[Initial Input for 802.16m project Goals]

IEEE 802.16 Presentation Submission Template (Rev. 8.3)

Document Number:

[IEEE C802.16m-07/004r1]

Date Submitted:

[2007-01-11.]

Source:

[Phil Orlik, Andy Molisch, Koon Teo] Voice: [+1 617 621 7570]
[Mitsubishi Electric Research Laboratories] Fax: [Fax Number]
[201 Broadway] E-mail: [{porlik, molisch, teo}@merl.com]
[Cambridge, MA 02139]

[I-Kang Fu, Wern-Ho Sheen and Chi-Fang Li] Voice: [+886-3-5712121 ext.59237]
[NCTU/ITRI]
[ED922, 1001 Ta Hsueh Rd.]
[Hsinchu City, Taiwan 300, R.O.C.] E-mail: IKFu@itri.org.tw

Venue:

[London interim meeting.]

Base Document:

[]

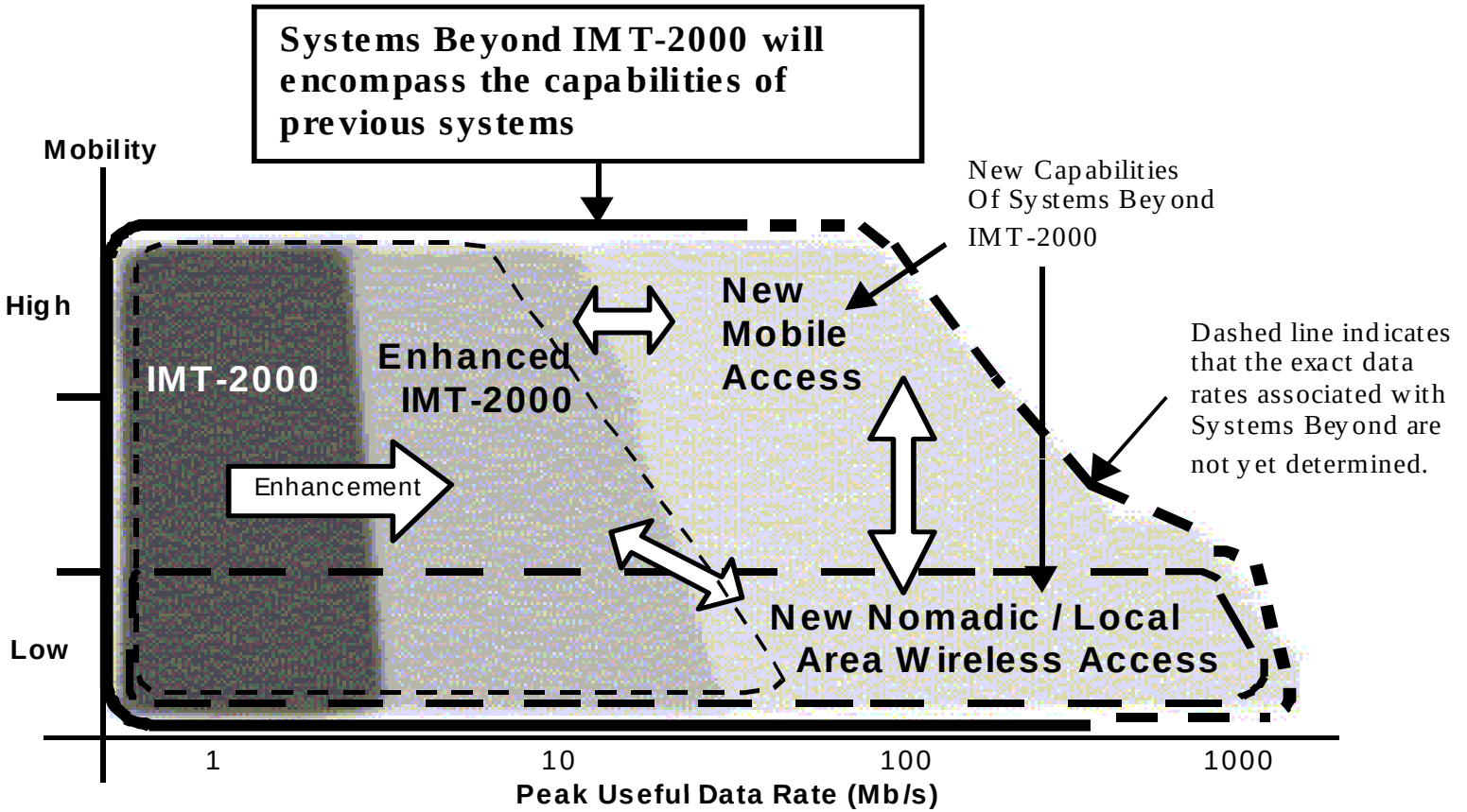
Purpose:

[Response to call for initial input regarding P82.16m Project.]

Outline

- 16m Goals
- Envisioned 16m Usage/Services
- Envisioned Requirements
  - Rate
  - Coverage
  - Flexibility/Adaptability
  - Geographic Considerations
  - Deployment Scenario

ITU-R Vision on Next Generation Wireless Communications



KEY: ⇔ denotes interconnection between systems via networks or the like, which allows flexible use in any environments without making users aware of constituent systems.

Nomadic / Local Area Access Systems

Digital Broadcast Systems

Dark gray color indicates existing capabilities, medium gray color indicates enhancements to IMT-2000, and the lighter gray color indicates new capabilities of Systems Beyond IMT-2000.

The degree of mobility as used in this figure is described as follows: Low mobility covers pedestrian speed, and high mobility covers high speed on highways or fast trains (60 km/h to ~250 km/h, or more).

Goals of 802.16m

- Support broadband multimedia services
  - Maintain minimum latency to support conversational type applications (voice)
- Improved data rate
- Improved spectral efficiency and reuse
  - 5 - 25 b/s/Hz required to offer new high rate services
- Flexible and adaptive
  - Allow trade-off between rate/complexity/performance
- Compatibility with OFDMA TDD frame structure

802.16m Usage

- Personal Use
  - Mobile Internet
    - New high bandwidth content (YouTube, MySpace,…)
  - Mobile entertainment
    - Access to digital content: music, video
  - Mobile Gaming
- Business Use
  - Mobile Office: Video conferencing, collaboration (application sharing)
  - Supply chain management
- Others
  - ???

It is expected that applications run on 16m will be similar to those on future wired networks (DSL/Cable/FTTH/Office) and therefore users will expect to be able to use existing applications and receive comparable performance from the 16m system

Application Environment

- Stationary
  - Fixed wireless access
- Pedestrian
  - 5 km/hr
- Vehicular
  - 30 – 300 km/hr

Services

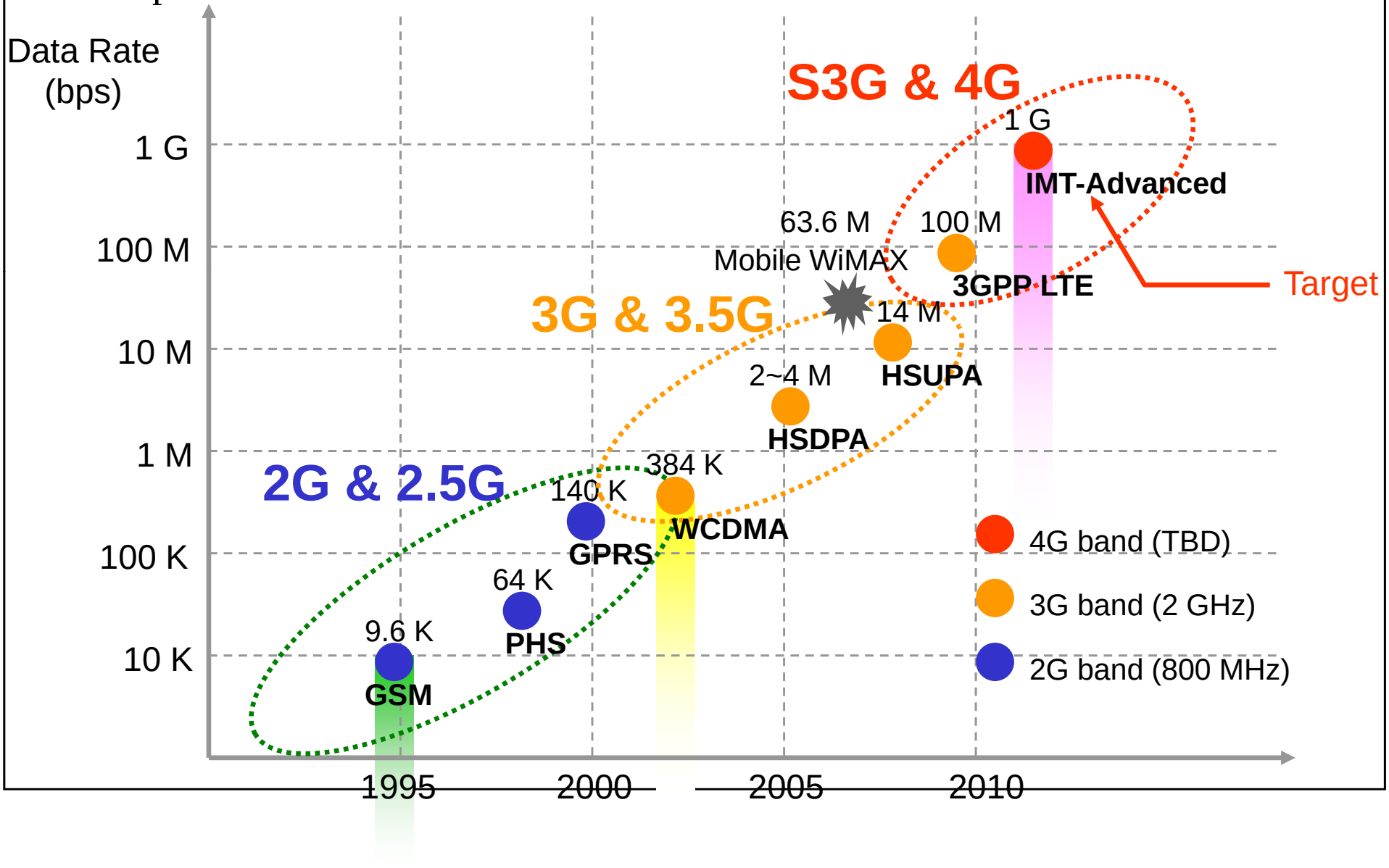
- Data Rate
  - Higher is better → support current and future applications
    - 1 Gb/s (peak) for stationary users
    - 100 Mb/s (peak) for highly mobile users
    - Peak data rate should scale linearly with spectrum allocation
- QoS
  - Support multiple classes of traffic with widely differing latency, error rate tolerance, …

802.16m Peak Data rate and QoS considerations

	Mobile Internet	**Mobile entertainment**	**Mobile Gaming**	**Mobile Office/Video Conferencing**
Stationary	•10 – 100 Mb/s •interactive	•10 – 100 Mb/s •Streaming/interactive	•10 - 100 Mb/s •Streaming/interactive	•10 – 100 Mb/s •Conversational
Pedestrian	•10 – 100 Mb/s •interactive	•10 – 100 Mb/s •Streaming/interactive	•10 - 100 Mb/s •Streaming/interactive	•10 – 100 Mb/s •Conversational
Vehicular	•1-10 Mb/s •interactive	•10 Mb/s – 20 Mb/s •Streaming/interactive	•10 Mb/s – 20 Mb/s •Streaming/interactive	•10 Mb/s •Conversational

Rate Requirements

- In order to fulfill the scope of IMT-Advanced, more than **1Gbps** peak data rate is expected for IEEE 802.16m.

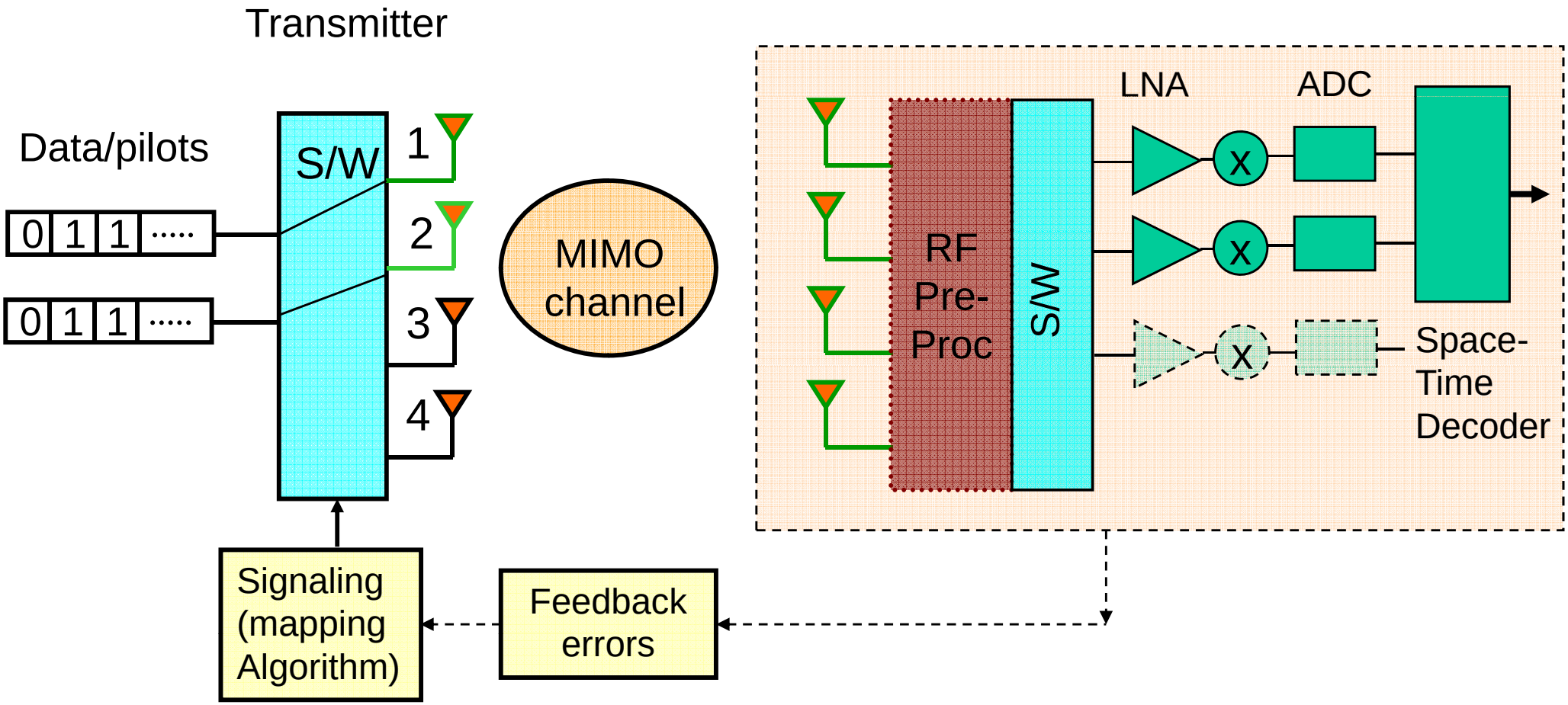


Flexibility/Adaptability

- System will serve a variety of users with different end device capabilities
- PHY/MAC should enable a variety of hardware platforms with different cost/performance/complexity requirements
  - Cellphone → few antenna elements, strict power/battery requirements
  - High end PDA/Laptop
    - More antenna elements, larger display, …
- Adapt bitrate based on target device
  - Provide date to higher layers regarding channel condition and end device type

Hardware complexity MIMO/AS

Reduced RF Chains/Complexity



Coverage

- Subscribers need service regardless of location.
  - ubiquitous coverage 99% of area in specified service areas
    - Rural → Multihop/relay for range extension
    - Urban (high subscriber density) → Greater Spectral efficiency
      - MIMO
      - Beam Forming
      - Interference Management/Avoidance

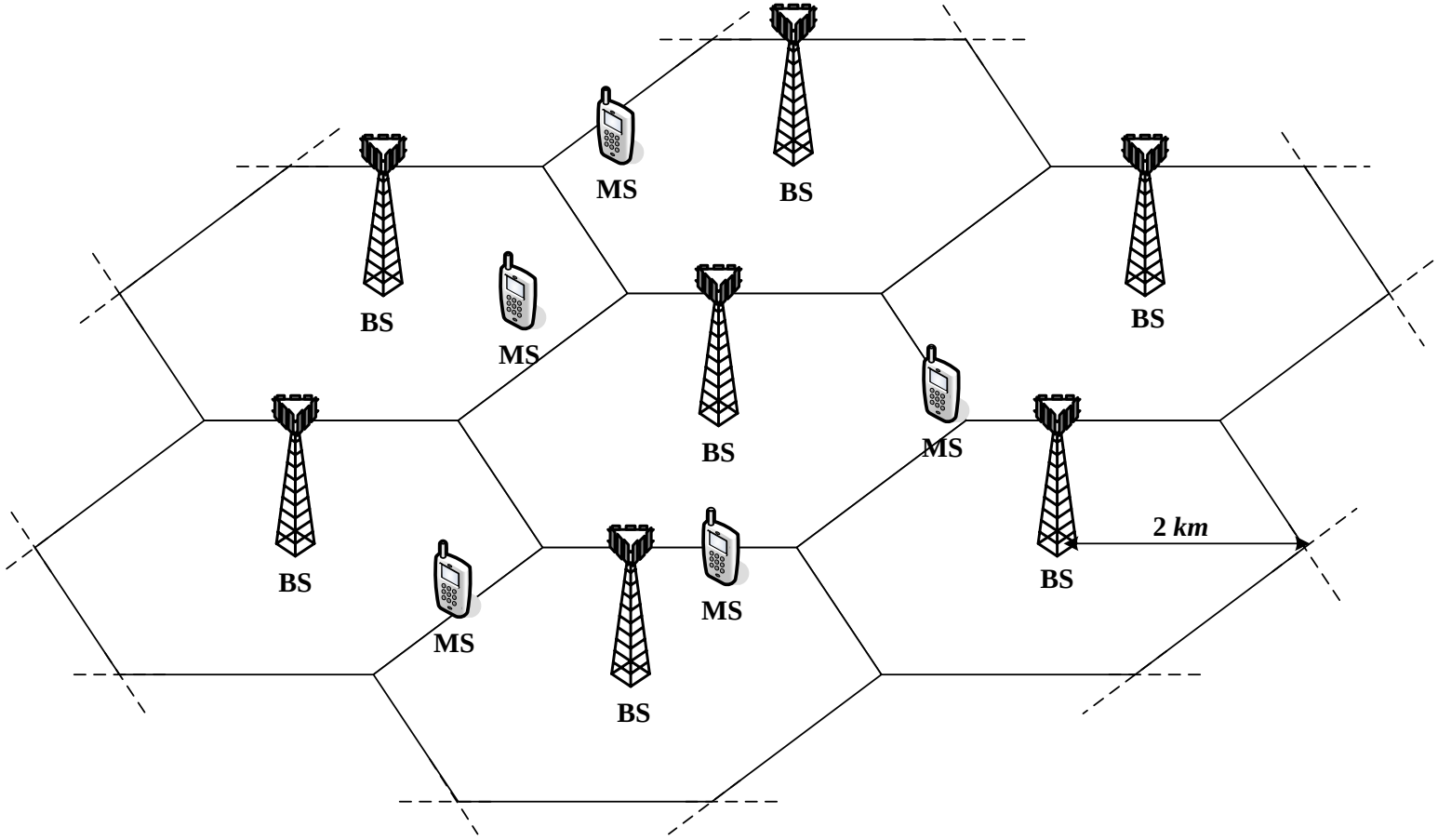
Geographic Considerations

- Improve cell edge bit rate – rate delivered to subscribers far from the base station

	Cell Size	Aggregate DL/UL
Rural	5-30 km	100 - 1 Gb/s / 50 - 100 Mb/s
Urban	1 – 5 km	100 - 1 Gb/s / 50 - 100 Mb/s
Dense Urban	300m – 1km	100 - 1 Gb/s / 50 - 100 Mb/s

Geographic Considerations

- In IEEE 802.16e system, 10W/200mW transmit power can support around 2 km cell coverage both DL and UL respectively.
  - Maximum allowable path-loss as 133dB/133.7dB for UL and DL [1]
  - Consider IEEE 802.16 Type C path-loss model [2] for this example

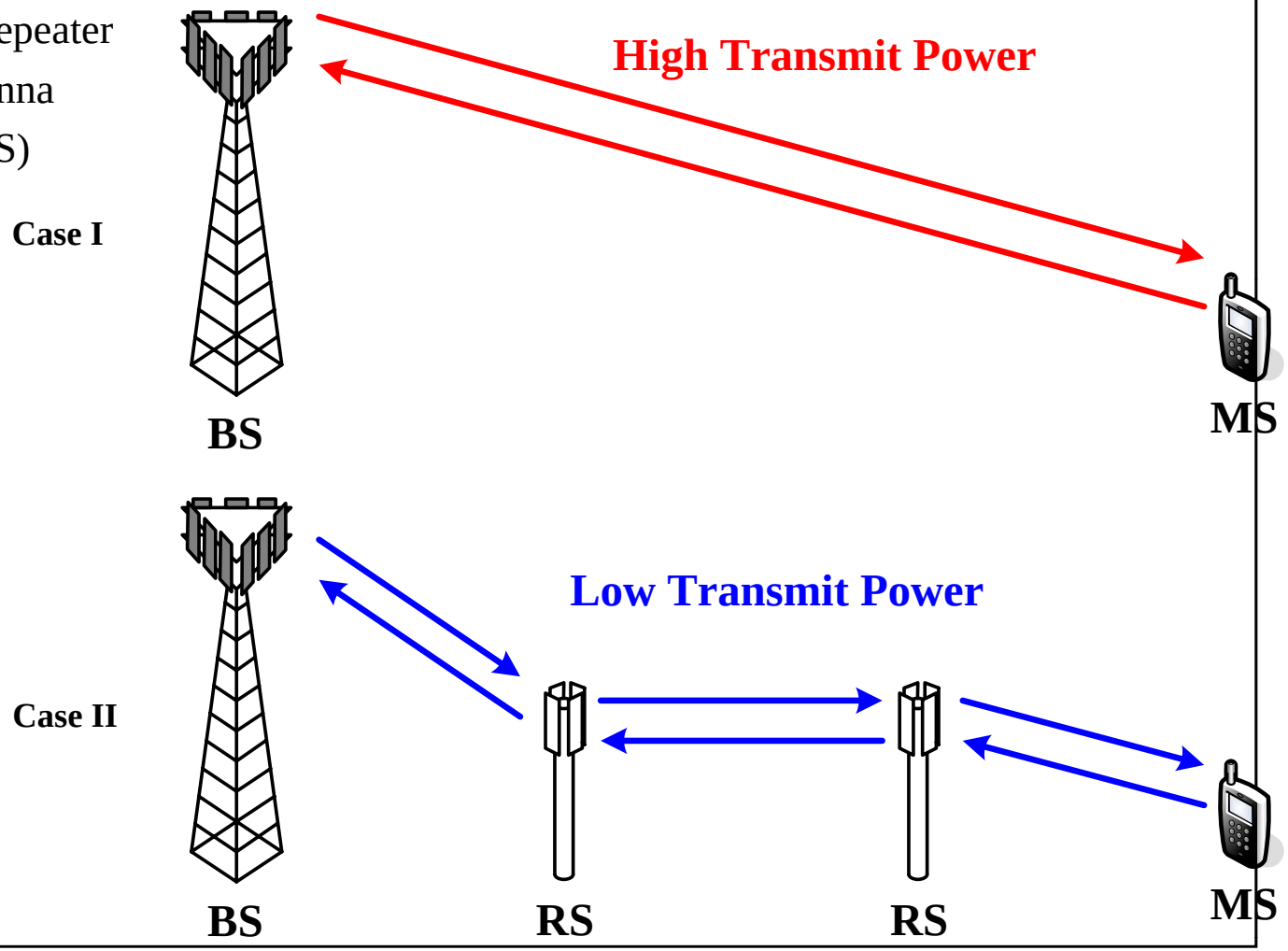


Geographic Considerations

- In order to perform 10~100 times data rate (i.e. 100M~1Gbps) higher than existing IEEE 802.16e system, over 10~100 times max. transmit power may be required to maintain the same received E_b/N_0 and the same cell coverage if we use the same cell deployment scenario as previous page.
  - Take the example in previous page, that means over 100~1,000W transmit power and over 2~20W transmit power may be required for BS and MS respectively.
    - This may be a very critical challenge for BS and MS hardware development
    - High transmit power will severely shorten the battery life of MS
  - The requirement may be even higher when taking the interference increment into consideration

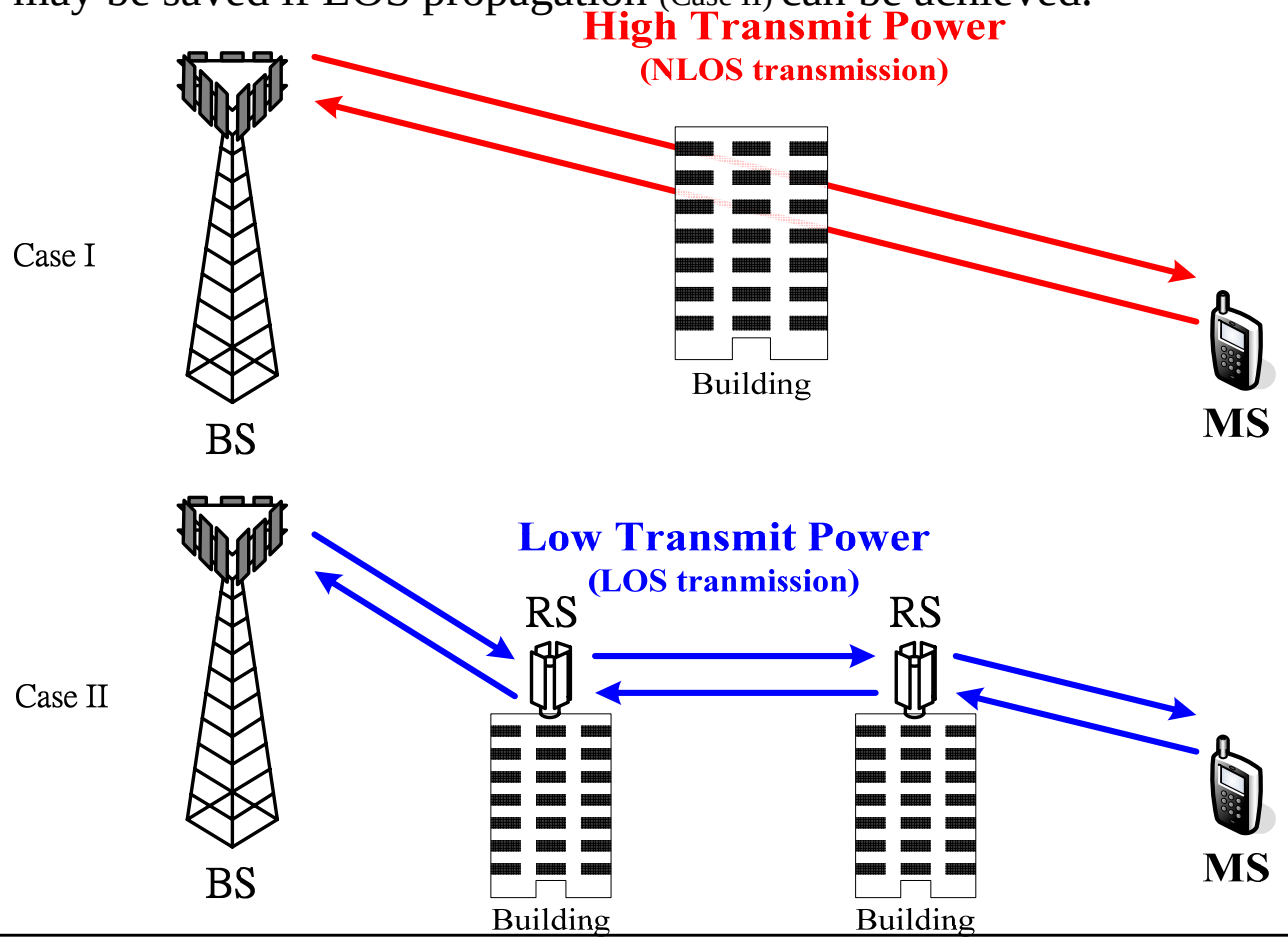
Deployment Scenario

- Instead of substantially increase the transmit power (case I), an alternative (case II) is deploying additional stations for power boosting between BS and MS.
  - The stations may have different level of intelligence, complexity and performance:
    - Analog/digital Repeater
    - Distributed Antenna
    - Relay Station (RS)



Deployment Scenario

- In addition, deploying additional stations between BS and MS can lead to higher flexibility to explore better propagation condition:
  - Compare with NLOS (Non Line-Of-Sight) propagation (Case I), more than 20 dB transmit power may be saved if LOS propagation (Case II) can be achieved.



Deployment Scenario

- Extending high data rate to users at the cell edge.
  - Consider cooperative techniques among base stations to improve reception near cell boundaries]