ITU-T Workshop on Bridging the Standardization Gap and Interactive Training Session

(Cyberjaya, Malaysia, 29 June – 1 July 2010)

Business Experience in Implementation of WiMAX

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International Telecommunication Union

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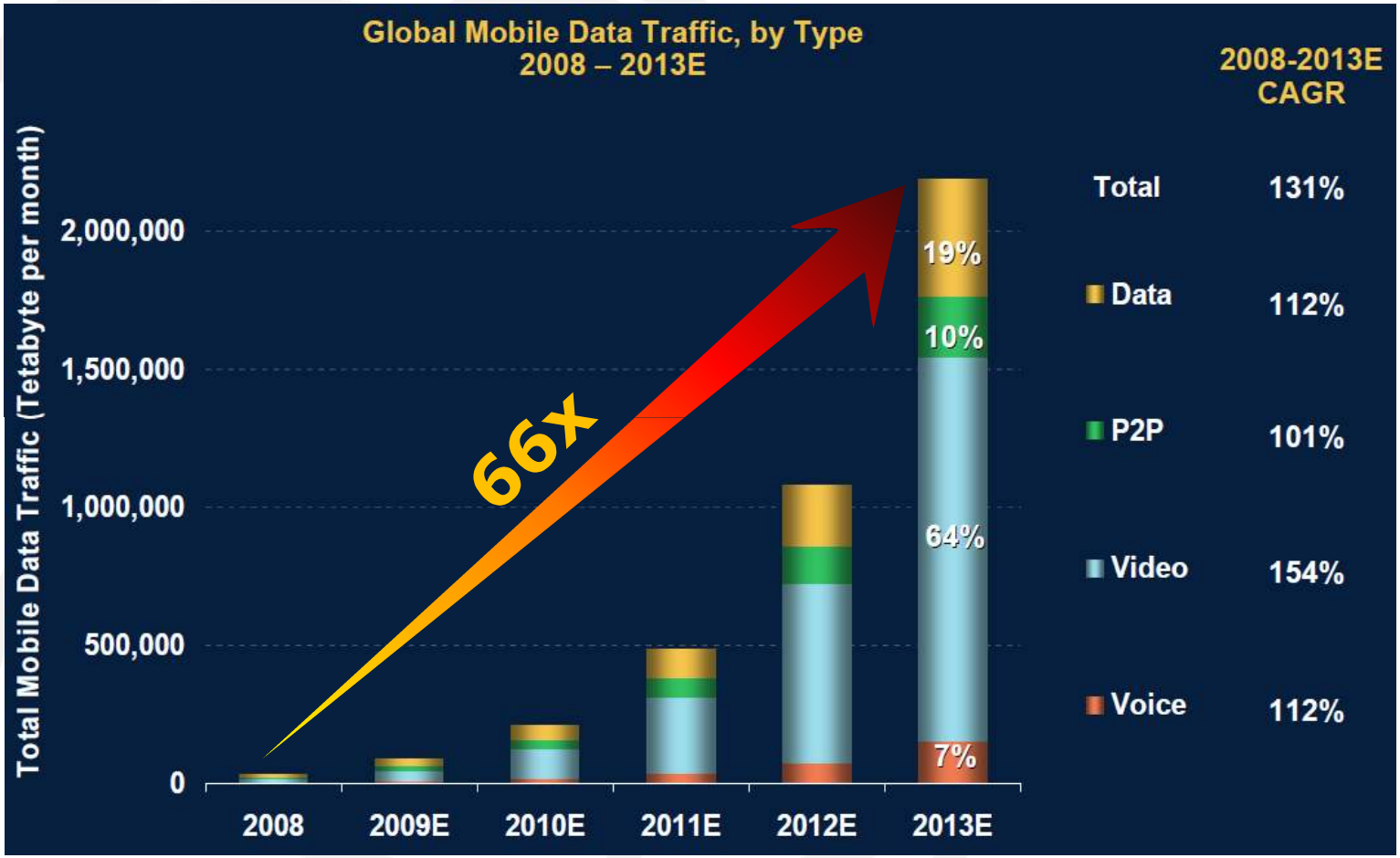
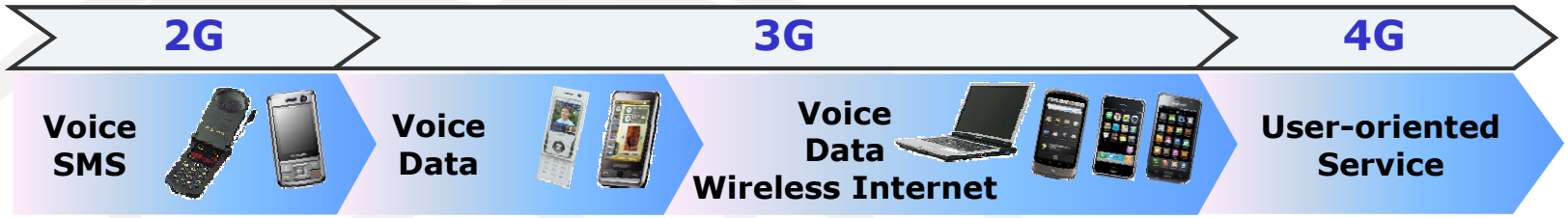
IMT-Advanced Standardization

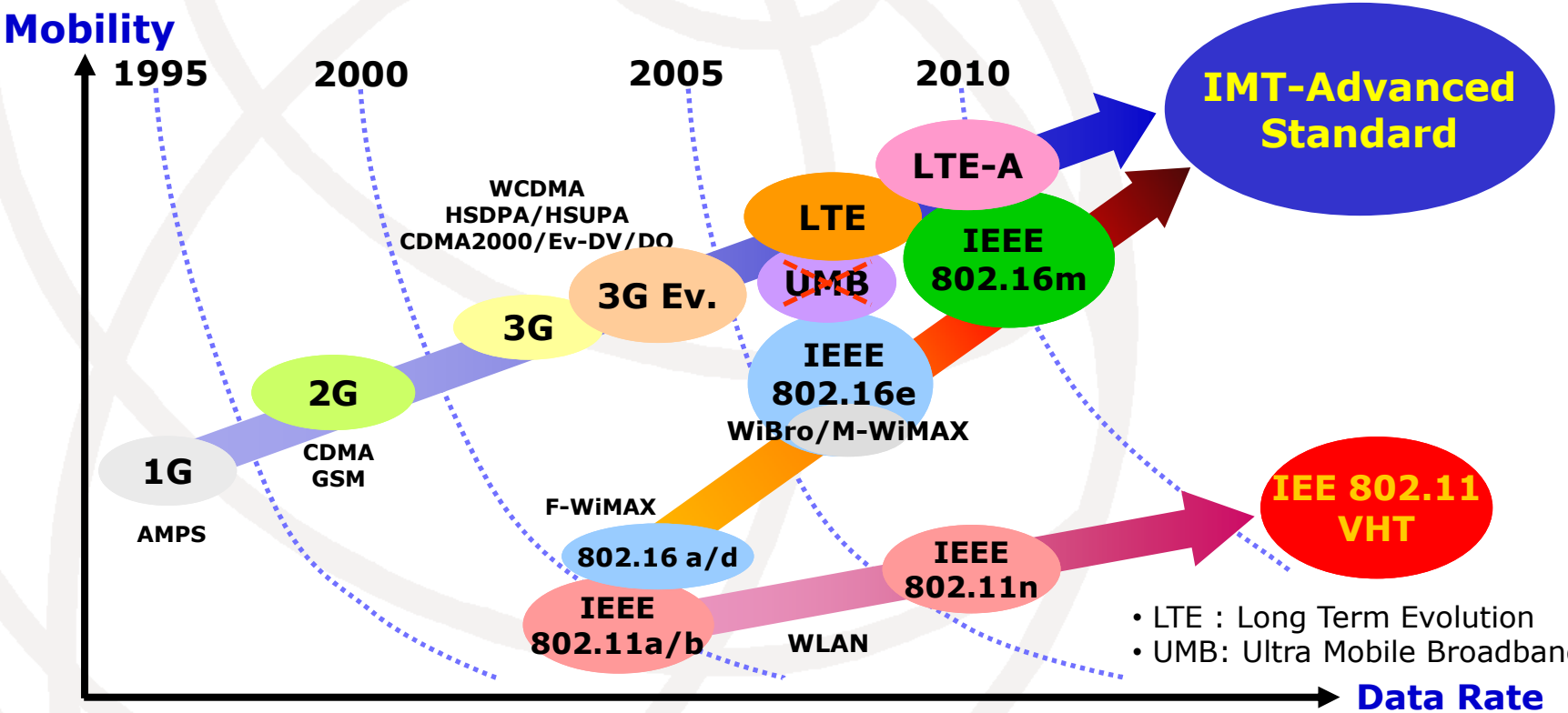
Mobile Data Explosion



- Source: Cisco Visual Networking Index

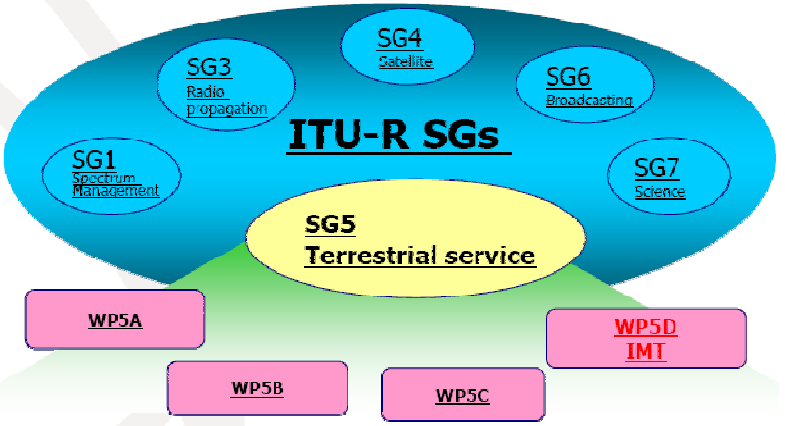
Evolution Path in Standardization toward IMT-Advanced





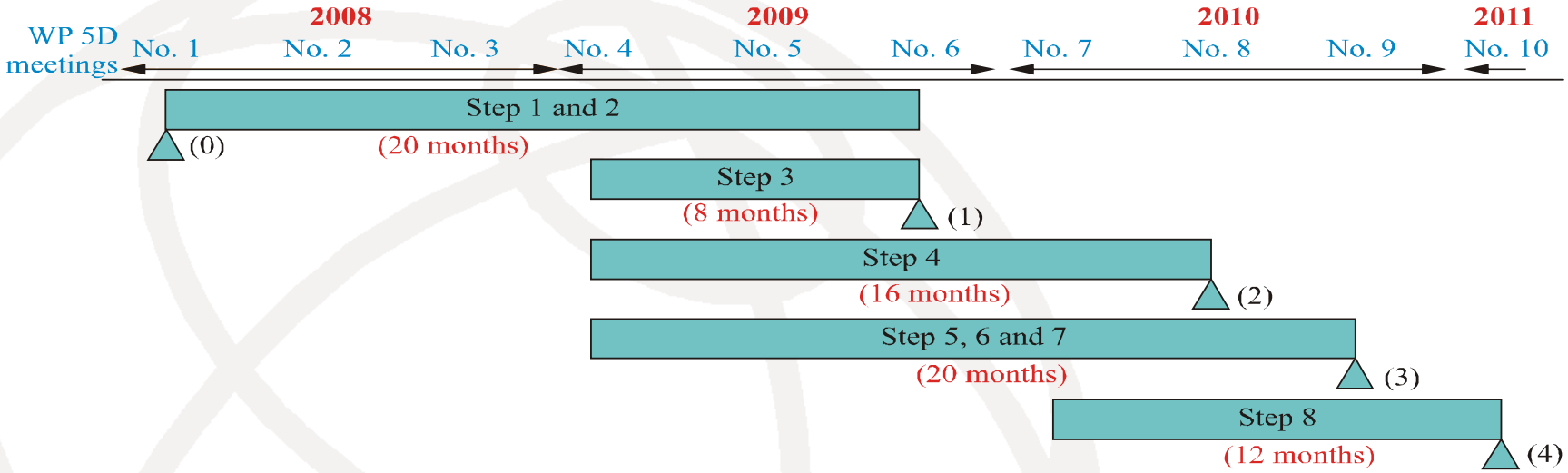
IMT-Advanced

- Official name of 4G defined by ITU-R SG5 WP8F [TG8/1('85)→WP8F('00)→WP5D('08)]
- Key features
  - Worldwide commonality
  - Service compatibility
  - Interworking capability
  - High-quality mobile service
  - Worldwide usability of user equipment
  - User-friendly applications, services and equipment
  - Worldwide roaming capability
  - Enhanced peak data rates



- Candidate RIT
  - 3GPP LTE-Advanced, IEEE 802.16m

IMT-Advanced Standardization Schedule



Steps in radio interface development process:

Step 1: Issuance of the circular letter
Step 2: Developement of candidate RITs and SRITs
Step 3: Reception of the RIT and SRIT submissions and acknowledgement of receipt
Step 4: Evaluation of candidate RITs and SRITs by evaluation groups
Step 5: Review and coordination of outside evaluation activities
Step 6: Review to assess compliance with minimum requirements
Step 7: Consideration of evaluation results, consensus building and decision
Step 8: Development of radio interface Recommendation(s)

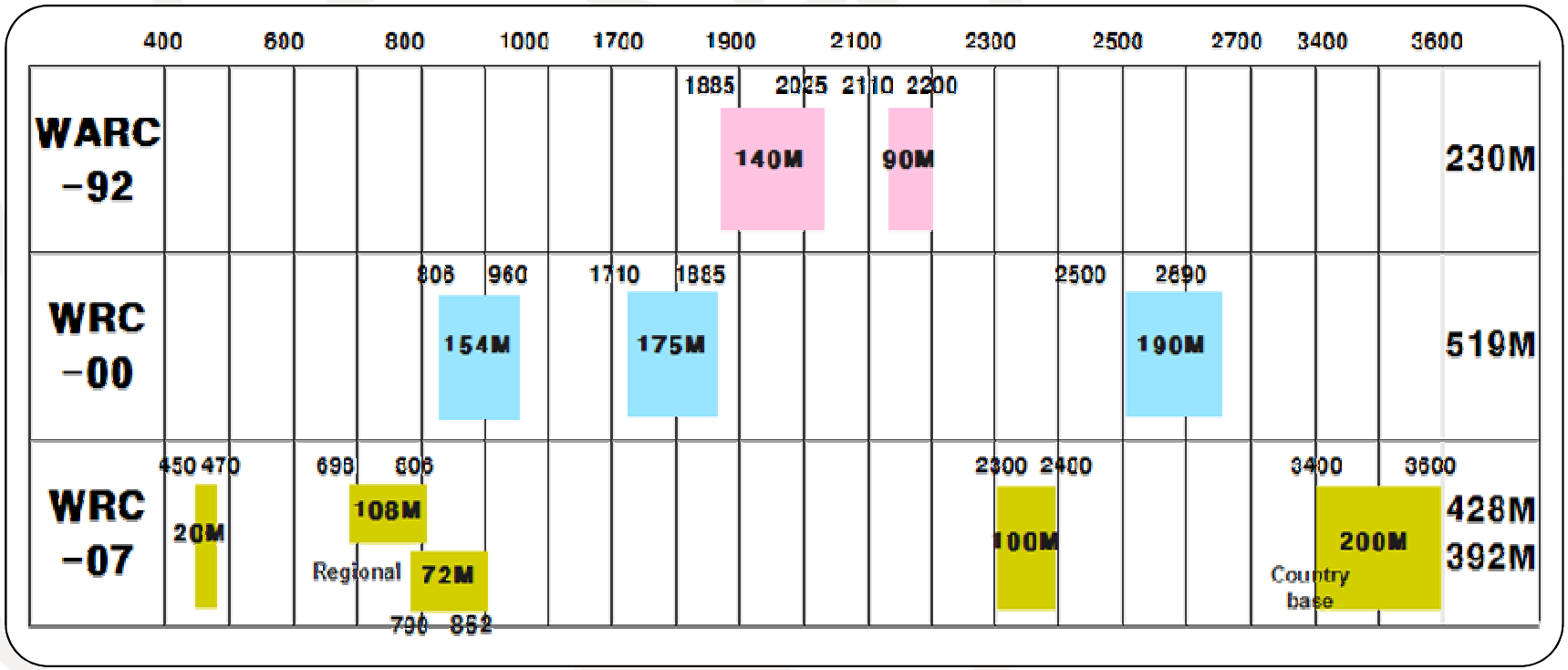
Critical milestones in radio interface development process:

(0): issue an invitation to propose RITs	March 2008	(2): Cut off for evaluation report to ITU	June 2010
(1): ITU proposed cut off for submission of candidate RIT proposals	October 2009	(3): WP 5D decides framework and key characteristics of IMT-Advanced RITs and SRITs	October 2010
		(4): WP 5D completes development of radio interface specification Recommendations	February 2011

IMT-Advanced A2-01

Spectrum Identification for IMT at WRC

- No distinction of IMT-2000 & IMT-Advanced in the use of frequency



IMT-Advanced Standardization Progress

- Issuance of Circular Letter (2008. 2)
- Minimum requirements (2008. 6)
- Technology Description Template : ITU-R Report M.2133
- Compliance Template : ITU-R Report M.2134
- Evaluation guideline : ITU-R Report M.2135
- WP5D 6th meeting(2009. 10)
- Six IMT-Advanced Candidate Proposals submission

Candidate Proposals	Proponent	Contents
IEEE 802.16m	**IEEE**	IEEE 802.16m (TDD/FDD)
	Japan	IEEE Technology excluding IPR
	Korea	IEEE Technology excluding IPR
LTE-Advanced	**3GPP** (39 members)	LTE Release10&Beyond (TDD/FDD)
	Japan	LTE Release10&Beyond (TDD/FDD)
	China	LTE Release10&Beyond (TDD)

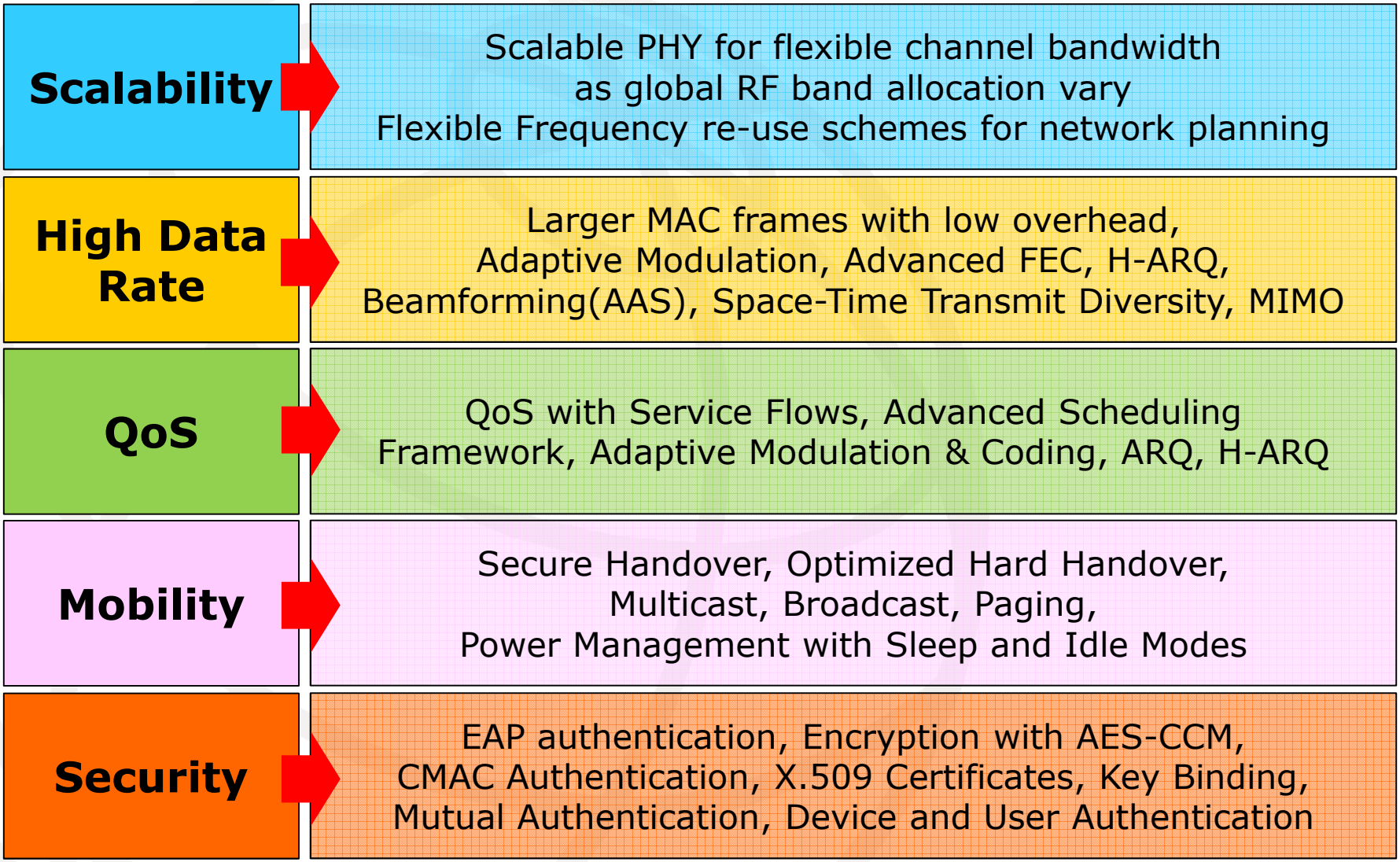
Preliminary Evaluation Reports
WP5D 7th meeting (2010. 2)

- Candidate technologies **satisfy the minimum requirements** of ITU-R IMT-ADV

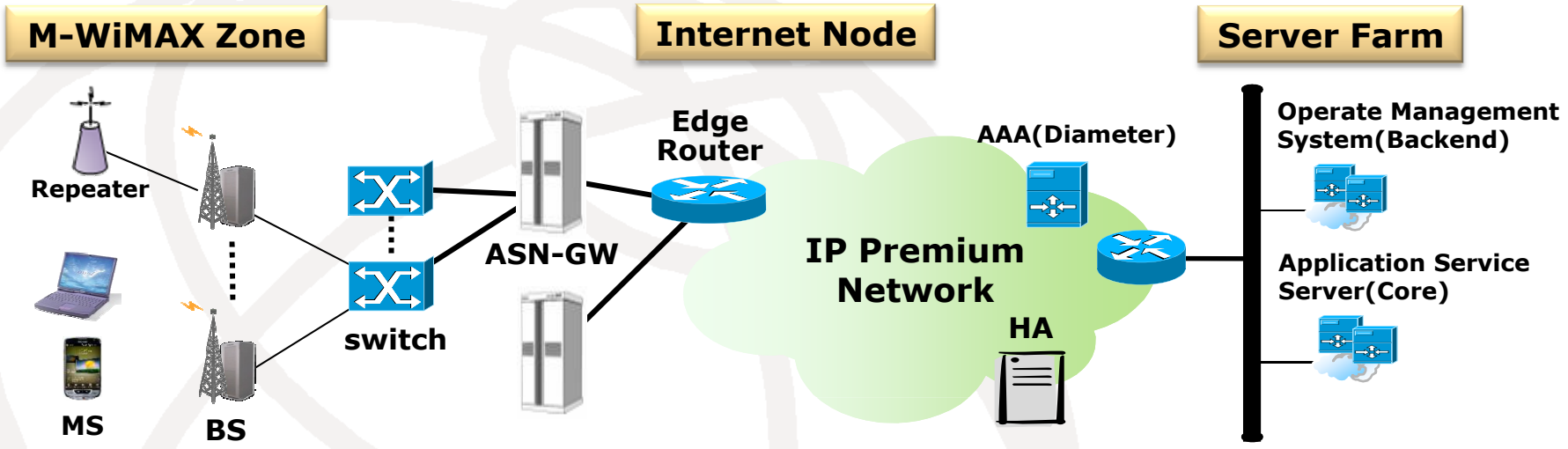
●(submission) ○(partial submission) □(expected) ☆(under consideration) X(No evaluation) (Evaluation Groups)		Contribution #	3GPP LTE-Advanced						IEEE 802.16m					
			FDD			TDD			FDD			TDD		
			I	A	S	I	A	S	I	A	S	I	A	S
1	ARIB(Japan)	628	X	X	X	X	X	X	X	X	X	X	X	X
2	ATIS(USA)	670/671	●	●	□	●	●	□	●	●	□	●	●	□
3	CEG(Canada)	668	○	○	□	○	○	□	○	○	□	○	○	□
4	ChEG(China)	650	●	●	●	●	●	●	□	□	□	□	□	□
5	RFG(Russia)	662	□	□	□	□	□	□	○	○	●	○	○	●
6	TCOE(India)	657	●	○	□	●	○	□	□	□	□	□	□	□
7	IR-45(USA)	669	○	○	□	○	○	□	○	○	□	○	○	□
8	TTA PG707(Korea)	652/653	□	□	○	☆	☆	☆	□	□	○	□	□	○
9	WCAI(USA)	667	-	-	-	-	-	-	●	●	●	●	●	●
10	WFEG(WiMAX)	651	-	-	-	-	-	-	-	-	●	-	-	●
11	WINNER+(EU)	661	●	●	□	●	●	□	-	-	-	-	-	-
12	Argentina	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Israel													
14	ETSI(EU)													

Mobile WiMAX
Introduction

Key features of M-WiMAX



M-WiMAX Network Architecture

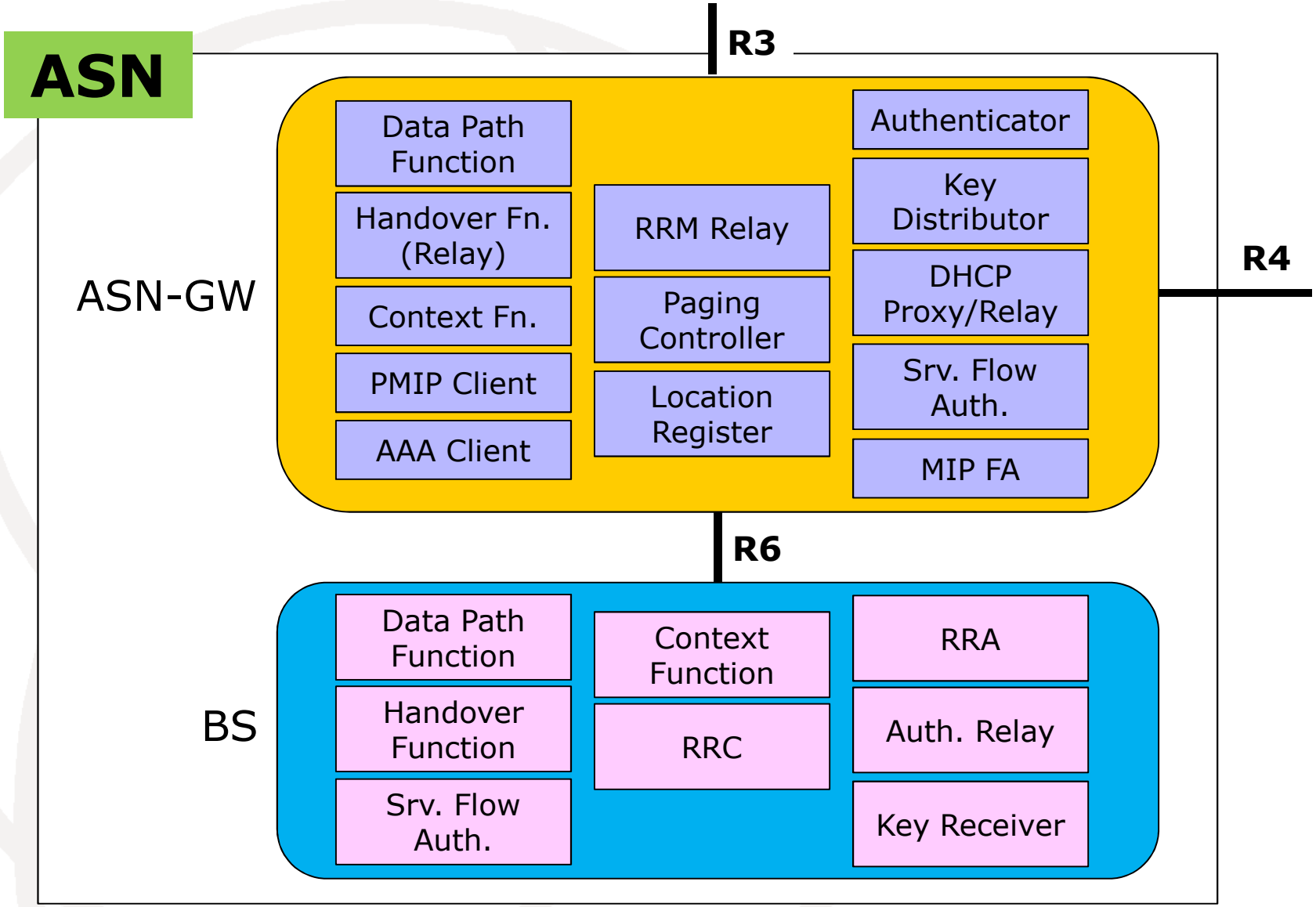


BS	Radio Access, Handover, Authentication, Security, QoS, Account etc
Repeater	Coverage extension
MS	Radio Access, IP Service, IP mobility, MS/user authentication, Security, Interworking w/ other network

ASN-GW	IP Routing/Mobility management, Authentication, Security, QoS, Account, Radio Resource Management, Handover
Core Network	Authentication, Account, IP mobility, Interworking w/ other network

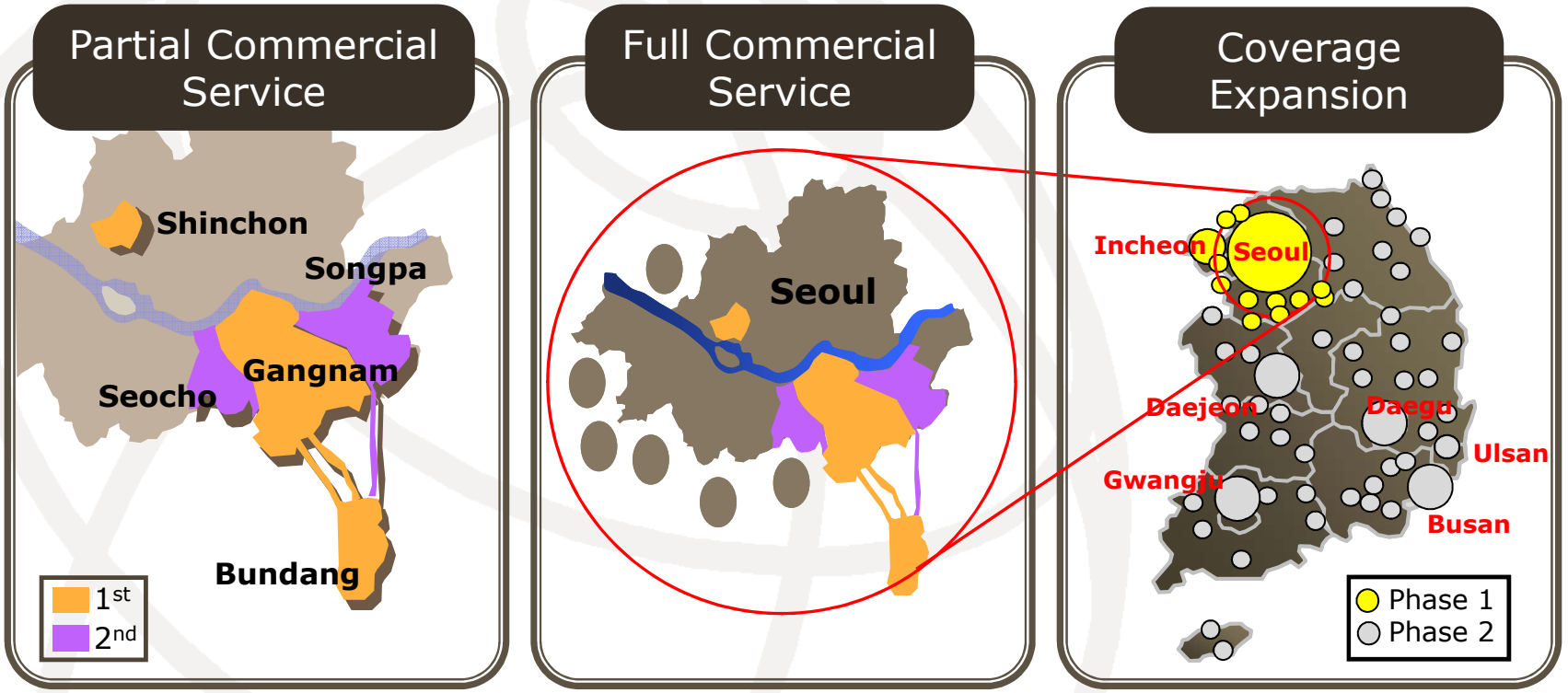
Application Server	Application service Optional service

ASN Reference Model



Mobile WiMAX
Deployment Issues

KT WiBro(Mobile WiMAX) Commercial Service Stage



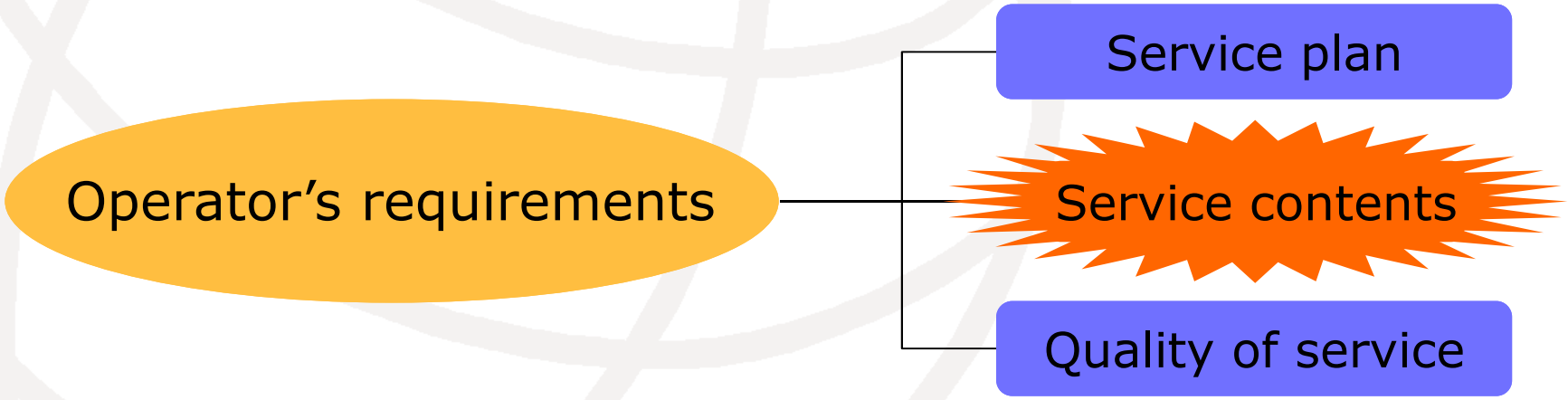
Commercial Launch (June, 2006)

Expansion (May, 2008)

Network Upgrade (By end of year 2010)

Operator's General Requirements

- RFP consists of traffic assumption, price, training plan, system feature list, network architecture, O&M requirement, optimization, etc.



Coverage

- Maximum coverage based on IEEE 802.16e

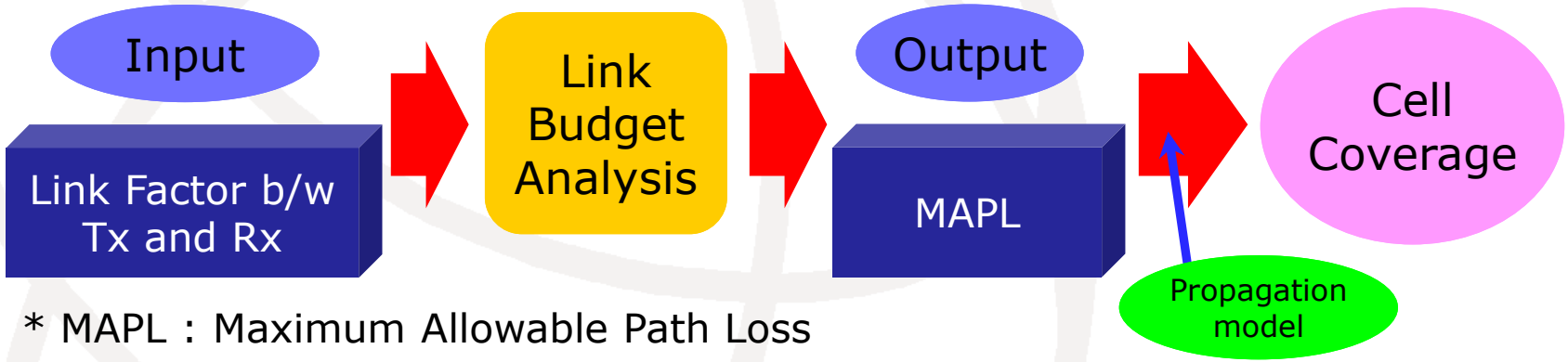
BW (MHz)	3.5	5	10	8.75
Effective symbols	33	47	47	42
Unallocated Frame Duration (TTG+RTG)	248.0	165.7	165.7	161.6
RTG (μs)	60	60	60	74.4
TTG (μs)	188	105.71	105.71	87.20
RTD (μs) = TTG – SSRTG	138.0	55.7	55.7	37.2
Maximum Range (km)	20.7	8.36	8.36	5.58

* RTD: round trip delay BS to MS, TTG: Tx to Rx transition gap at BS, RTG: Rx to Tx transition gap at BS
* SSRTG: mobile station receive to transmit transition gap

- KT coverage criteria
  - Minimum supportable TP per user: 512kbps(DL), 128kbps(UL)
  - RSSI ≥ -75dBm
  - CINR ≥ 5dB
- KT BS coverage in Seoul: 300 ~ 400 m
  - About 500 BSs excluding subway BS in Seoul

Coverage: Link budget

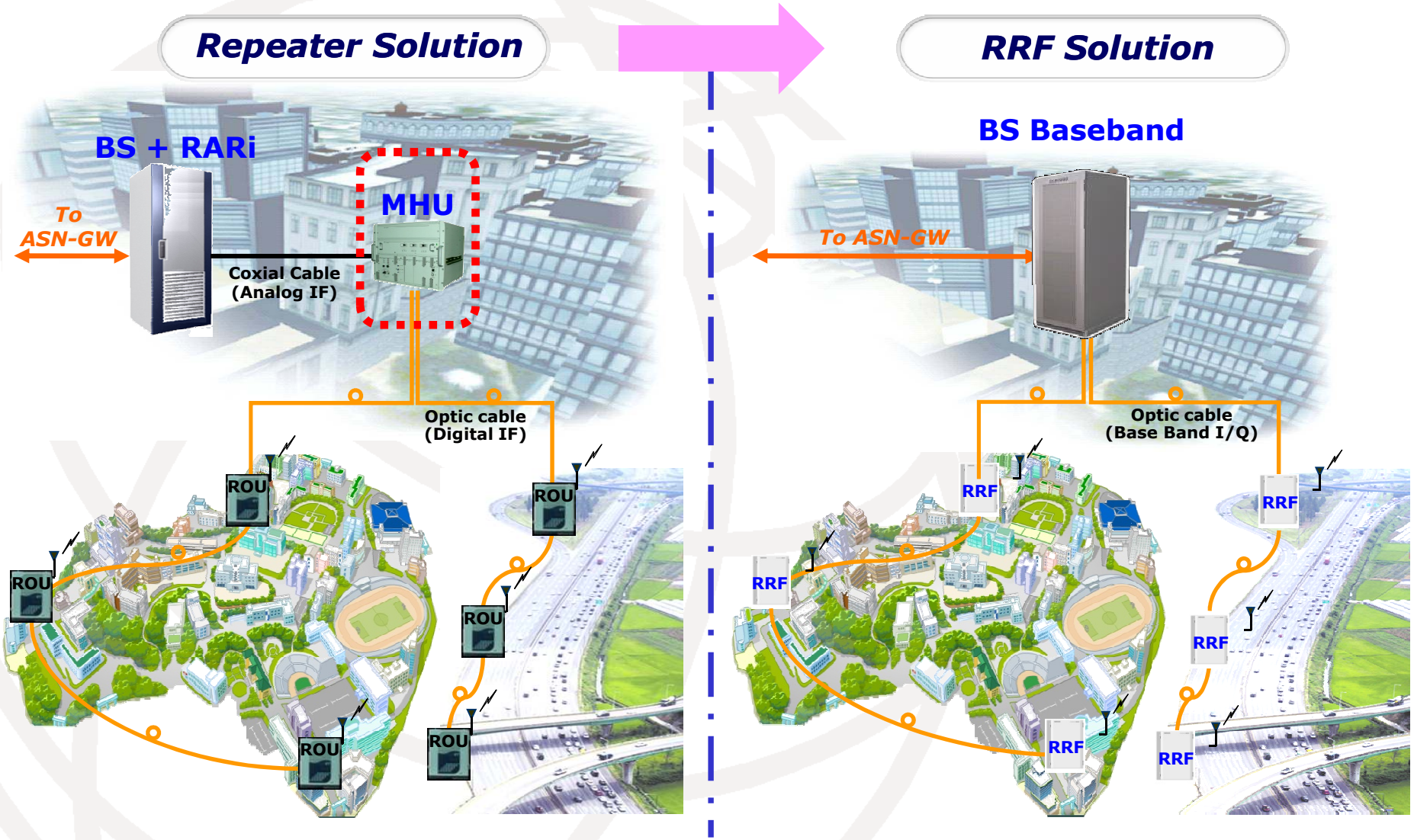
- Link budget
  - An assessment of the losses and gains that occur on a link between transmitter and receiver
  - To predict cell coverage



* MAPL : Maximum Allowable Path Loss

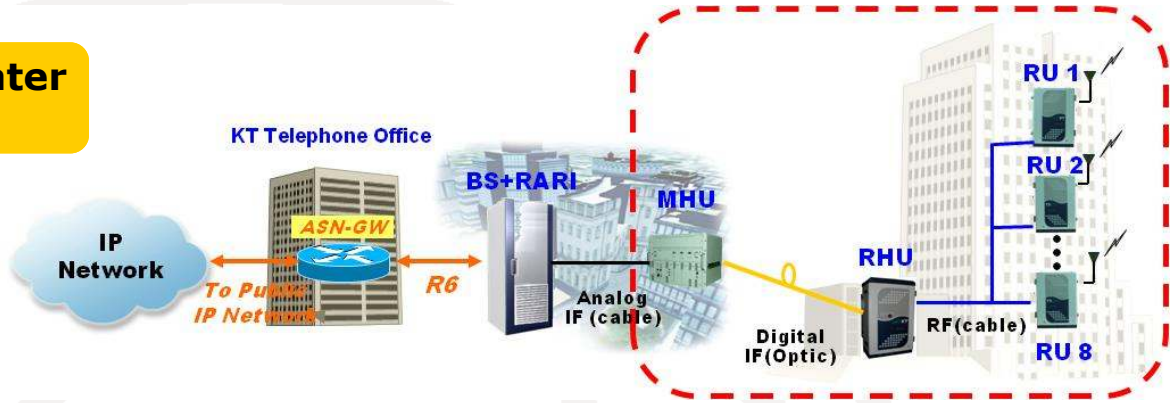
  - Link budget analysis process
    - MAPL(dB) = Tx_EIRP – Rx_sensitivity + sum of (gains & losses)
      - Tx_EIRP: Max Tx power per traffic channel + Tx ant. gain – cable loss
      - Rx_sensitivity: Required minimum received signal power at Rx

Coverage? Remote RF Unit

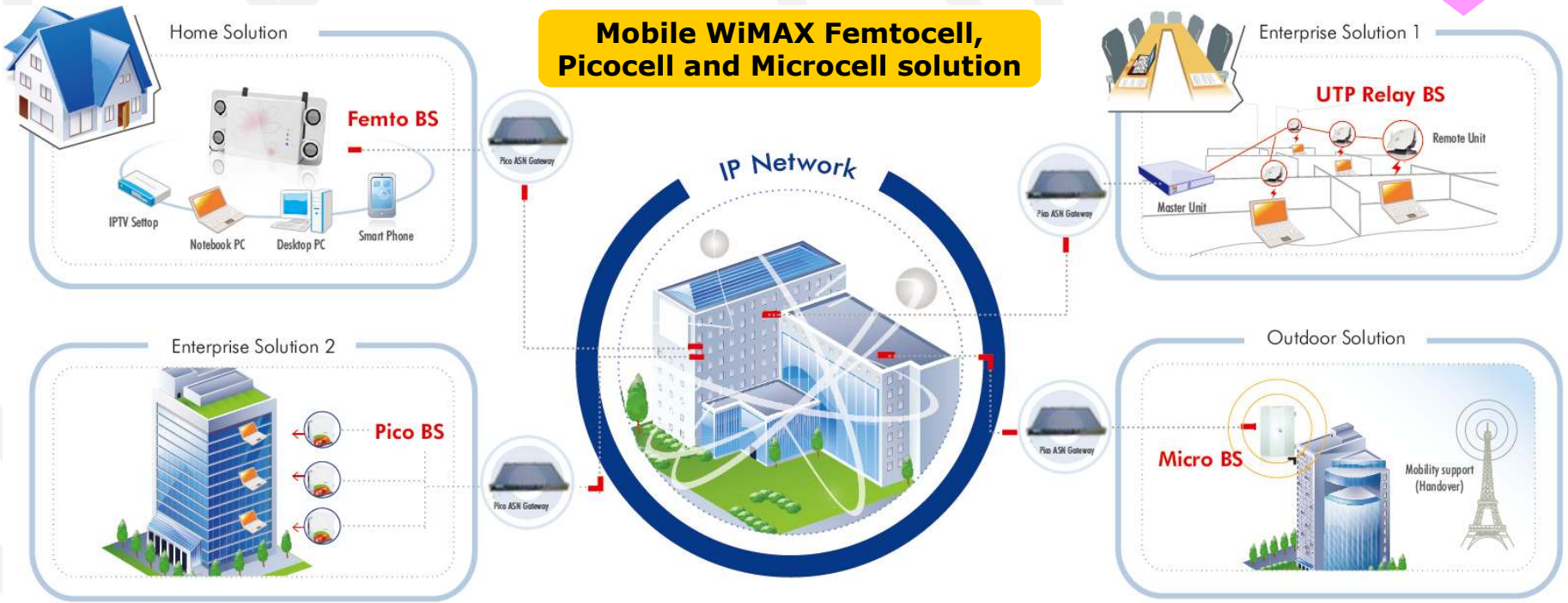


Coverage? Indoor Solution

Indoor Repeater solution

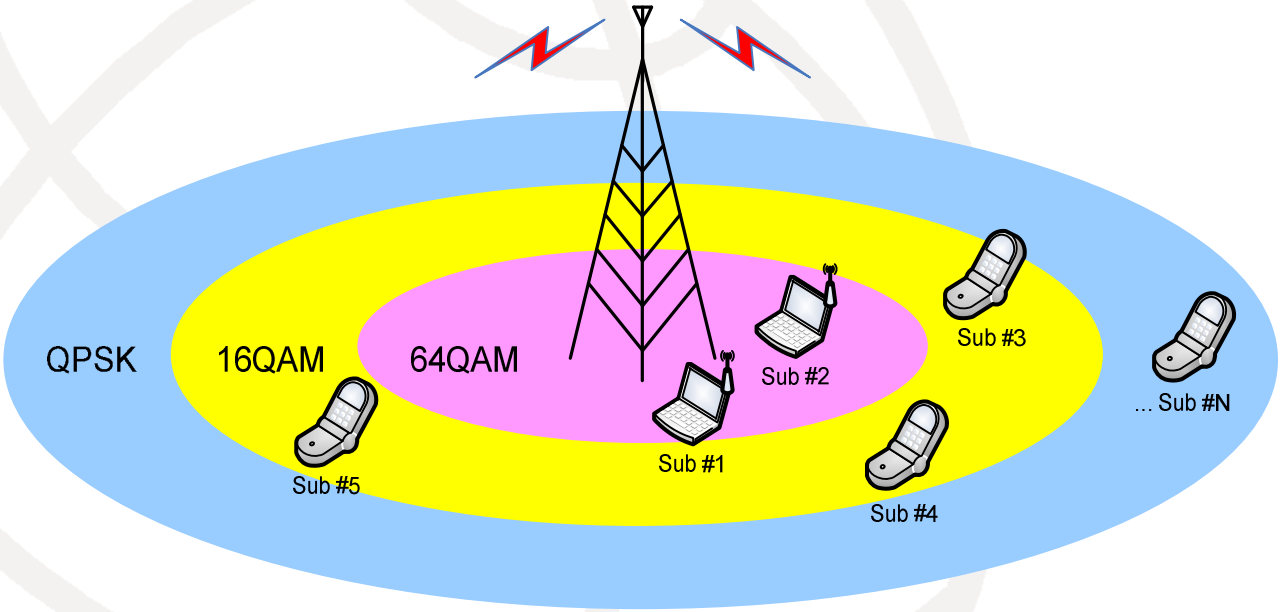


Mobile WiMAX Femtocell, Picocell and Microcell solution



Fast Link Adaptation

- Adaptive Modulation on a burst by burst basis
  - Each subscriber operates at the data rate corresponding to its link quality



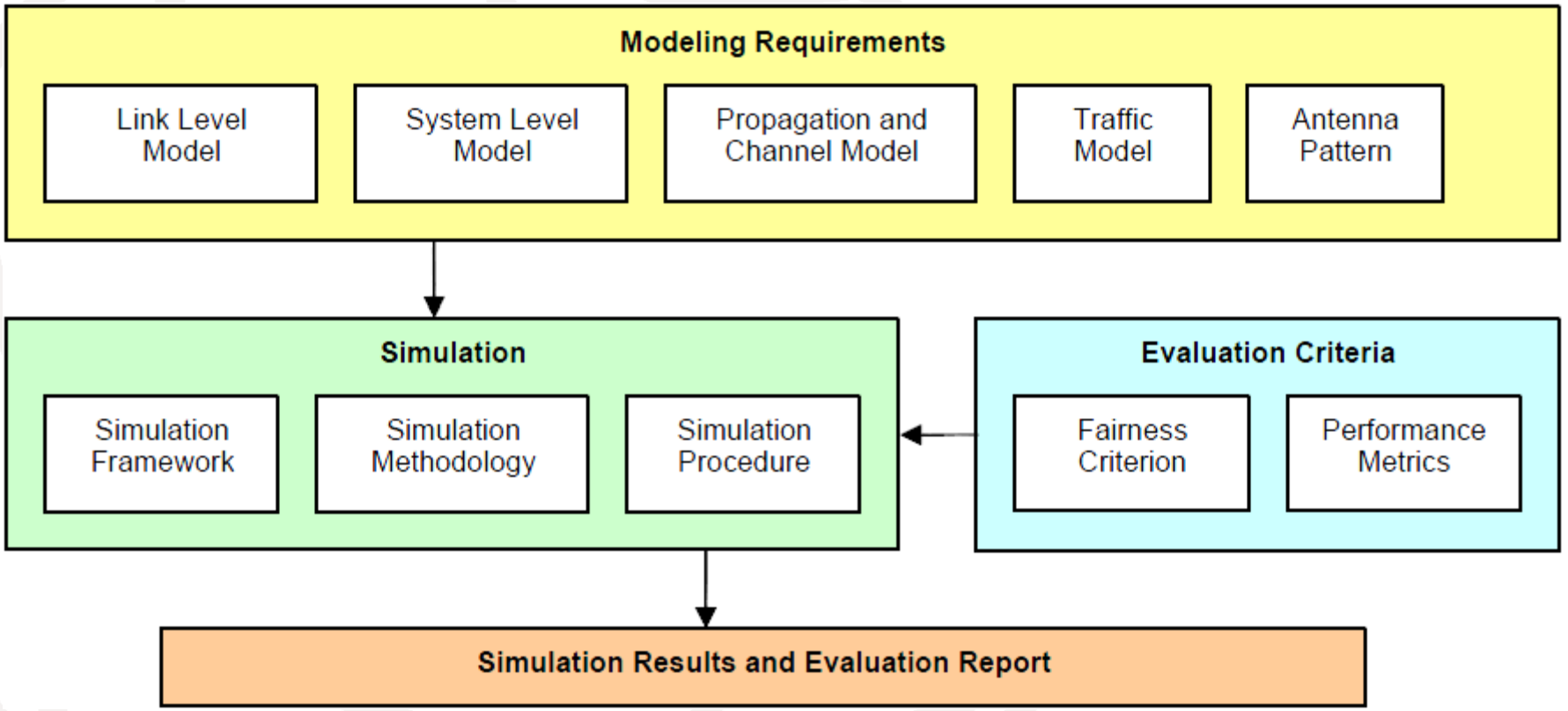
  - MCS table: MCS level transition criterion
  - Outer loop power control: efficiency improvement at user throughput

Handover Process

- Handover in M-WiMAX: Hard handover
- Handover Process
  - Cell reselection
    - Receiving neighbor BS information (MOB_NBR-ADV)
    - Scanning neighbor BSs
  - HO decision & Initiation
    - Handover decision from Serving BS to Target BS
  - Synchronization to Target BS Downlink
  - Ranging
    - Handover RNG processing for synchronization to target BS uplink
    - Handover optimization process
  - Termination of MS context in serving BS
- Inter-sector, Inter-BS, Inter-ACR Handover

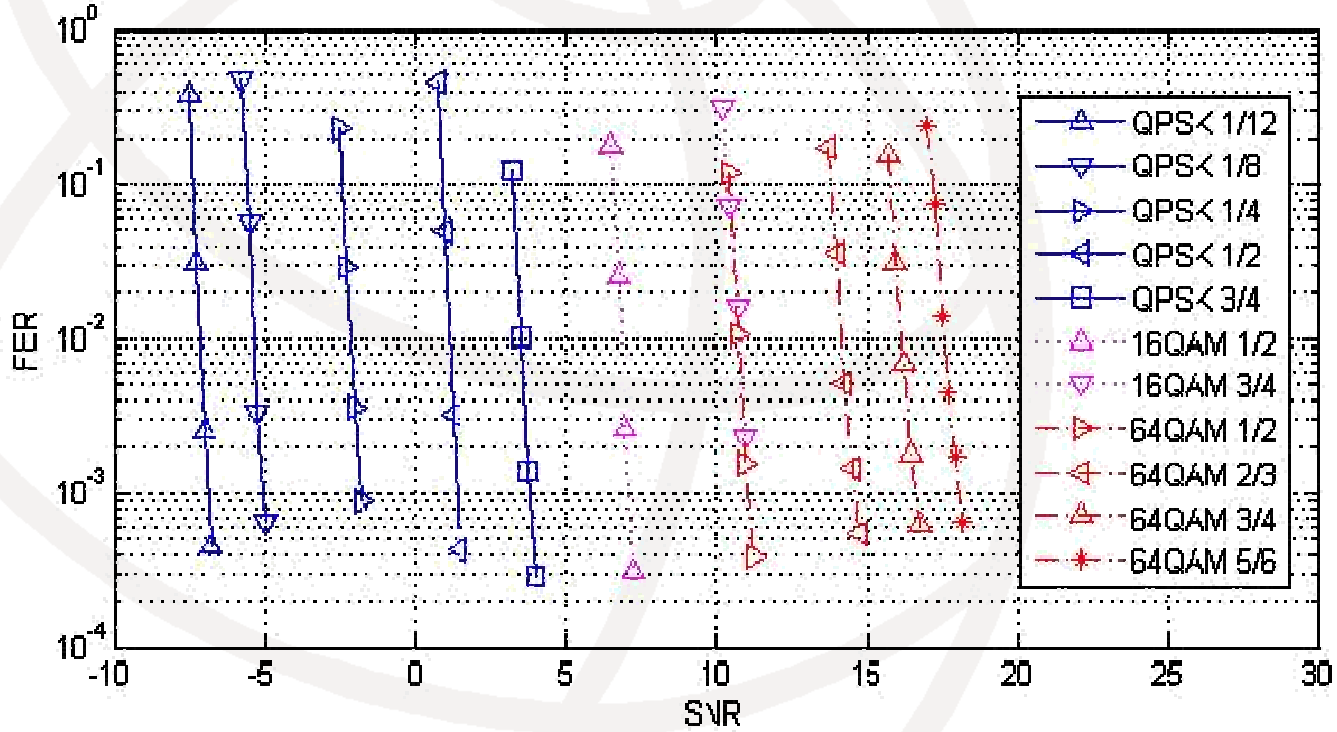
Performance Evaluation

- Simulation components



Performance Evaluation
Link level simulation

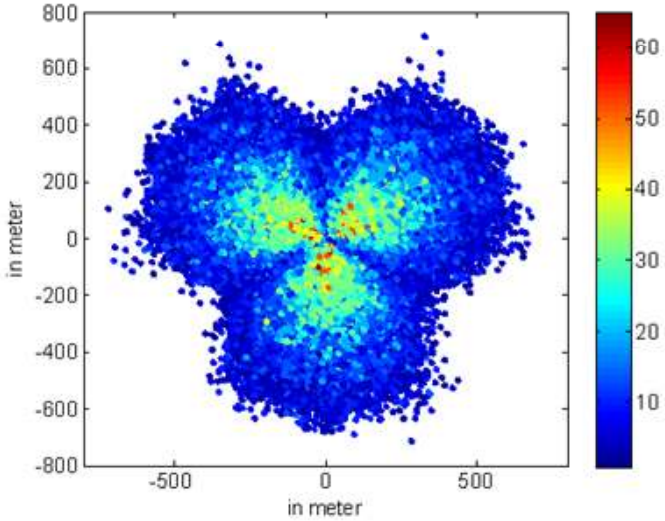
- To probe the characteristics of a point-to-point link
- Result
  - Link performance curves (as a function of received SNR)



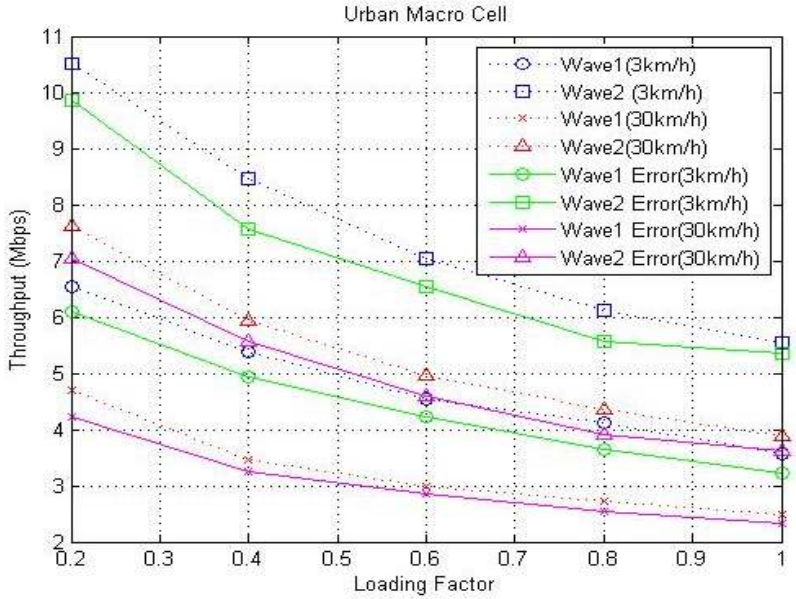
  - Link-level simulation results for AWGN channel

Performance Evaluation
System level simulation

- To evaluate the overall performance of a whole system
- Result: System throughput
- Snap time simulation ⇔ Full motion simulation



- SINR distribution (MIMO)



- Average system throughput

Summary

- IMT-Advanced standards establishment
  - Scheduled to be early 2011 through the expert evaluation process
  - 2 Candidate RITs: LTE-Advanced, IEEE 802.16m
  - Now evaluation stage
    - Candidate RITs satisfy the minimum requirements
- Mobile WiMAX
  - Flat architecture due to All-IP services
  - Deployment issues
    - Coverage
    - Fast link adaptation
    - Handover
    - Performance evaluation

Thank You

Q & A

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