- NTT DoCoMo's Area Mail Disaster Information Services
  - Cellular based – IP-based implementation complexities
- Em-Net and others, enhance the email mechanism to provide added reliability and alert capabilities
  - Relies on redundant technical links
- Satellite Backhaul, GPS location, Internet Kiosks

Observations From “311”

- Accommodating new users and demand comes at a price and evaluating public interest is a challenge for regulators
- Services, Technologies, Business Models, and User Behavior are all in transition
- Differing perspectives reveal much of the back and forth of debates about spectrum
- Evolution of New Technologies, Applications and Influence from the Fixed Internet World, Lead to unpredictable outcomes that require regulators to predict the future and be “boldly” conservative

Legacy Technology Transitions

- Video Broadcast Transitions in US, Japan, and Korea
- Interplay with Mobile
- Challenges going forward

US DTV Regulatory Background

- Budget Act of 1997 obligations to reallocate 24 megahertz of spectrum in the UHF channels 60-691 for public safety services by January 1, 1998, and 36 megahertz
- Total of 108 MHz reallocated to new uses after transition
- 1997 FCC Adopts Service Replication / Maximization (Grade B but not full-service requirement)
- Stations receive DTV channel with many moving twice
- VHF Stations Largely Move to UHF (Though some stay)
- Lower Power for DTV Transmissions using Error-Correcting / SNR

Japan's 7/24/11 Digital TV Transition

- Requirement that digital coverage be extended to regions in same manner by December 2010
- 2012 “Final” Transition of Translator Stations to core 13-52 out from 53-62
- Lower VHF for mobile multimedia - High-VHF (14.5 MHz in 207.5-222 MHz) for Mobile Multimedia Broadcasting (MMB)
- Spectrum usage fees to enabled necessary changes to analog broadcasting frequency planning
- Transition Timeline
  - October 1988 MIC announced Basic Strategy for the Promotion of Broadcasting implementing changes to Art. 2(2)(5) of Broadcasting Law requiring transition of all non-digital television broadcasting to digital by July 24, 2011
  - National Terrestrial Digital Broadcasting Promotion Group rendered opinion in August 2002 that $2 billion (1,800??) necessary for transition with 801 response centers responding to 42,600,000 households affected
  - By February 2003 group reported reached some 90% of households focused on the three major regions; then turned to remaining 571 regions nationally
  - 2003 provisional terrestrial digital broadcasting using the ISDB-T standard began in the three major regions of Kanto, Chukyo, and Kinki, and by 2006 included all the major capitals of the Japanese Prefectures
  - 2009 digital broadcasting had reached 48 million households (97% of the total), and shipments of digital compatible devices had reached 49.69 million
  - Focused Assistance (including antennas) on need-based standard (NHK fee exemption) (2.6 Mil Households)
  - 52 MIC sponsored “deiji sapo” TV viewer support centers around the country, “soudan kai” advice clubs organized as local municipal offices, Other Joint Activities

Technology Neutral?

- Historical Background on Differing Digital TV Standards and Trade Issues
  - ISDB in Japan Brazil
  - ATSC in US and Korea
  - DVB in Europe
- 1980's Nippon Hoso Kyokai (NHK), Japan's national broadcasting company, began broadcasting HiVision HDTV system, MUSE (Multiple sub-Nyquist sampling encoding)
- US-Japan Trade Frictions Fueled as US Industry Takes MUSE as New Challenge to a US Engineering Dominance
- FCC Opens Proceeding in 1983 to Review Possibility of Public Safety Use in Broadcasting UHF Bands
- 1995 FCC Names ATSC as Next Generation Digital TV Standard
- Japan Moves to Develop Fully Digital Standard After ITU Rejects MUSE, and December 2003 Welcomes First Broadcasts of Japans All Digital ISDB-T

Importance of Industry Background in Spectrum Debates

- At the US DTV Transition OTA Market Share 13-15%
- OTA Market Share in Japan ¾ of Total TV Market
- Japan Population: 127.7 Mil (95.7 Mil OTA)
- US Population: 391.4 Mil (46.9 Mil OTA)
- Japanese Market Breakdown by Revenue
  - OTA $25.95 billion (2 兆 5,946 億円),
  - Sat $3.7 billion (3,737 億円),
  - Cable (CATV) $4.7 billion (4,746 億円),
  - NHK $6.8 billion (6,848 億円)
    - 平成 21 年版 情報通信白書 2.4.4.1,

Korea DTV Plans for 12/31/12

- Digital TV Transition and Analog Shutdown
  - Five blocks in the 700-megahertz band (between 698 megahertz and 806 megahertz) will also be available in South Korea from 2013 when analog TV broadcasting will be completely replaced by digital broadcasting.
- August 2011 - Spectrum Auctions
  - 20-megahertz block of 1.8 gigahertz band for 10 years soared to 995 billion won ($920 million),
  - SK Telecom was the biggest spender, paying 1 trillion won ($926 million) for 20 megahertz in the 1.8 GHz band. The 20 MHz chunk was thought ideal for LTE.
  - KT Corp dropped out of the 1.8 GHz race but got 800 megahertz licenses that were 10 megahertz wide for 261 billion won.
  - LG Uplus picked up 20 megahertz of spectrum in the 2.1 GHz band, at the minimum price of $412 million. The Korean government prevented SK and KT from bidding on the 2.1 GHz spectrum as it wanted to open up that band for new entrants. LG ended up the sole bidder for the license.
- Industry Organization
  - SK Telecom - 51% market share
  - KT Corp - 31% market share (combined 80% of the country's mobile market)
  - LG Uplus 17.8 percent share.

New approaches and New Challenges

- OI, Network Neutrality, Reasonable Network Management and Video
- Broadcast, Citizen Media, Rumormongering and Redefining the Press and 1st Amendment
- FMC and Evolution of Internet Appplications

Video

- Quantitatively bigger than other kinds of content
  - Audio will be commodity on the web at less that 100kbit
  - Despite advances in compression video now dominates Internet traffic
- How to manage video on over any medium is a challenge
  - Unicast / Multicast tradeoffs
  - Network Neutrality and Traffic Management

- 3% of smartphone consumer 40% of data
- Pricing plans, consumer behavior and “hogs”
- Need to increase capacity scales with user
- Tyeing pricing to usage to “temper” usage
  - Slow uptake for 4G services
  - Premium speed pricing versus great number of customers served

Tracking fixed Internet, FMC and Internet-Centric View

- Counterpoint to legacy
- Broadcast – Internet vs. legacy
- Network Neutrality
  - Treatment of Fixed and Mobile
  - US variation of rules for mobile

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