

Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: [Personal Space Communication with WPAN Broadcasting]

Date Submitted: [18 August 2010]

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Re: [In response to 802.15 WNG call for presentations.]

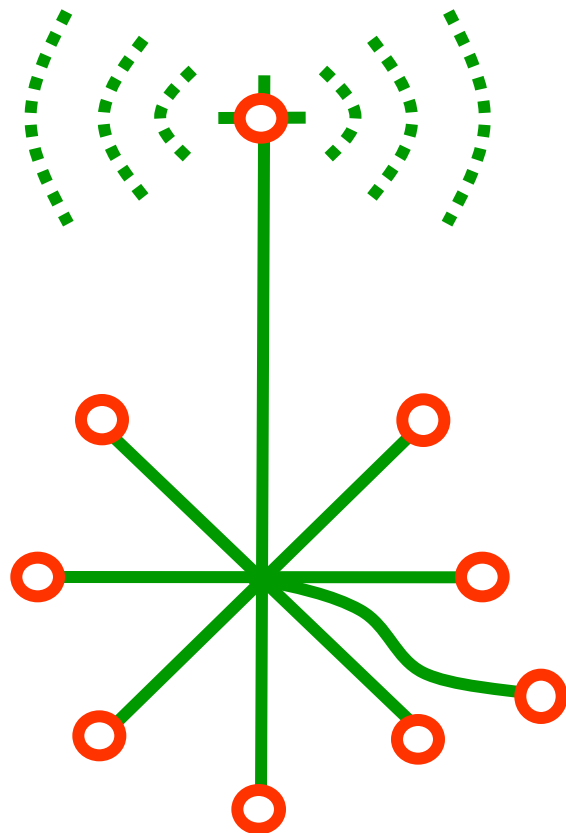
Abstract: [In 5G with mobile computing, control will shift from service providers to users, thus the personal space will be central, not peripheral, to the global communication. Users will maintain intact the essential features of their personal space while seamlessly floating over the global communication infrastructure. The 802.15 Personal Space Communication(PSC) will define technologies empowering this inevitable paradigm shift, among which broadcasting capability is one of the most essential. PSC devices are themselves personal broadcast stations. Service providers will enter this personal space just as another broadcast station. 5G communication is nothing more than connections of these PSC spaces.]

Purpose: [[Information related to the request for international cooperation](#)]

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Personal Space Communication with WPAN Broadcasting



March 2010

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Talking Points

- Congratulatory Remark
- Long Term Evolution from “Wire” to “Wireless”
- Power Shift from Carriers to Users
- User Requirements
- Technical Requirements
- IEEE PSC Standard and ISO/IEC 29157
- PSC as mobile carrier business

Part 1

Congratulatory remark

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Part 2

Long term evolution from “wire” to “wireless”

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Long Term Evolution

- **1980's: wiring the missing-link**
- **1990's: unwiring the wired**
- **2000's: nothing but the same old G-jargon**
- **2010's: toward an humanitarian WPAN**

Why CDMA?

Because it was

- like green bananas, IS-95
- from a small but creative “chip house”
- the best choice for Korean challenge

Challenge always accompanies risk and reward

- More the risk, more the reward
- CDMA at home, multi-standard for export

With PicoCast

- **Smartphone becomes “smarter”**
- **WPAN becomes a killer application for the personal space of communication, broadcasting, education and entertainment.**

WPAN Today

Neither Multi-peer Group Game nor Broadcasting



Sure,
I will get one for
you soon...

Grandpa, I need a
smarter
“Smartphone” to
enjoy multi-peer
game!

WPAN Tomorrow

Personal Space for Communication, Broadcasting, Education and Entertainment



Sure, it is.
Let's enjoy multi-
peer game! ...

Thanks, Grandpa.
"Smarterphone"
is also a
chatting game
machine.

Part 3

Power Shift from Carriers to Users User Requirements for PSC

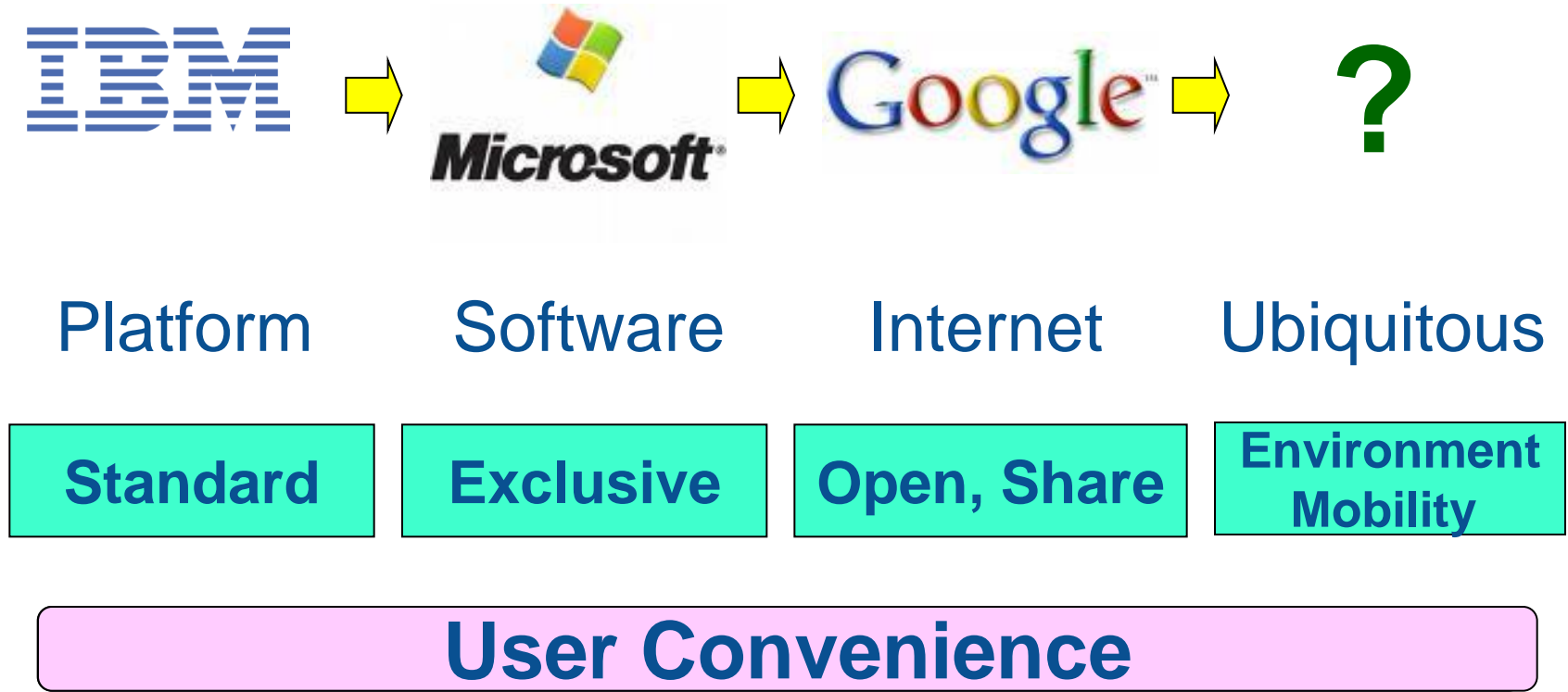
Dr. S.M. Ryu

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Power Shift – Invisible World

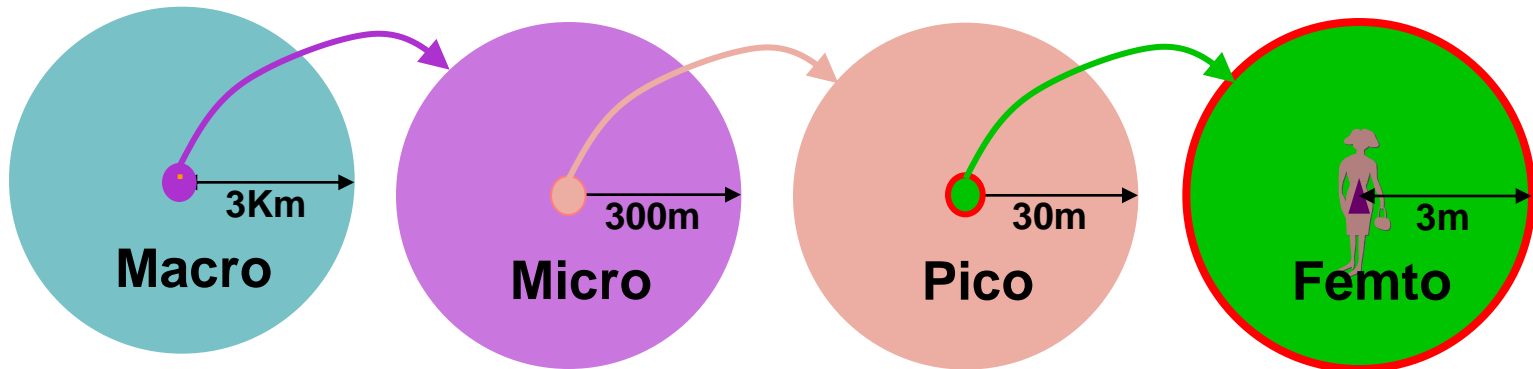
User-Oriented Mobile Space Personal Space Communication



Why WPAN ? - Capacity

How to increase mobile channel capacity ?

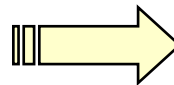
- ❖ Find new frequencies that haven't been developed?; no more available
- ❖ Find new signal processing techniques ?; only few times increasable
- ❖ The only way to achieve few thousand times capacity ; reduce cell size



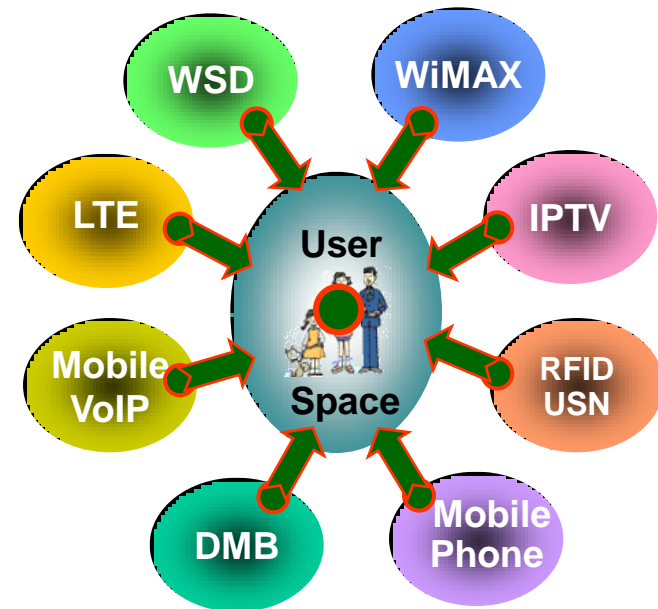
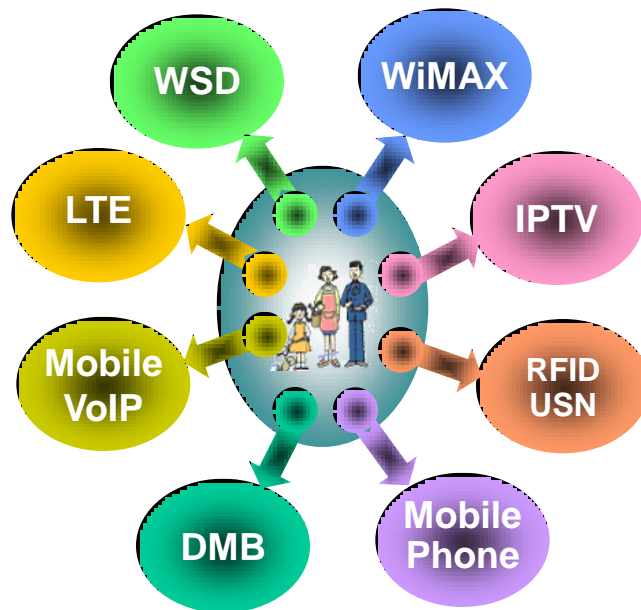
	Macro	Micro	Pico	Femto
Capacity	1	100	10,000	Low Power Personal Space Mobility
Tx Power	1	1/1,000	1/1,000,000	

Power Shift – User-Oriented Terminal

Provider-Oriented



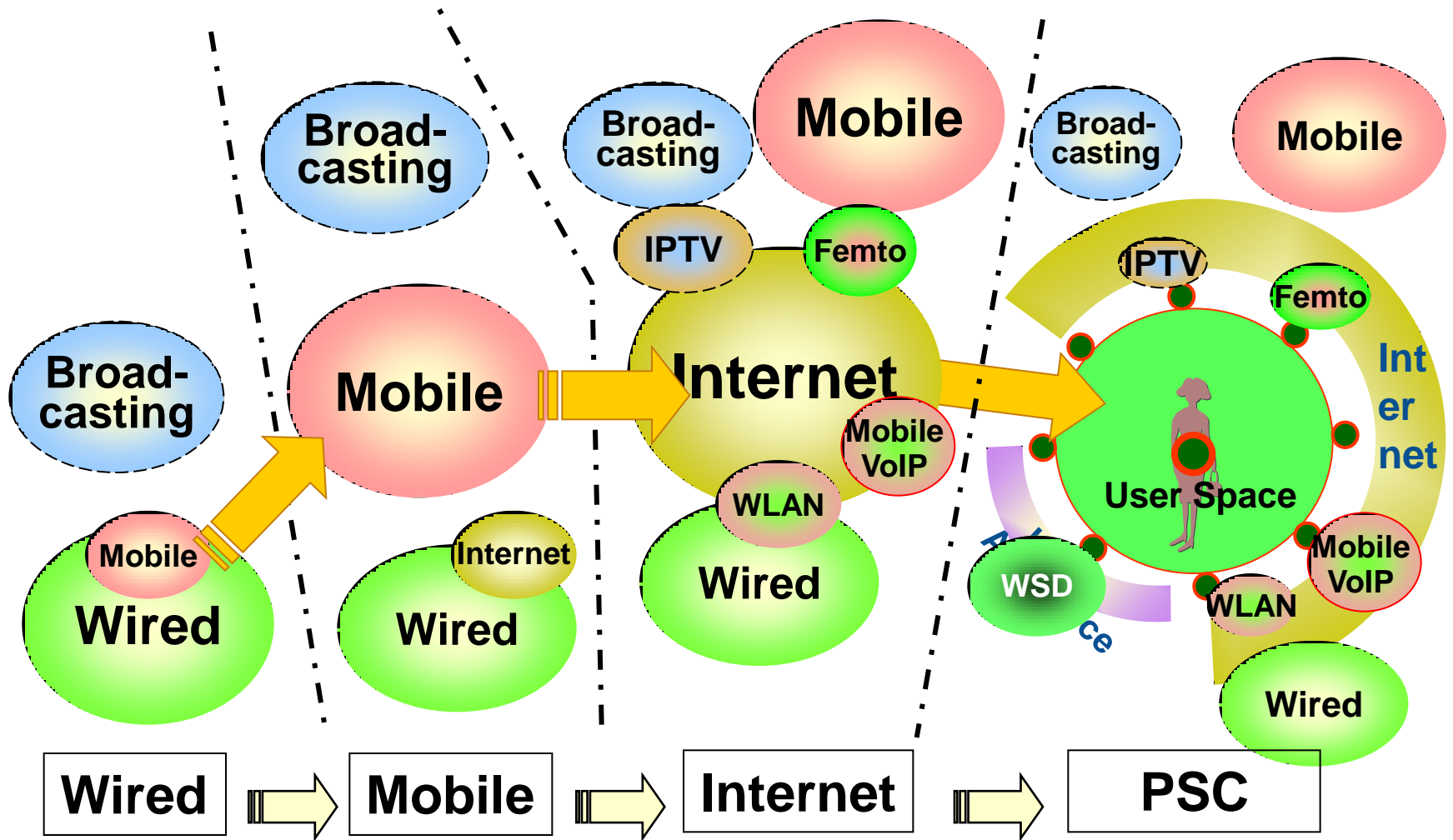
User-Oriented



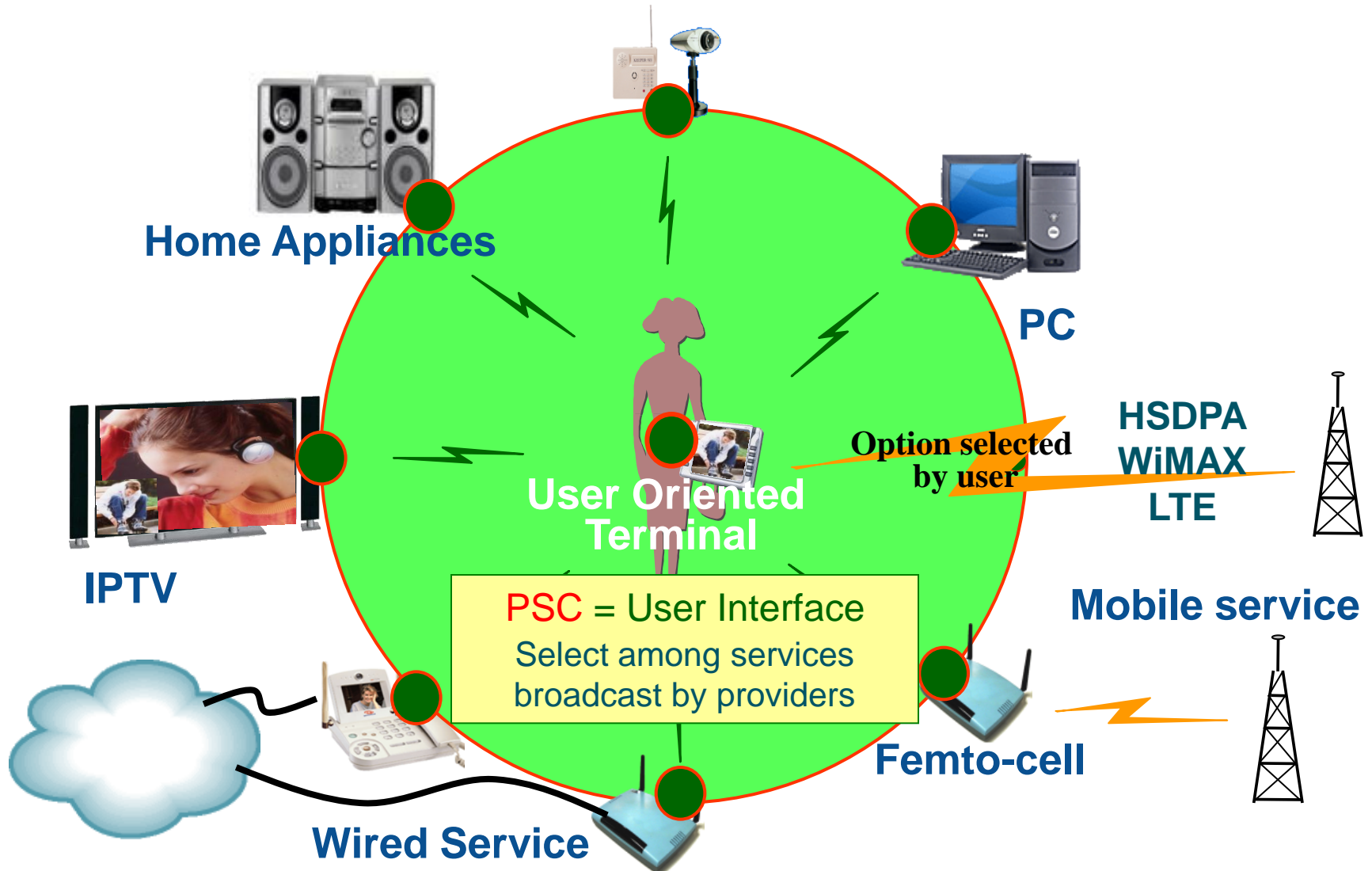
User terminals should meet provider I/F specs.

Providers should translate their services to user I/F spec. within user mobile space.

Power Shift – Personal Space Communication



Power Shift – Personal **Broadcasting** (PicoCast) Service



PSC Scenario –Space Secretary



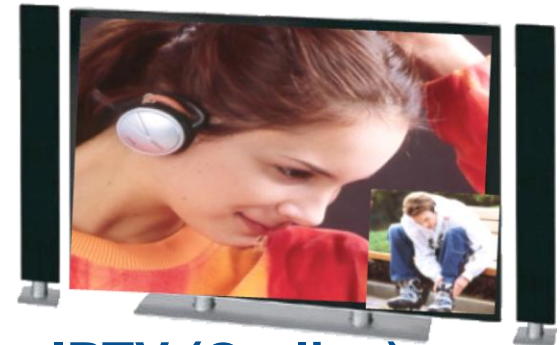
- ✓ Seeing
- ✓ Hearing
- ✓ Feeling

Space Secretary

- ✓ Mobile video
- ✓ Audio / Voice
- ✓ Sensor
- ✓ Location / Direction
- ✓ Control data



Low power & Medium speed
WPAN 2-way Broadcasting

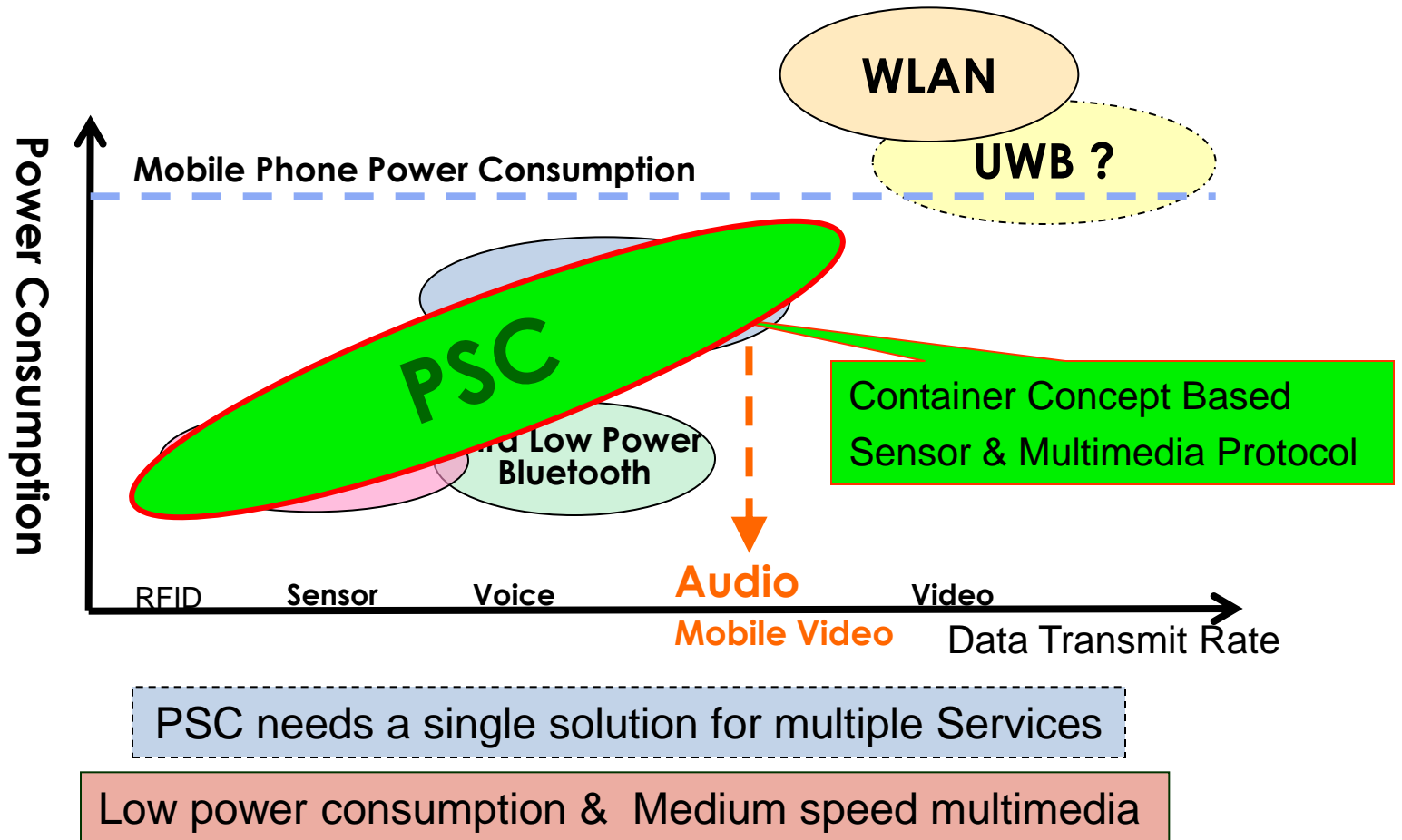


IPTV (On-line)

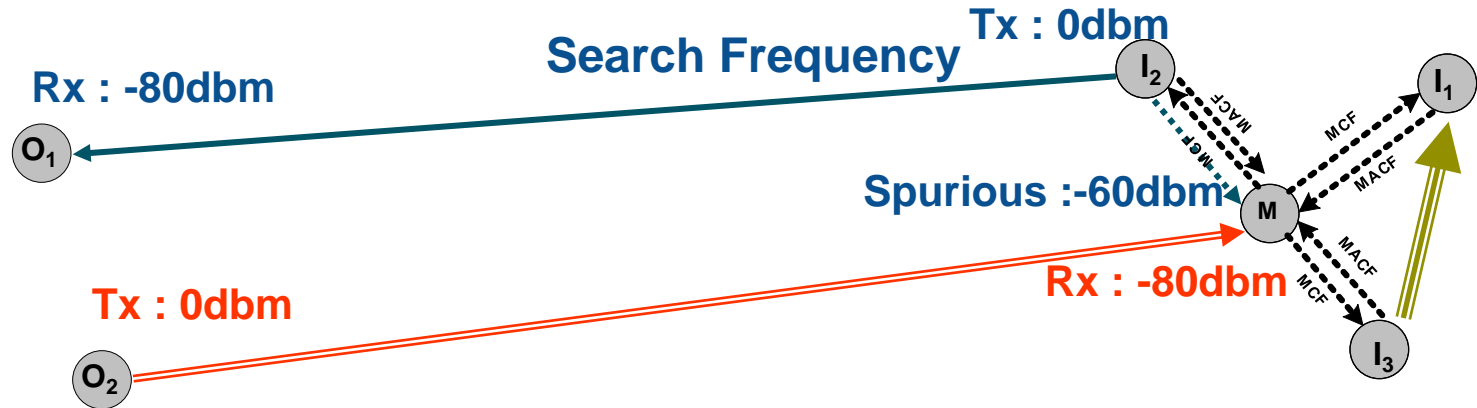


Off-line

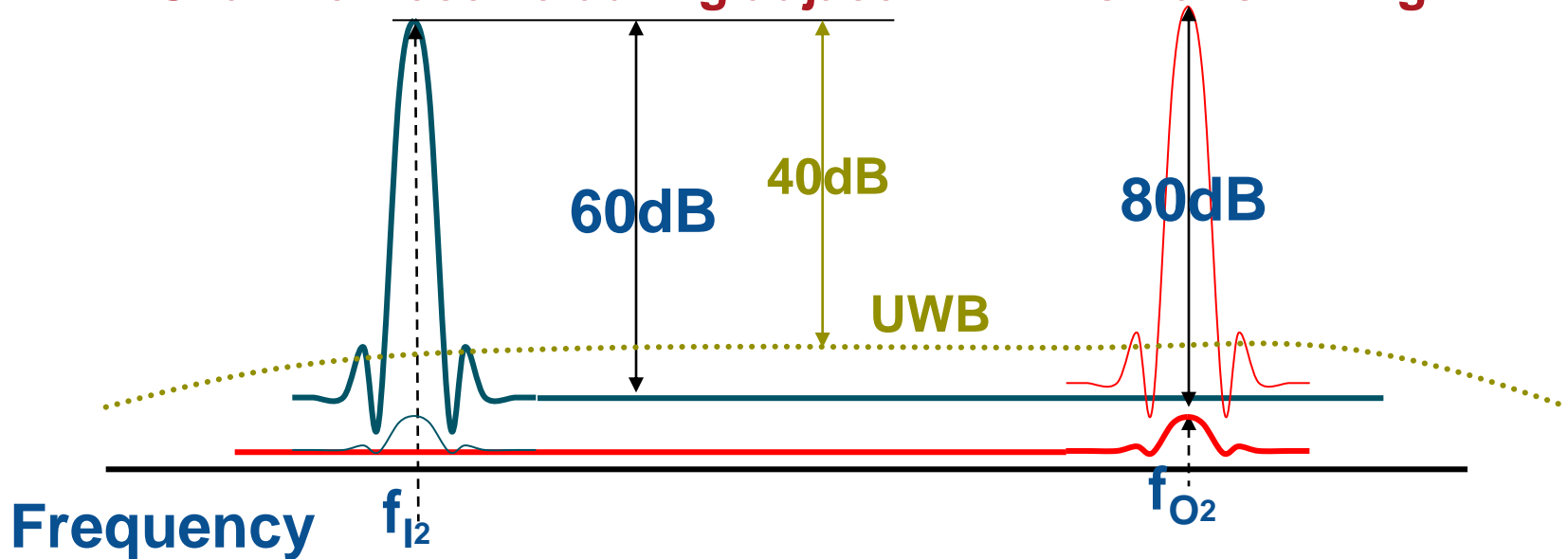
PSC Requirements –Single solution for multiple services



PSC Requirements – Avoid mutual interference

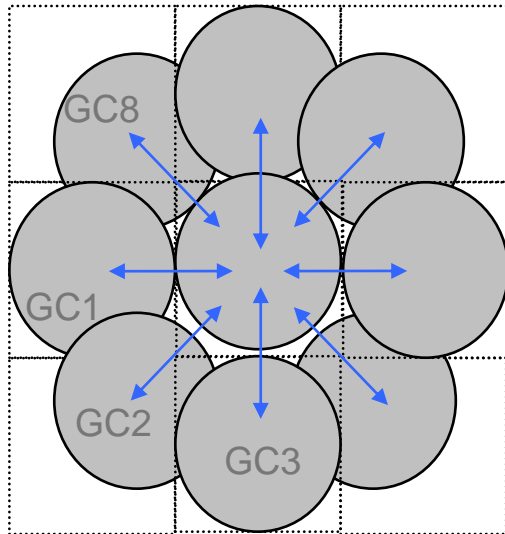


Shall not receive during adjacent PHY is transmitting

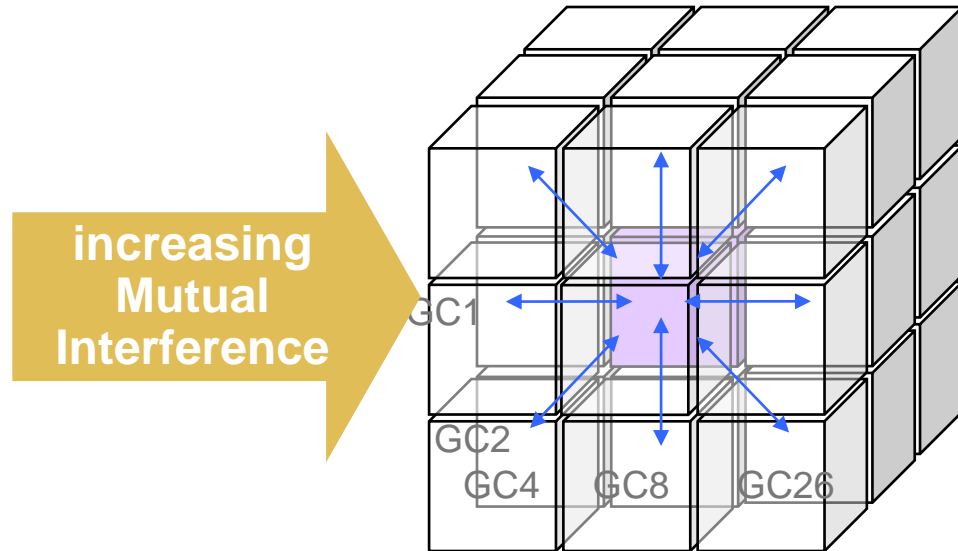


PSC Requirements – 3D Cell Planning

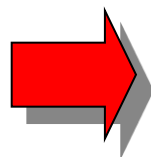
• 2-D



• 3-D

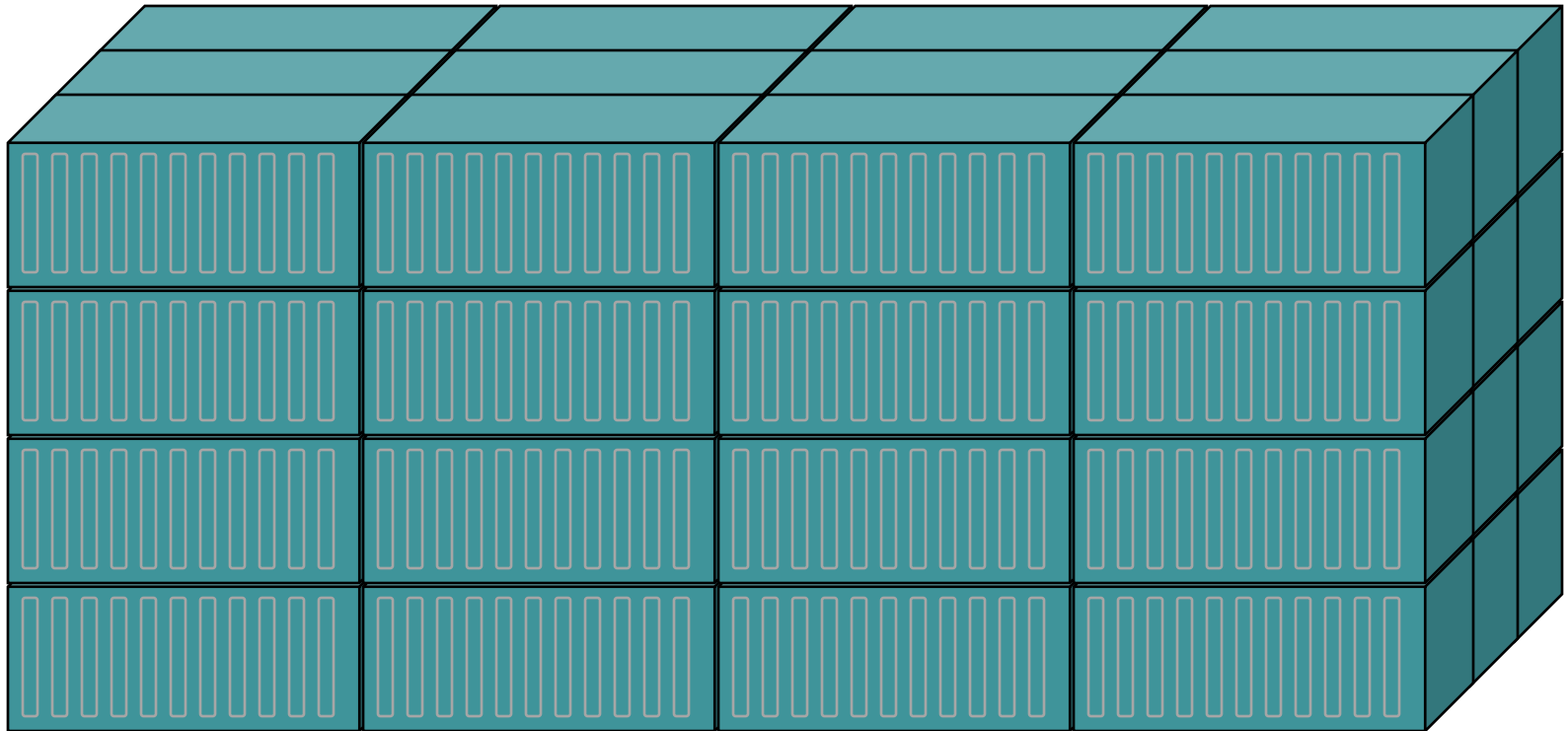


Self Organizing Cell Planning is inevitable



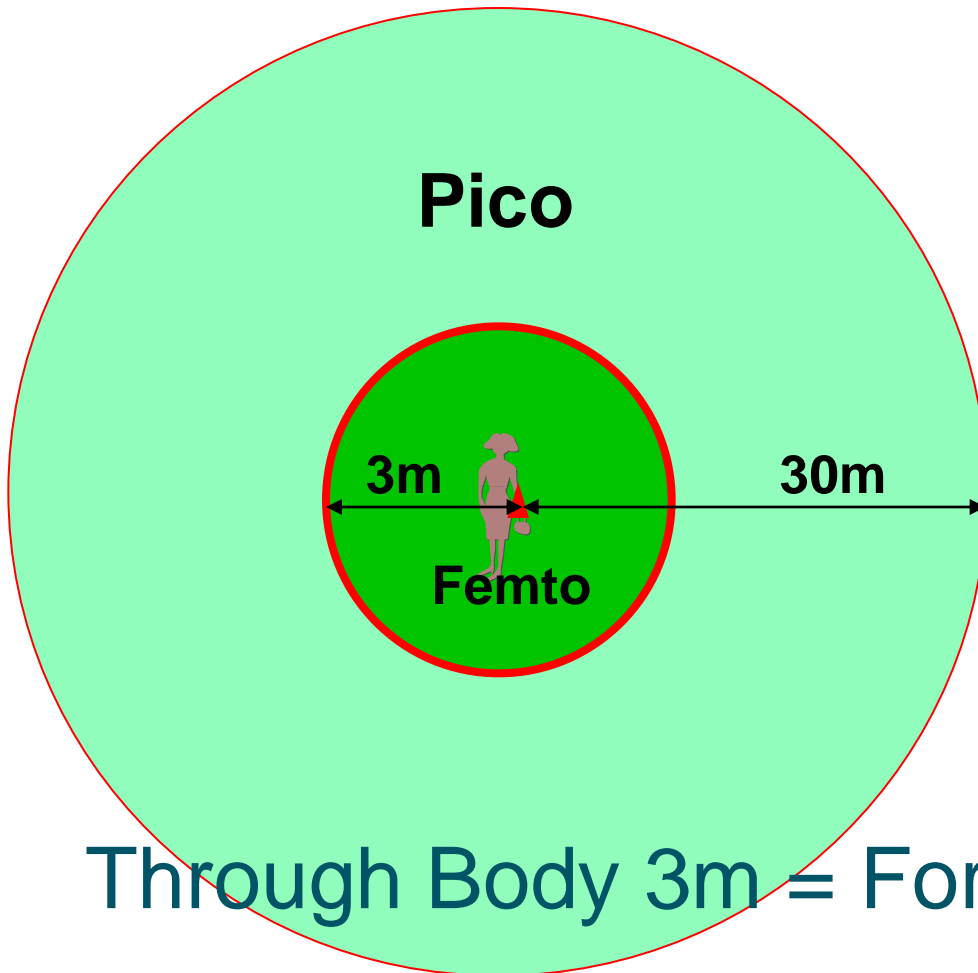
Container Concept is Required to avoid mutual interference in dense environment

PSC Requirements –Container Structure



Higher synchronization performance is required ; 128bits preamble

PSC Requirements – Further considerations



- Open PHY Interface
- Power Control
- Smooth Sliding Sync
- Role Exchange
- QoS Check / Sounding
- Location / Direction
- Emergency Flooding
- Roaming / Hand-over
- Sensor Mesh Relay
- FCC Regulation

Through Body 3m = Forward Body 30m

Part 4

Technical Requirements for PSC IEEE PSC Standard and ISO/IEC29157

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Chair, ISO/IEC JTC 1/SC6

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PSC Characteristics

1. Concurrent Broadcast;

- ❖ Unlimited # of receivers (Synch. frame , No ARQ)

2. Low latency (for Karaoke) ;

- ❖ Mono ; <7msec, Stereo ; <16msec)

3. Flexible Container Structure

- ❖ Low power Sensor & Mobile Video Simultaneously

4. High QoS for real time streaming data

- ❖ Hybrid Time & Frequency Diversity

5. Multiple Preamble for high Synchronization Performance

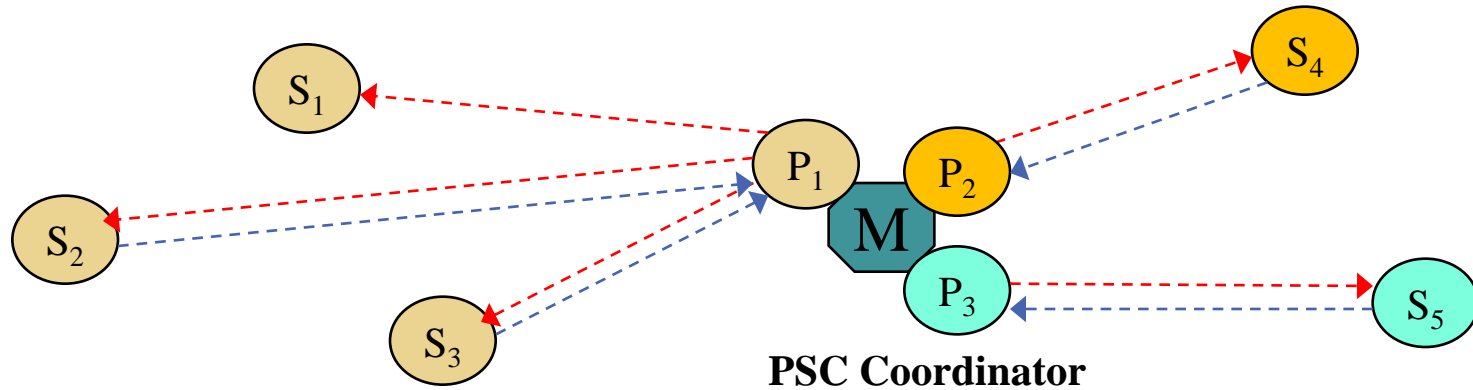
- ❖ # of Preambles : 127 Gold codes (128bits)

PHY(RF) Requirements

❖ Support the operation of Box structure

- Box Size : 400 μ sec ~ 15.2msec
- Basic Data Rate : 4Mbps
- Scalable Data Rate : 250K,500K,1M,2M,4M,8M,16Mbps (option)
- Lock Time : Less than 500 μ sec (230 μ sec recommended)
- End of Box (EOB) : Less than 300 μ sec (40 μ sec recommended)
- Operation Mode : Tx / Rx / Idle / Sleep / Power-off
- Write Parameters : Frequency, Power Level
- Read Parameters : RSSI, Frequency Drift
- Clock Stability : Less than 20ppm

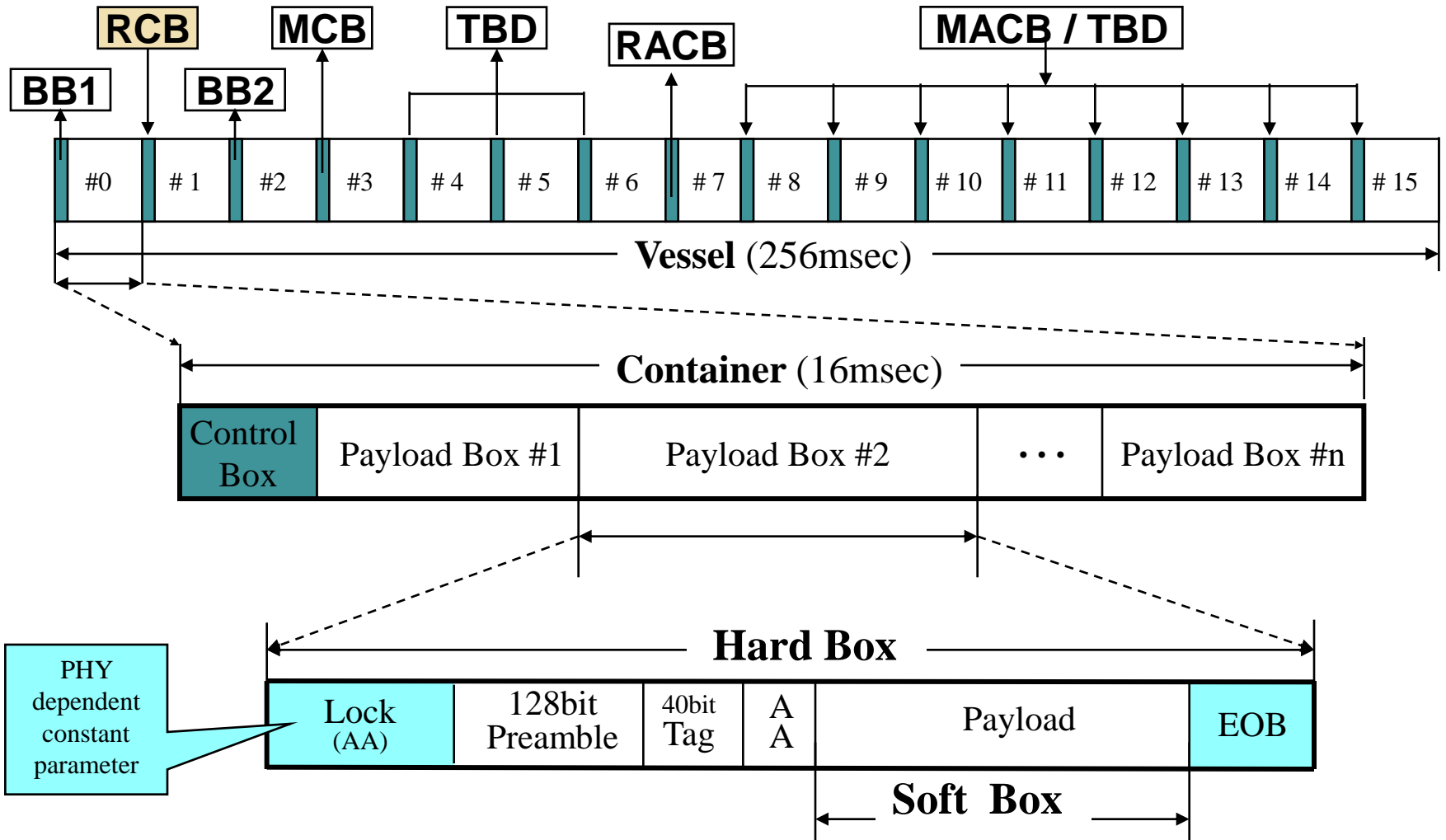
Avoid Interference thru Synchronized Containers



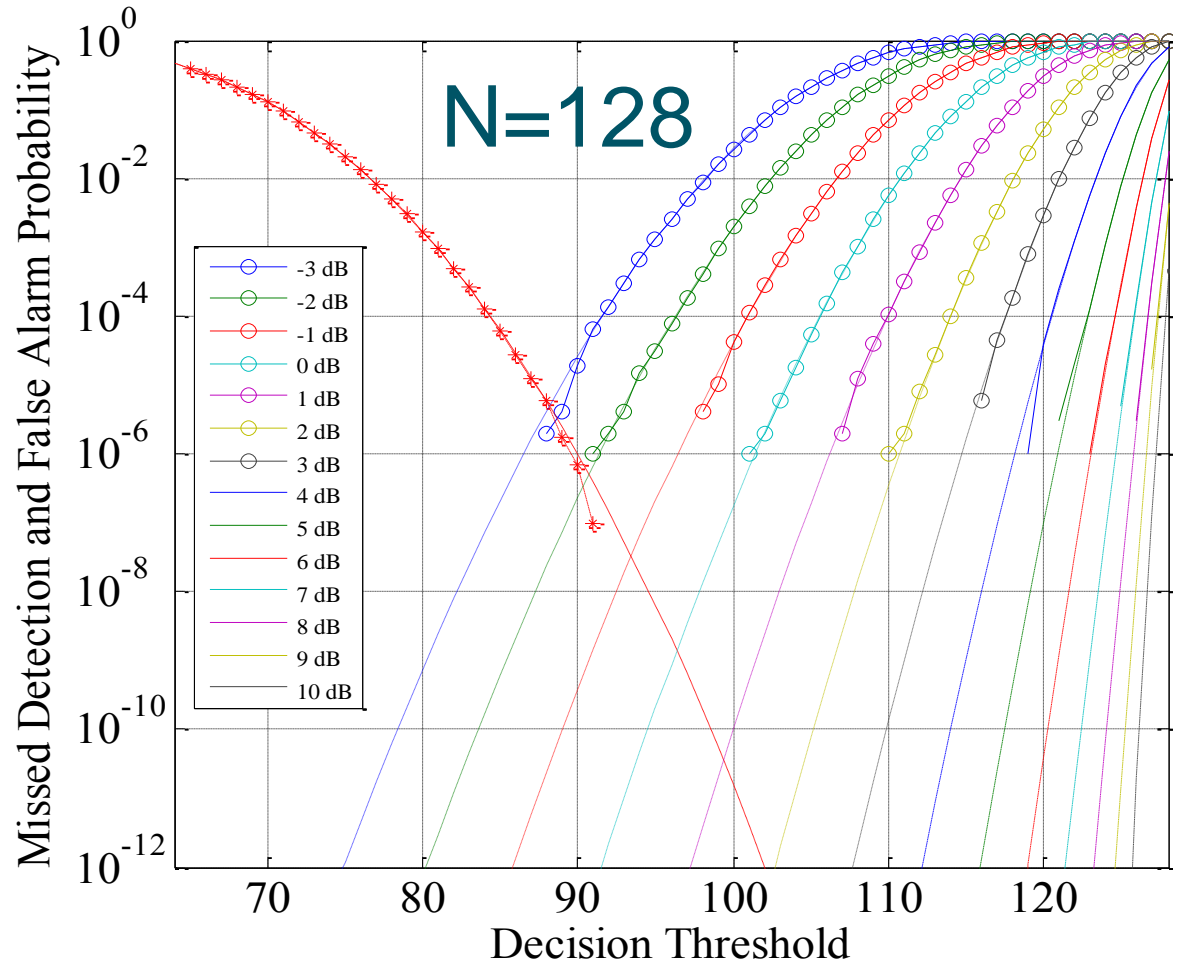
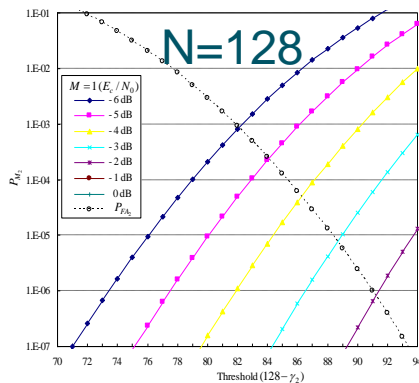
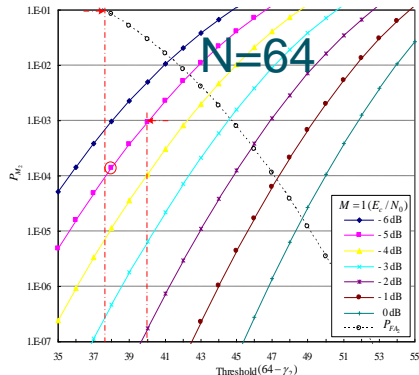
PHY # 1	Tx	Idle	Idle	Idle	Idle	Rx	Idle	Rx
PHY # 2	Tx	Rx	Idle	Tx	Rx	Rx	Idle	Rx
PHY # 3	Idle	Rx	Idle	Tx	Idle	Rx	Tx	Rx

- ❖ **Avoid mutual interference among PHYs in PSC**
 - Shall not receive during adjacent PHY is transmitting.
 - Transmit together at the same time.

Synchronized Container Structure



128bits preambles for synchronization

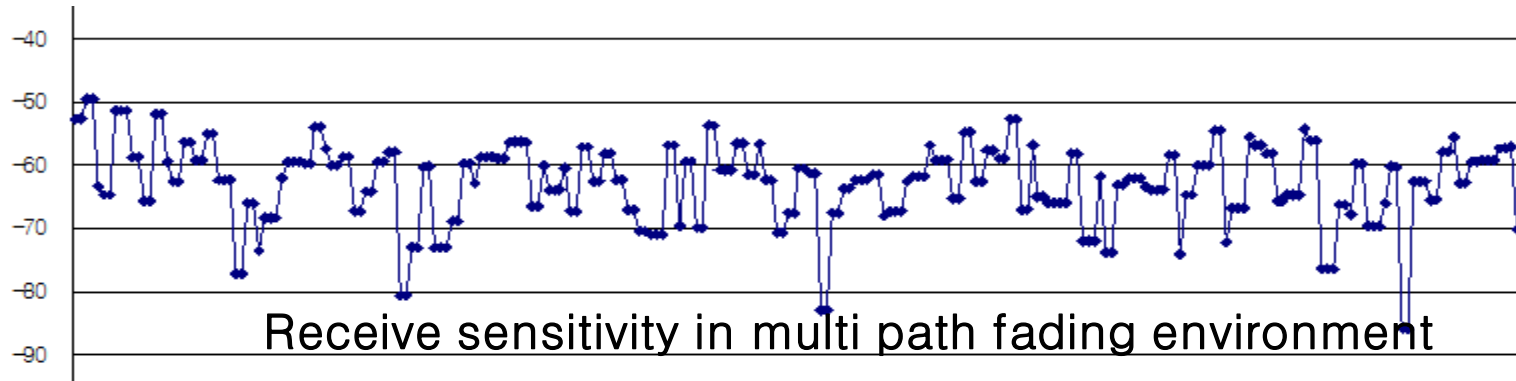


64bit is not enough but 128 bit is high enough ; so we suggest multi Preambles

Multiple Preamble Usage

C_1	Remarks
1 ~ 8 (8)	General Box purpose (Control, Payload)
9 ~ 12 (4)	Hierarchy Beacon Box for synchronization
13 ~ 16 (4)	Pairing Box (Fast Beacon Box)
17 ~ 18 (2)	Sounding Box
19	Secure 1bit/symbol data transmit
20 ~ 35 (16)	Reliable 4bit/symbol data transmit ※ would be substituted by the best code set after simulation study.
36 ~ 41 (16)	Hands over for the local broadcasting
42 ~ 49 (8)	Define Multi-RF to indicate sequence order
50 ~ 127 (except 119)	TBD ; for special PHY applications
119	Emergency

Ensure broadcasting performance without ARQ

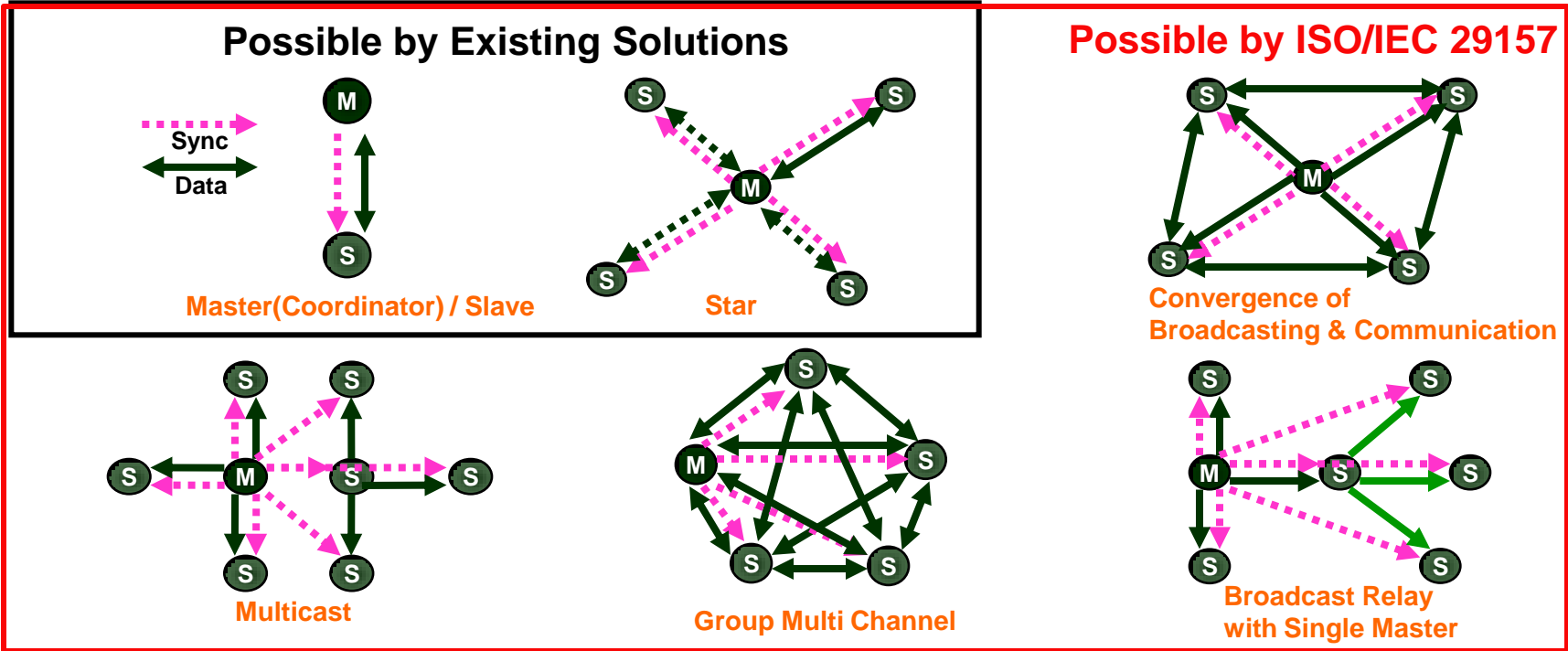


of frame error / # of Sync loss

Test Path	Diversity Mode	Diversity Number				
		1	2	3	4	5
Case A 1 soft wall ~30m	Freq / Time	2700 / 329	106 / 2	9 / 0	1 / 0	0 / 0
	Time with f_1	3601 / 601	2487 / 303	2136 / 254	1945 / 237	1816 / 229
	Time with f_2	2361 / 422	1706 / 185	1457 / 135	1310 / 125	1215 / 111
Case B 2 soft wall ~30m	Freq / Time	8264 / 1272	3545 / 101	1536 / 8	637 / 0	480 / 0
	Time with f_1	4648 / 724	3416 / 424	2976 / 363	2750 / 332	2580 / 309
	Time with f_2	5640 / 961	4287 / 614	3749 / 514	3461 / 460	3280 / 418

Should use frequency / Time hybrid diversity algorithm ; **Frequency Hopping**

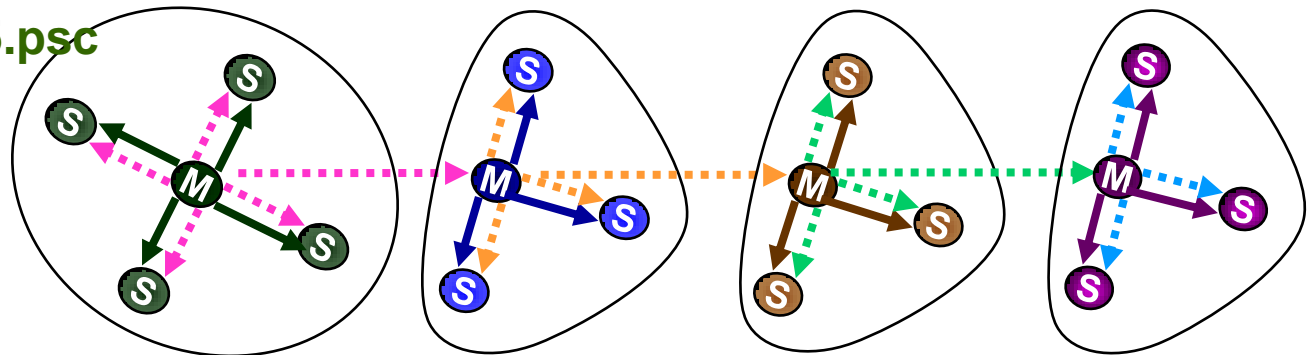
PSC Solution – Protocols



Add to IEEE802.15.psc

Sync Relay

- Ad-hoc
- Hand-over



Overview of ISO/IEC 29157

- ❖ **Why ISO/IEC29157(PicoCast) is suitable for PSC service ?**
 - **Container concept supports both low-power sensor & medium-speed multimedia.**
 - **Abundant channel capacity due to avoidance of mutual interference.**
 - **Provides broadcast, multicast & communication convergence protocol.**
 - **Local broadcasting gives an additional business model such as advertisement.**
 - **Adaptive common channel signaling supports mobile communication protocols.**

Proposal	February 5, 2008
NP	<ul style="list-style-type: none">■ Ballot: February 5, 2008 – May 5, 2008■ Meeting: Geneva, Swiss, April 6 – 11, 2008■ Meeting: Montreux, Swiss, November 3 – 7, 2008
CD	Ballot: November 18, 2008 – February 18, 2009 Meeting: Tokyo, Japan, June 1 – June 5, 2009
FCD	<ul style="list-style-type: none">■ Ballot: July 14, 2009 – November 14, 2009■ Meeting: Barcelona, Spain, January 18 – 22, 2010

Upgrading Points for PSC Standard

		ISO/IEC 29157	IEEE802.15.PSC	
P H Y	media	2.4G ISM,	Unlicensed Band	
	speed	1Mbps	~ 4Mbps	
M A C	protocol	P-P, Star, broadcast, Multicast, multi-direct, broadcast relay	← Sync relay, Mesh	
	PHY interface	Single	Multiple	
	Container	Hard Box, 128bit preamble	Hard & Soft Box 0 ~ 128bit preamble	

Comparison of Low Power Wireless Solutions

Types	WiFi	DECT	ZigBee (RF4CE)	Bluetooth (Wibree)	PSC (PicoCast)
Speed (bps)	54M	96K	250K	1M (3M)	4M (16M)
Broadcasting (Local Ad.)	△	△	△	X	O
Hands Free	X	△	X	O	O
Mobile VoIP	O	O	X	X	O
2-way Remote	X	X	△	△	O
Conference	△	X	X	X	O
Microphone	X	X	X	X	O
Stereo Ear-set	X	X	X	O	O
TV, Game Headset	X	X	X	X	O
Mobile Video	O	X	X	△	O
5.1ch Speaker	O	X	X	X	O
Sensor	X	X	O	△	O
Container	X	X	X	X	O

Part 5

PSC as mobile carrier business

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1G



3G



Device Fragmentation source: Svein Therkelsen, mBricks, 2008
 (handsets, operating system, security and network technologies)

notebooks, other form factors, TV, STB	OS X, Android, S60, Linux - html7, applets	login, OTP, EAP-SIM, - AKA,....	802.11, .16, LTE++, frequency
-------------------------------------------------------	-----------------------------------------------------------	------------------------------------------------	----------------------------------------------

Source: Josef Noll, 5G Comm, Oct.2009



4G

All Roads Lead to LTE

Logos shown above the arrow: SK telecom, KT, Telstra, Verizon, KDDI, 中国电信 CHINA TELECOM.

Logos shown below the arrow: at&t, TDMA, 中国移动通信 CHINA MOBILE, TD-SCDMA.

Technologies along the path: GSM, W-CDMA, HSPA, LTE, 4G.

- China Telecom, KDDI and Verizon Wireless join the GSMA
- All 3 operators commit to LTE technology for future Mobile Broadband deployments
- Qualcomm join the GSMA as Associate Members
- 74 mobile operators globally have now committed to LTE

MOVING TO A GLOBAL MOBILE STANDARD

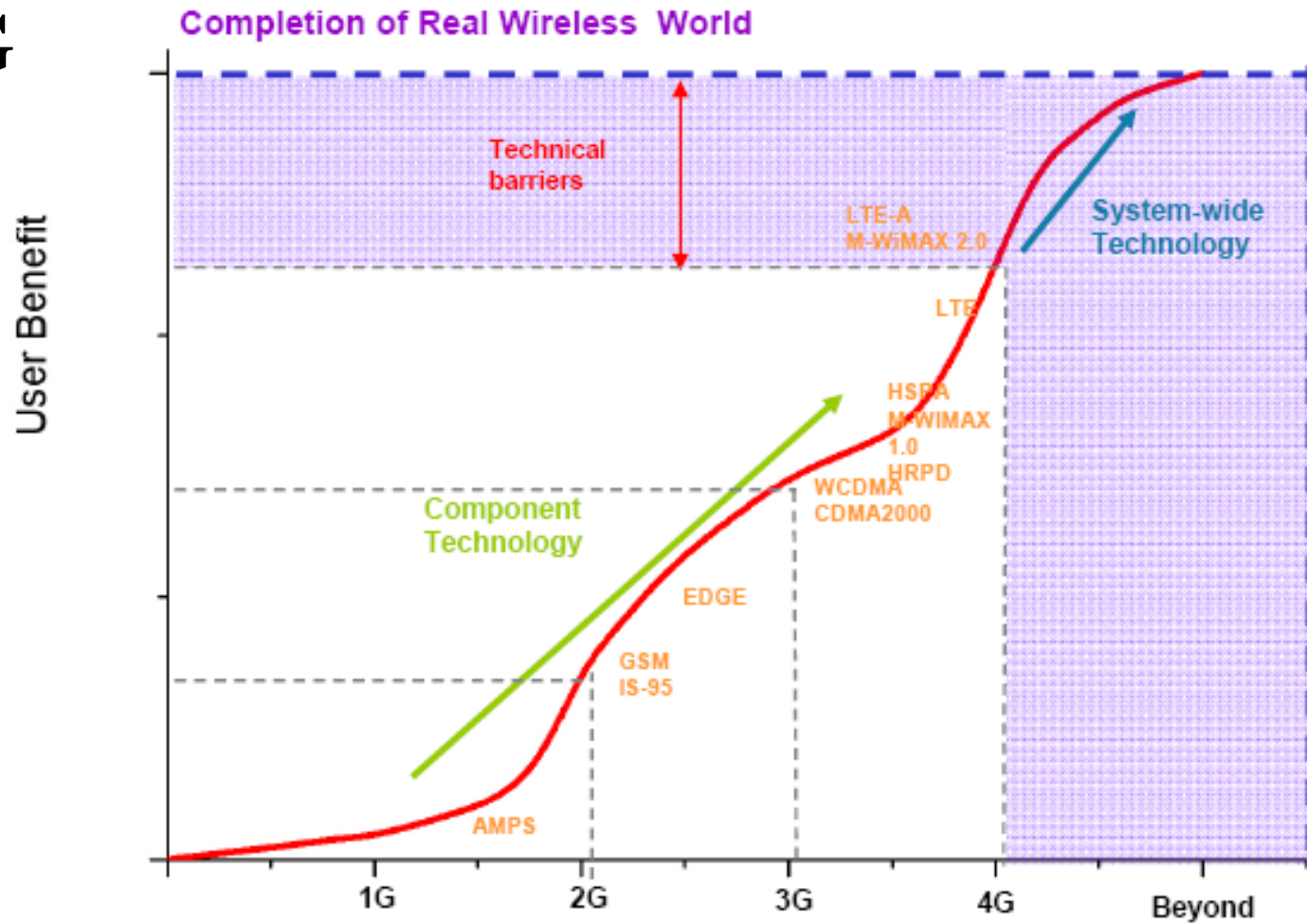
© GSM Association 2010

Source : Rob Conway @WMC 2010, Feb. 2010

3GPP /GSMA may simplify some 3G issues ... but not enough!

Approach toward future mobile communication

5G

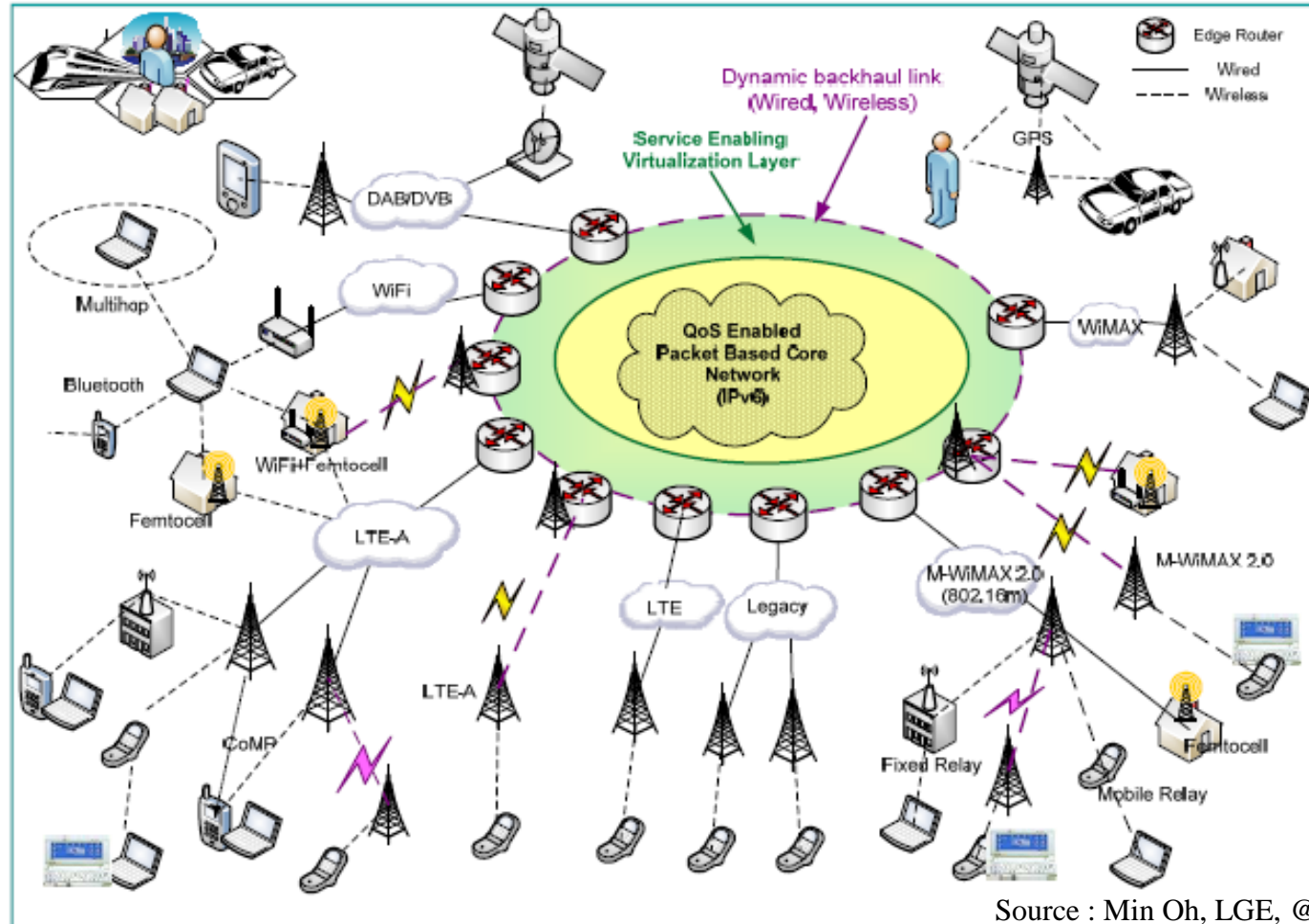


Source : Min Oh, LGE, @Krnet 2009

Paradigm shift to System-wide technology

5G

Future Network Architecture (Year 2020)



Source : Min Oh, LGE, @Krnet 2009

- Pervasive and Trustworthy Network
- Capacity/coverage extension by relay nodes
- Dynamic wireless backhauls
- Seamless handover by layer virtualization

But Still ... ?



Device Fragmentation source: Svein Therkelsen, mBricks, 2008
(handsets, operating system, security and network technologies)

**notebooks,
other form
factors, TV, STB**

**OS X, Android,
S60, Linux -
html7, applets**

**login, OTP,
EAP-SIM, -
AKA,....**

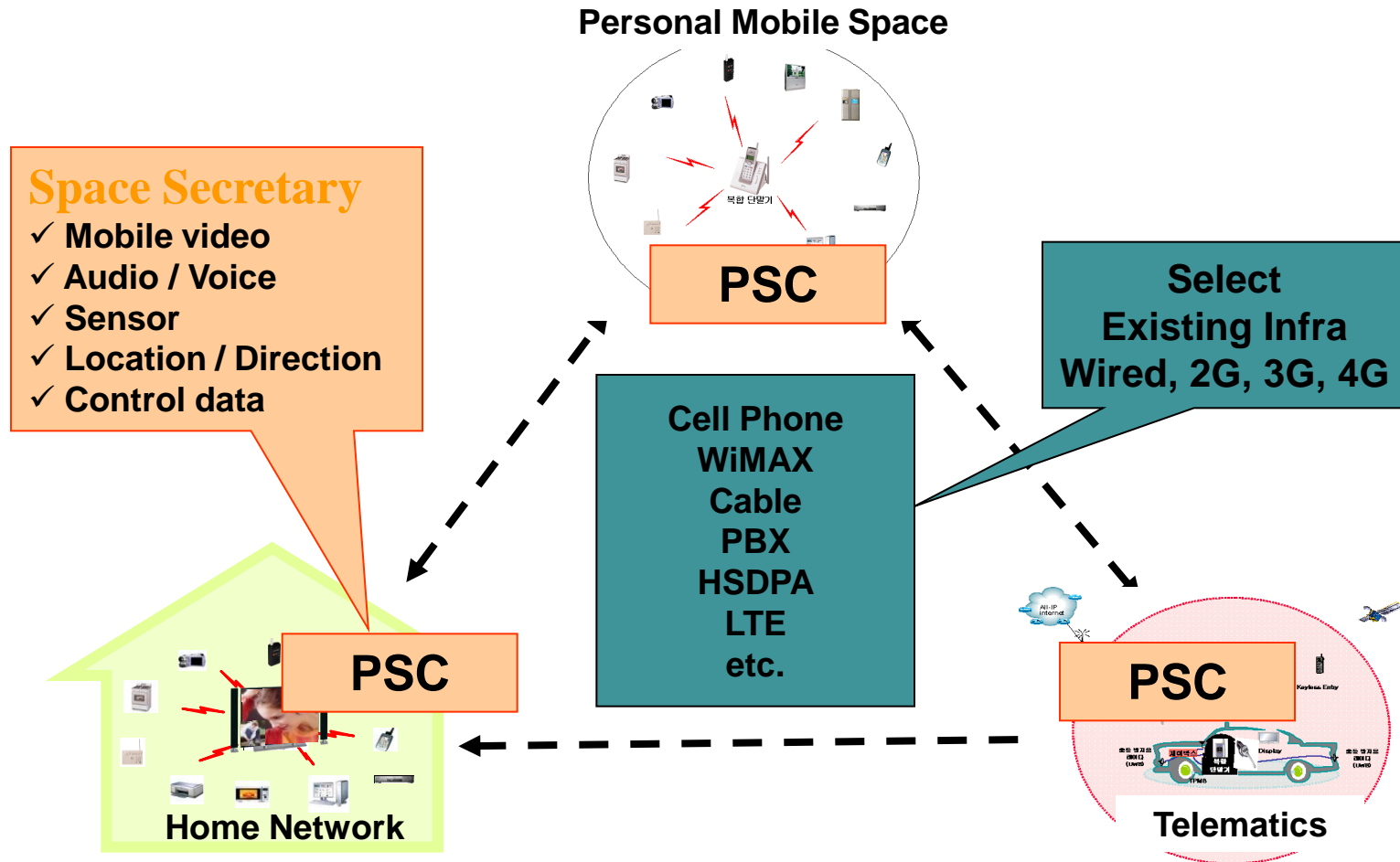
**802.11, .16,
LTE++,
frequency**

Source: Josef Noll, 5G Comm, Oct.2009



Service Fragmentation :
Power, TV, Phone, Security, ...

Why PSC is so important ? ; 5G infra

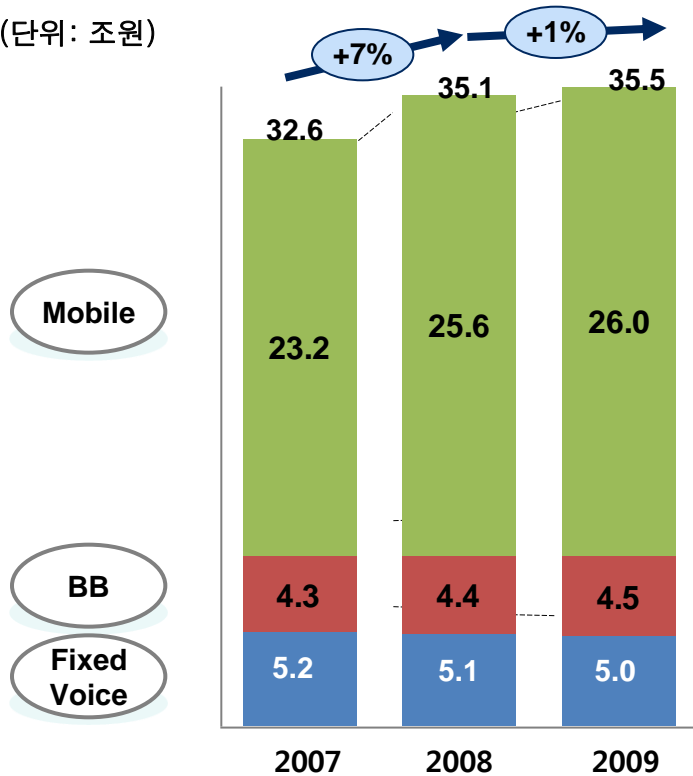


In the future, most of users want to maintain their environment mobility within a moving personal space. So, Personal Space Communication(PSC) based on WPAN technology would be leading & killer application of Ubiquitous services in the future. We can view 5G mobile communication is simply the connections of the PSC spaces.

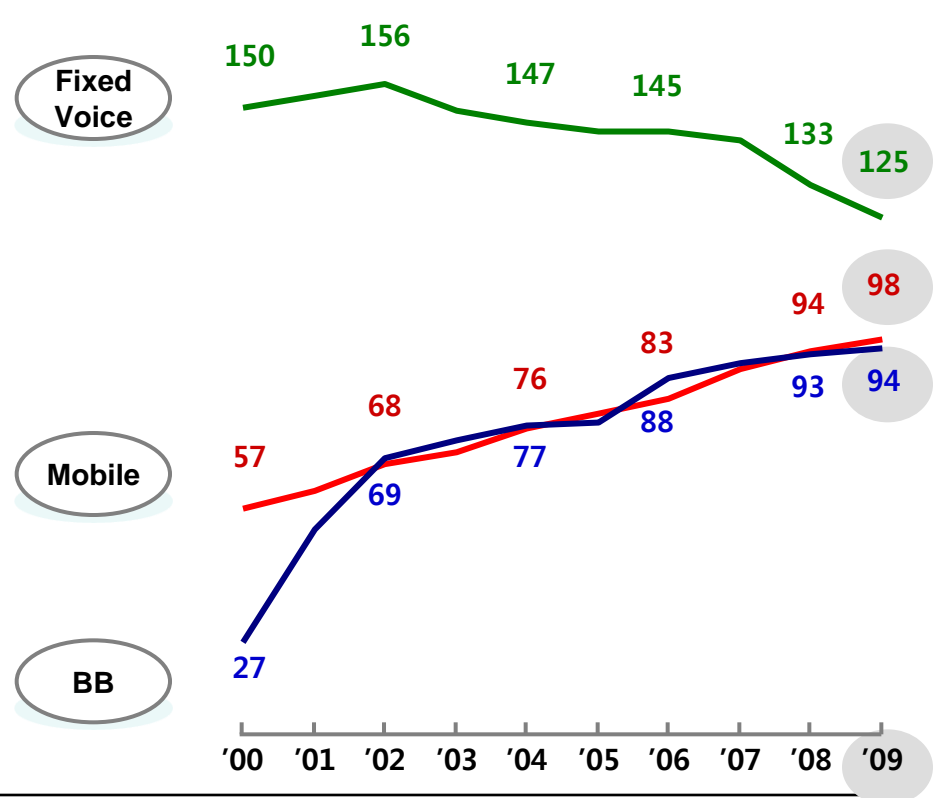
Telco Market status : Korea

Korean Telco Market (T Won)

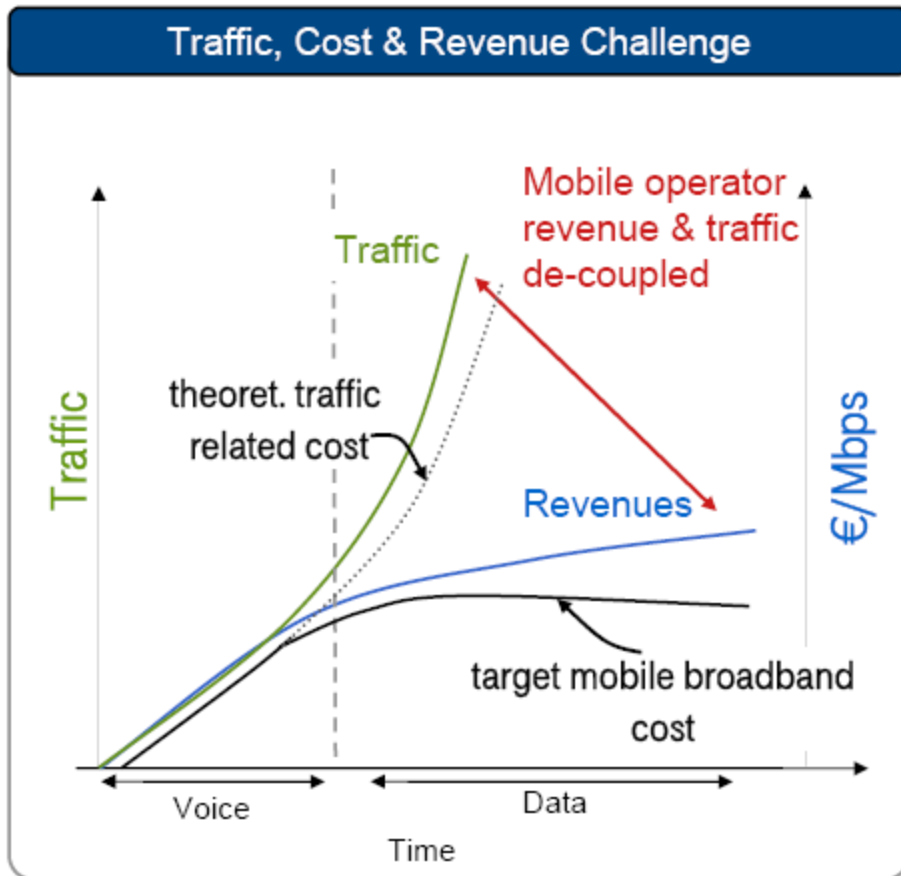
(단위: 조원)



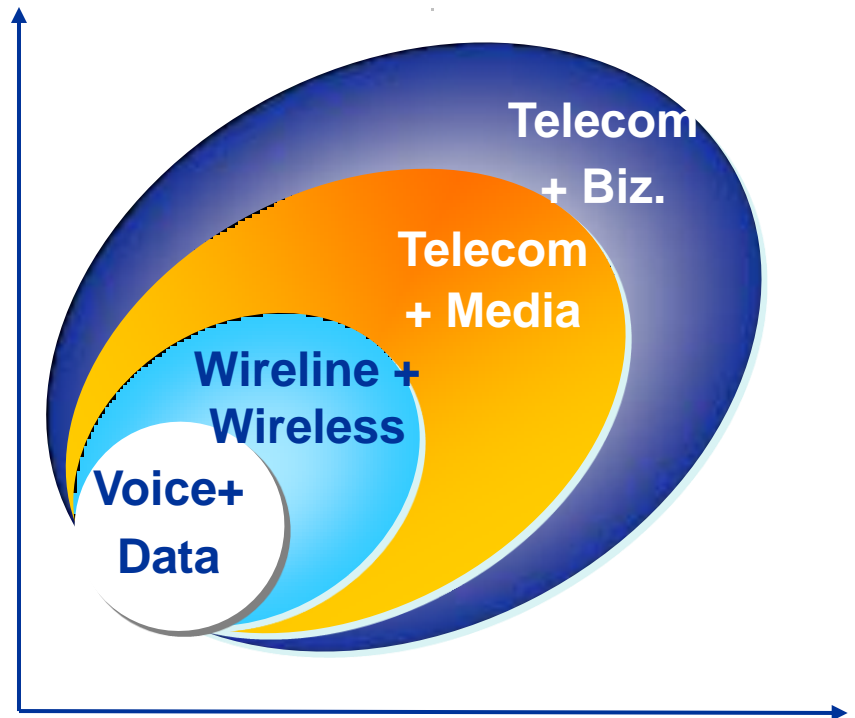
Subscriber Penetration Rate (%)



Telco Market status : Global



脱 通信 (Beyond Telco)
by PSC/5G



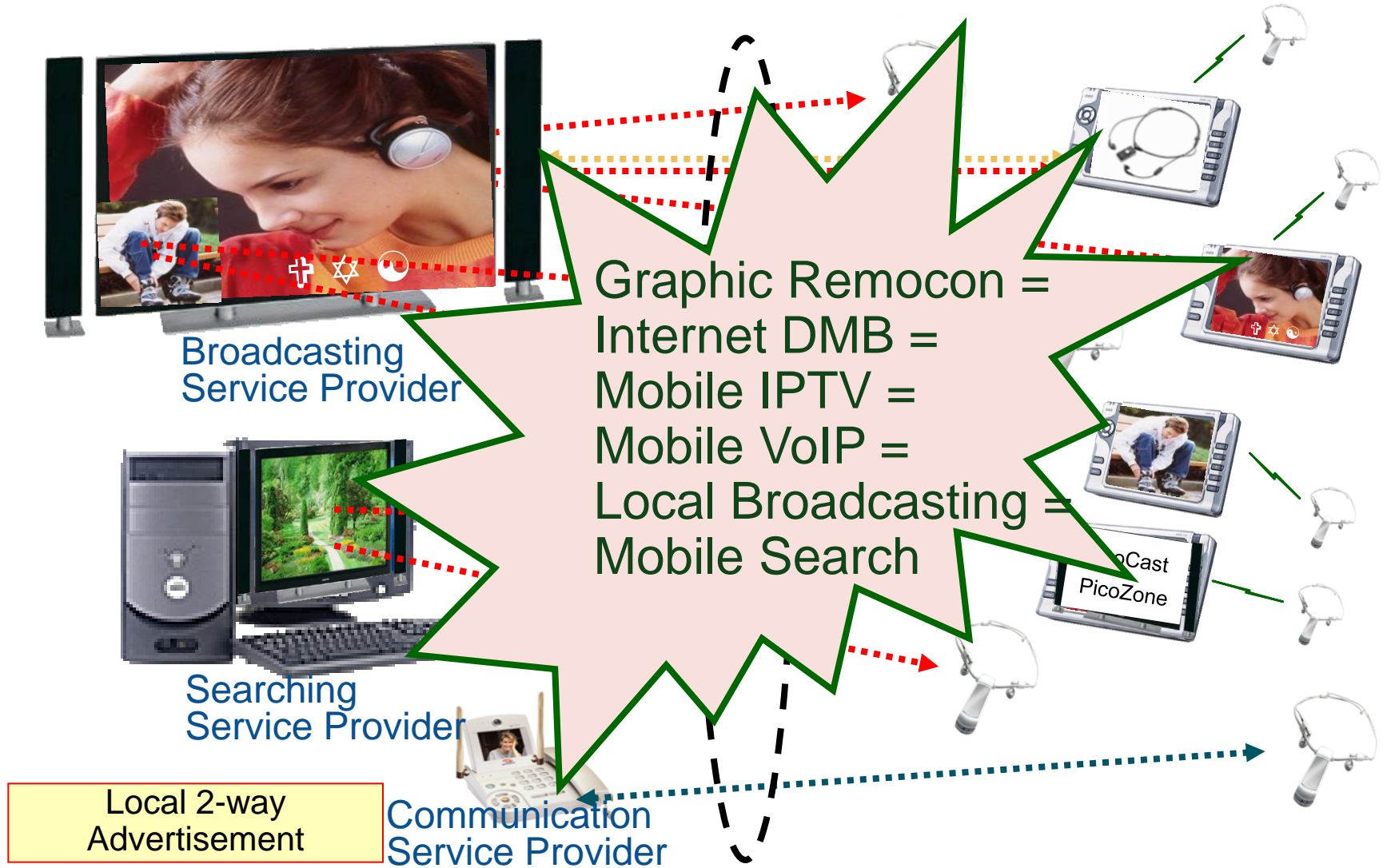
5G : Network Transformation and Business Model Transformation

User Scene : Daily life of a youth with PSC

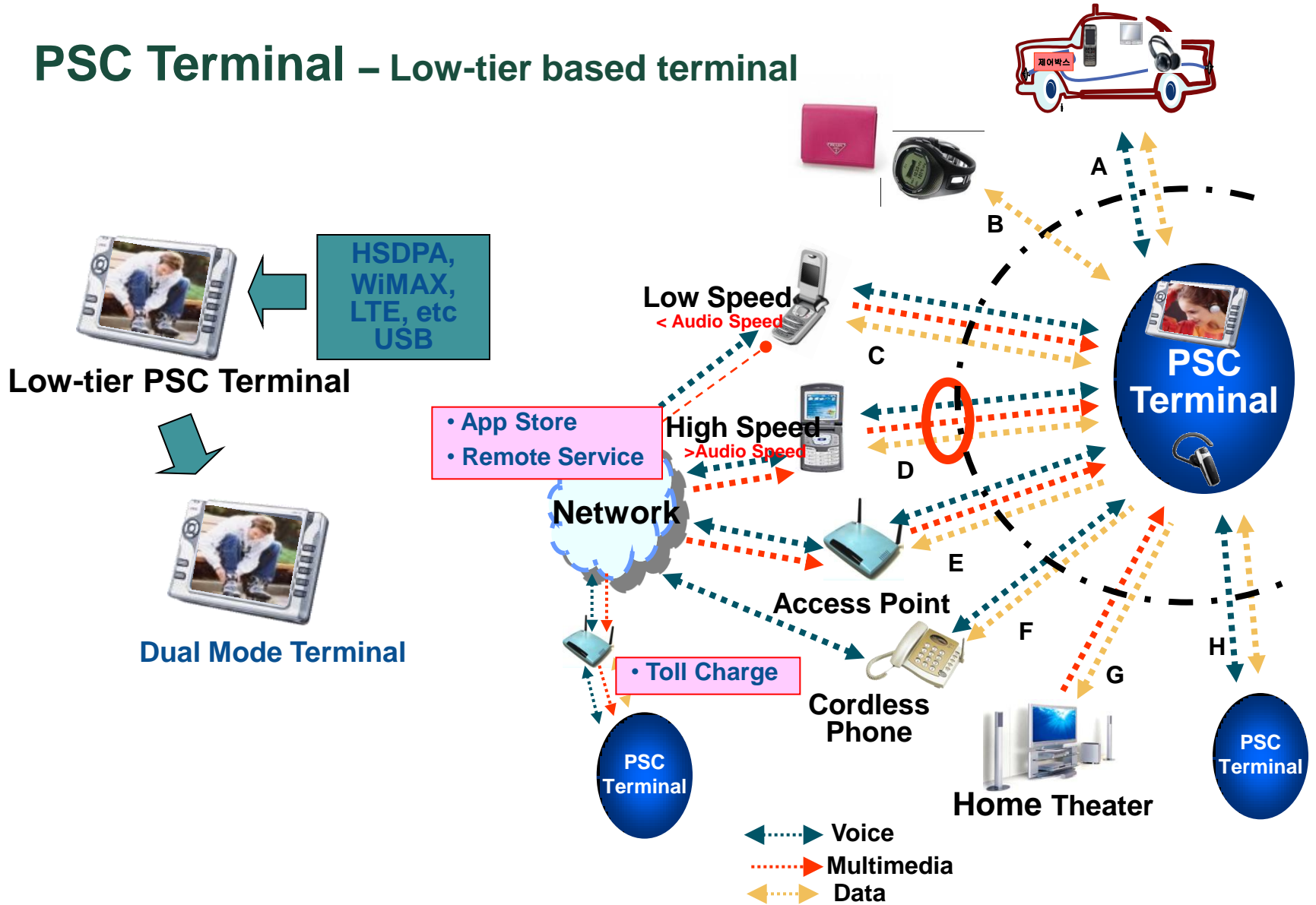


... Seamless Authentication, Macro/Pico Zone, Common Terminal

User Scene : 2-way Graphic Remote controller



PSC Terminal – Low-tier based terminal

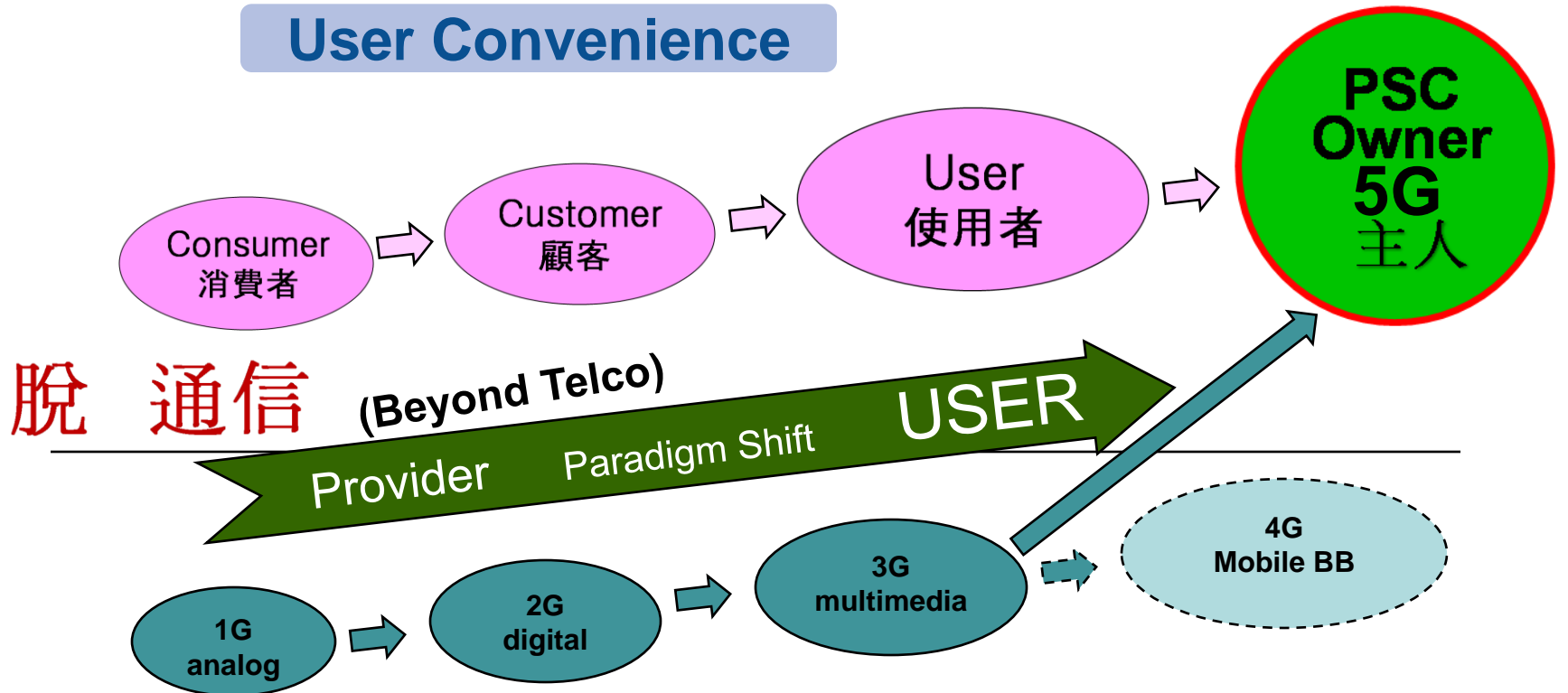




Your Personal Value Provider

Device & Service Convergence

User Convenience



Part 6

PSC Interest Group Schedule for PSC IG & SG

Q & A

Mr. P. Murray

Chairman PSC Interest Group

petermurr@mac.com