

# Mobile Multi-hop Relay Networking in IEEE 802.16

## IEEE 802.16 Presentation Submission Template (Rev. 8.3)

Document Number:

IEEE C802.16-05/013

Date Submitted:

2005-07-13

Source:

Mitsuo Nohara, Kenji Saito, Keizo Sugiyama, Hideyuki Shinonaga  
**KDDI R&D Laboratories Inc.**

2-1-15, Ohara, Kamifukuoka, Saitama, 356-8502, Japan

Voice: +81-49-278-7562

Fax: +81-49-278-7510

E-mail: [nohara@kddilabs.jp](mailto:nohara@kddilabs.jp)

Jaeweon Cho, Jungje Son, Panyuh Joo, Hyeonwoo Lee

**Samsung Electronics Co., Ltd.**

416 Maetan-3, Suwon, 442-600, Korea

Voice: +82-31-279-5796

Fax: +82-31-279-5130

E-mail: [jaeweon.cho@samsung.com](mailto:jaeweon.cho@samsung.com)

Nat Natarajan, David T.Chen, Masahito Asa

**Motorola Inc.**

1501 W Shure Drive, Arlington Heights IL 60004, United States

Voice: +1-847-632-6303

Fax: +1-847-435-9970

E-mail: [Nat.Natarajan@motorola.com](mailto:Nat.Natarajan@motorola.com)

Venue:

IEEE 802.16 Session #38, San Francisco, USA

Base Document:

None

Purpose:

Proposal of a new study group for mobile multi-hop relay networking in IEEE 802.16 systems

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**KDDI R&D Laboratories Inc.**

Jaeweon Cho, Jungje Son, Panyuh Joo, Hyeonwoo Lee  
**Samsung Electronics Co., Ltd.**

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**Motorola Inc.**

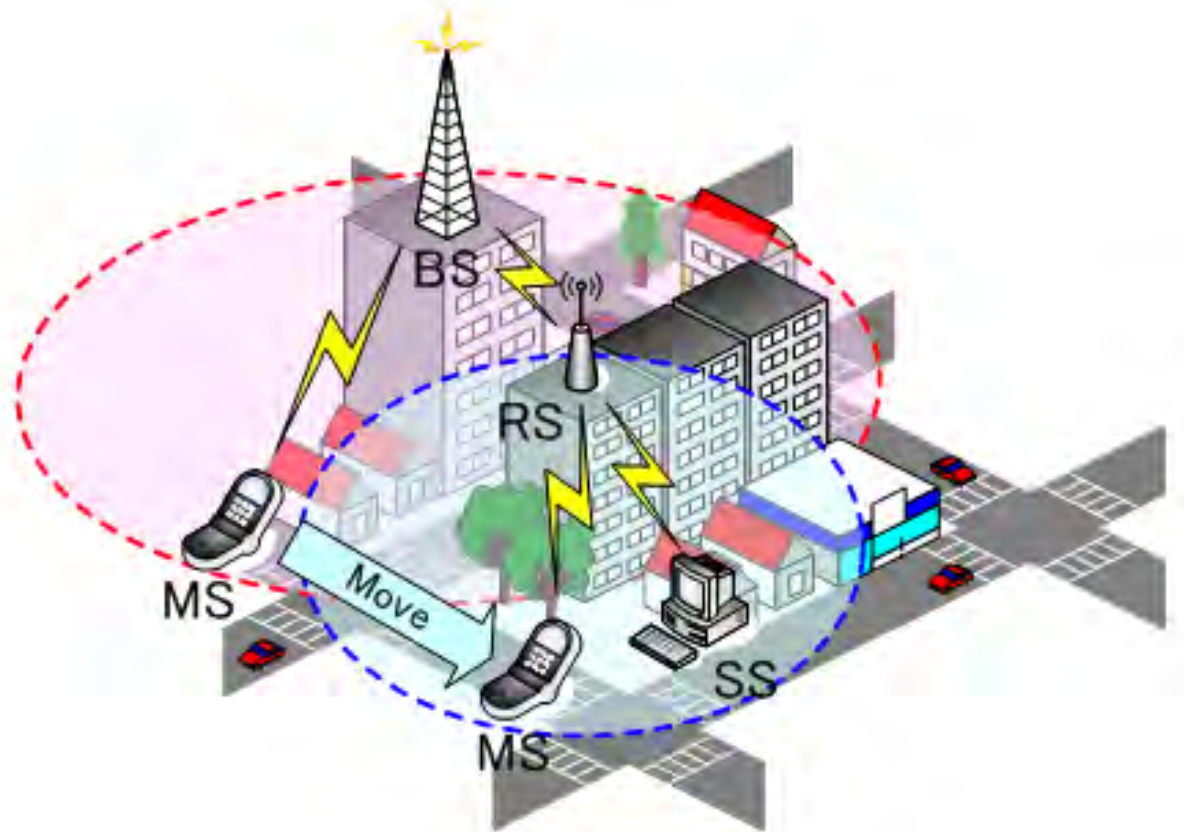
July, 2005

# Outline

- Scope of Proposed Relay Project
- Purpose
- Network Topology in IEEE802.16
- Classification
  - Mesh vs. Relay
  - Fixed / Nomadic / Mobile RS
- Concept of Proposed Relay mode
- Schedule
- Summary

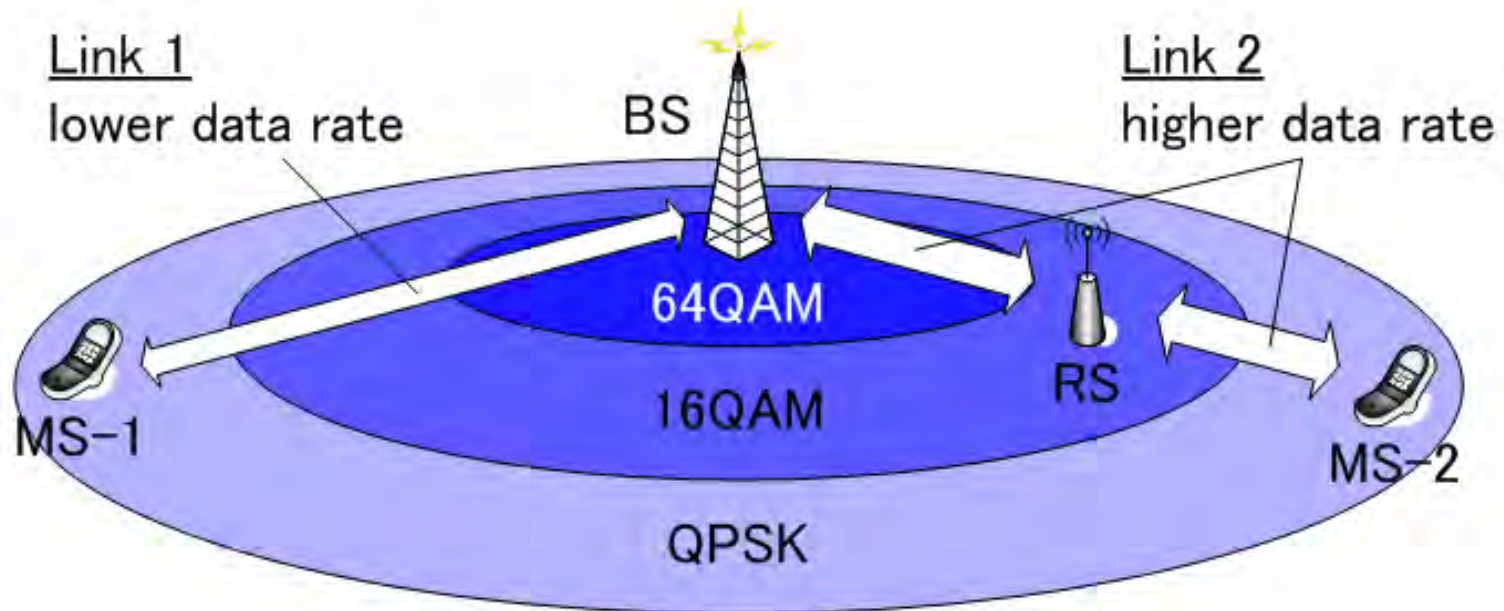
# Scope of Proposed Relay Project

- Develop Proposed Relay mode for fixed / mobile terminal
  - PHY: Enhance normal frame structure
  - MAC: Add new protocols for the Relay networking



# Purpose

- Coverage extension
  - Expansion for coverage area
- Throughput enhancement
  - Higher throughput over multi-hop paths



# Network Topology in IEEE802.16

## - PMP and Mesh mode -

- PMP mode

- Mandatory topology in 802.16-2004 and 16e
- “ ***traffic only occurs between BS and SS*** “

- Mesh mode

- Optional topology in 802.16-2004 (OFDM PHY only)
- “ ***traffic can be routed through other SSs and can occur directly between SSs*** “

# Network Control Configuration of Mesh mode in 802.16-2004

Mesh scheduling		Content
Distributed	Coordinated	Schedule coordination to <b>all neighbor SSs</b>
	Un-coordinated	Schedule negotiation by directed requests and grants <b>between two SSs</b>
Centralized		<ul style="list-style-type: none"><li>• Mesh BS Determination of flow assignments by <b>resource requests</b> from SSs</li><li>• SS Determination of <b>actual schedule</b> from Mesh BS's flow assignments</li></ul>

# Classification – Mesh vs. Relay –

	Mesh	Relay
Infra-structure		
Client	<p><b>Mesh mode in 802.16-2004 may be classified into this category.</b></p>	

- “Infrastructure” means that a operator provides dedicated equipment that has Mesh or Relay function.
- “Client” means that a user terminal has Mesh or Relay function.



# Classification – Mesh vs. Relay – (cont'd)

	Mesh		Relay	
	Infrastructure	Client	Infrastructure	Client
Network topology	Multi-connection to other nodes		Tree	
Purpose	Inter-BS communication for backhaul	Inter-SS/MS communication (such as ad-hoc mode)	<ul style="list-style-type: none"> <li>• Coverage extension</li> <li>• Throughput enhancement</li> </ul>	
Who is the repeater?	All of BS/RS	All of SS/MS	Fixed RS or Nomadic RS	<ul style="list-style-type: none"> <li>• Nomadic RS</li> <li>• SS/MS that has relay function</li> </ul>
Licensed band?	Business use: Licensed band Other one: Unlicensed band			

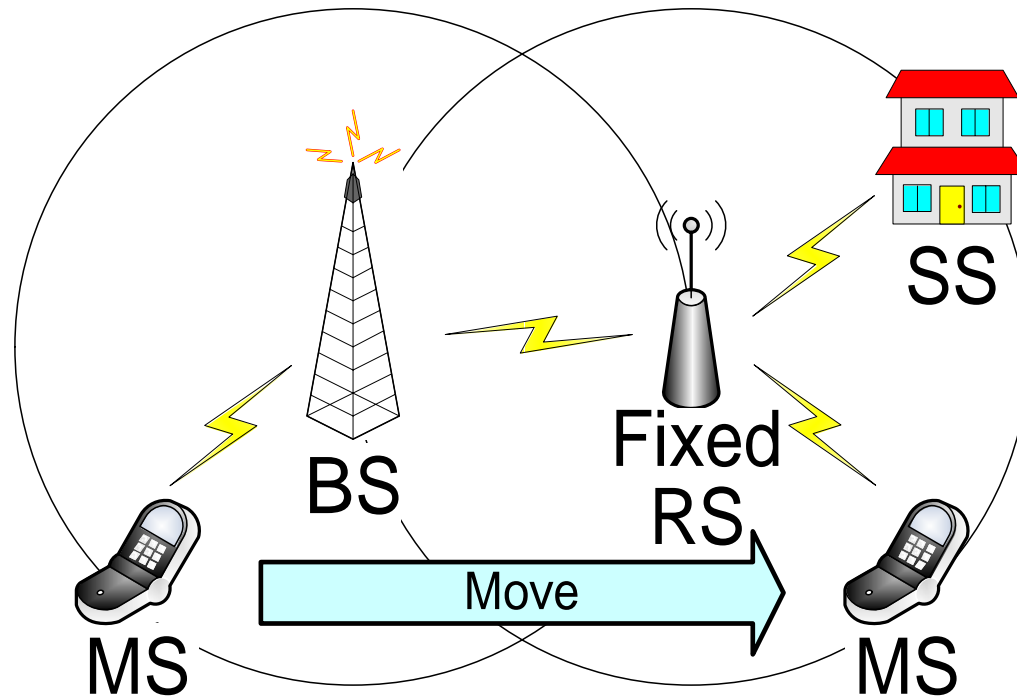
# Classification – Fixed / Nomadic / Mobile RS –

		Relay Station		
		Fixed RS	Nomadic RS	Mobile RS
Scenario	Infrastructure	<ul style="list-style-type: none"> <li>• Permanent installation</li> <li>• Coverage extension for non-service area</li> </ul>	Temporal / portable installation	Installation to public vehicle, such as train and bus
	Client	Coverage extension by SS that has relay function	<ul style="list-style-type: none"> <li>• Allow user to enable/disable relay function</li> <li>• Coverage extension for indoor</li> </ul>	Inter-MS communication
Higher Layer		<ul style="list-style-type: none"> <li>• Out of scope of IEEE 802</li> </ul>		
MAC	Infrastructure	<ul style="list-style-type: none"> <li>• Optimal route selection (L2 Routing)</li> <li>• Control of relayed SS by BS or RS</li> </ul>		
	Client	<ul style="list-style-type: none"> <li>• Substitute route selection</li> <li>*Avoidance of service interruption by SS power off</li> </ul>	Control of relayed SS by BS	<ul style="list-style-type: none"> <li>• Dynamic / optimal route selection</li> <li>• Centralized control by BS</li> </ul>
PHY	To fixed terminal	(802.16-2004) OFDM : 256, OFDMA : 2048		
	To mobile terminal	(TGe) OFDM : 256, OFDMA : 128, 512, 1024, 2048		
RF Band	Infrastructure	Relay mode and PMP mode share a same frequency band or use different but adjacent frequency bands		
	Client	Relay mode and PMP mode share a same frequency band		

- The considered scope in a new relay mode is filled with cyan color

# Concept of Proposed Relay mode

- Fixed RS for infrastructure relay

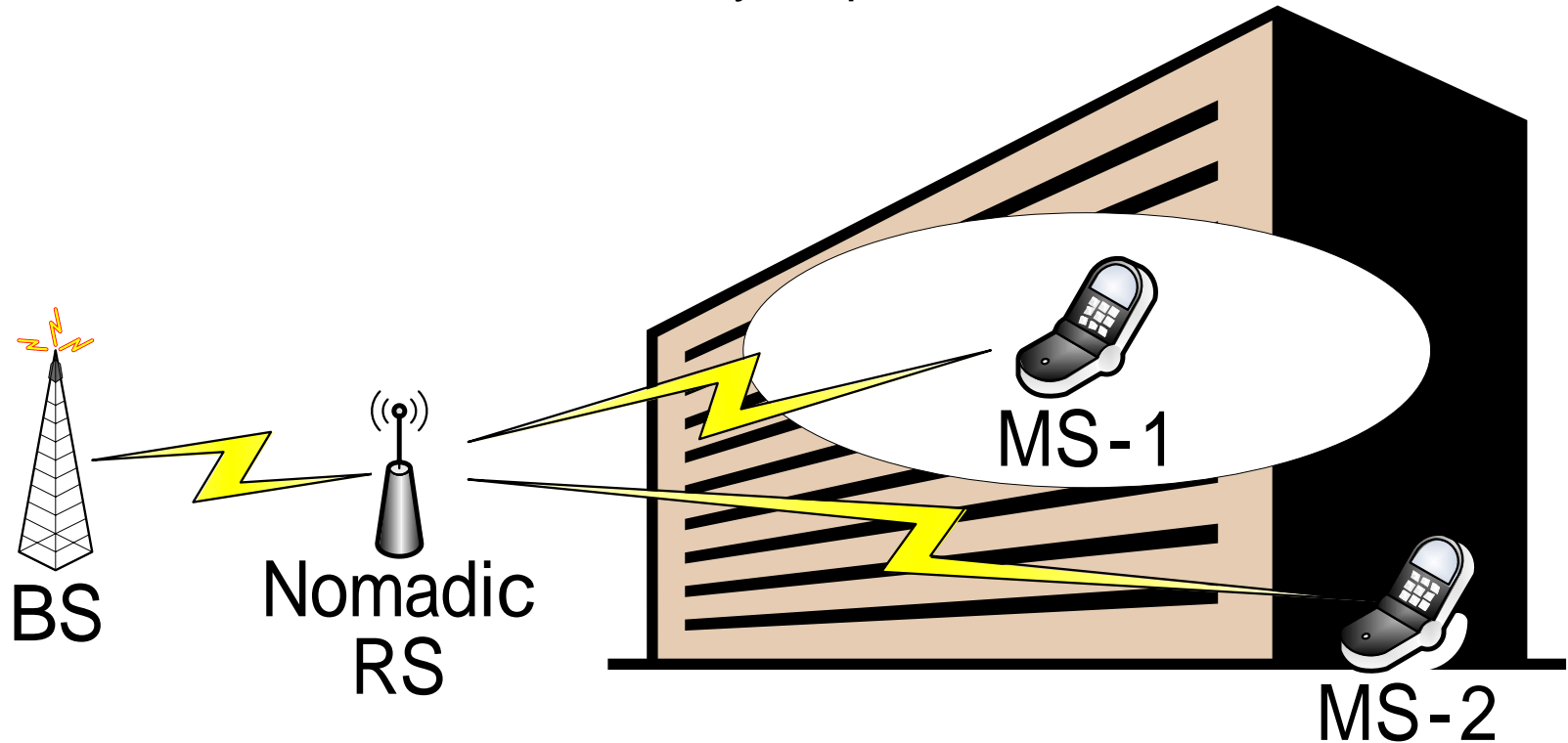


- RS is located within BS coverage
- RS connecting with BS shares radio resource with other SS/MS

# Concept of Proposed Relay mode

(cont'd)

- Nomadic RS for infrastructure relay
  - Providing BWA service for an event, exhibition etc.
  - Nomadic RS shall be installed by an operator

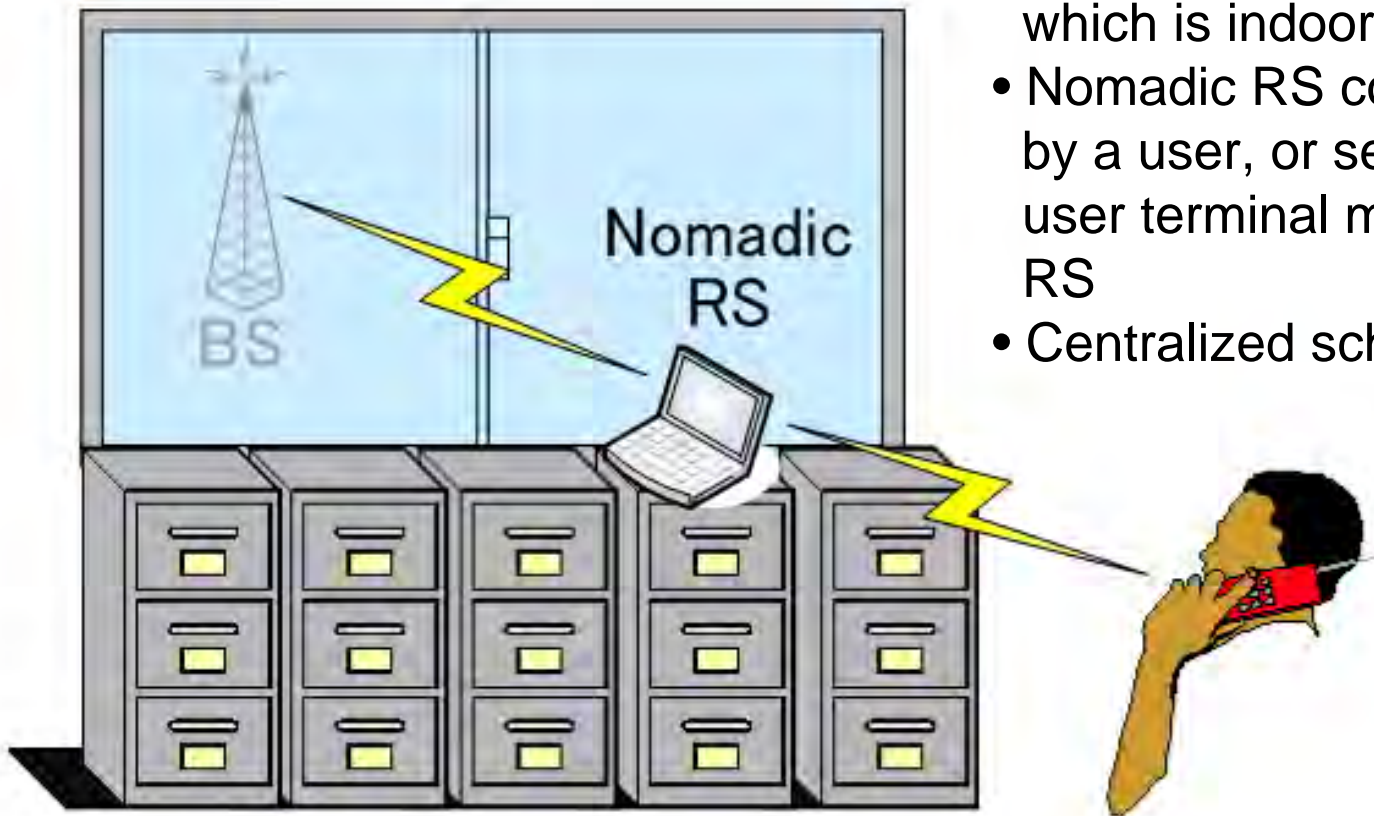


# Concept of Proposed Relay mode

(cont'd)

- Nomadic RS for client relay

- Coverage extension to SS/MS which is indoors
- Nomadic RS could be installed by a user, or semi-stationary user terminal might be a nomadic RS
- Centralized scheduling by BS



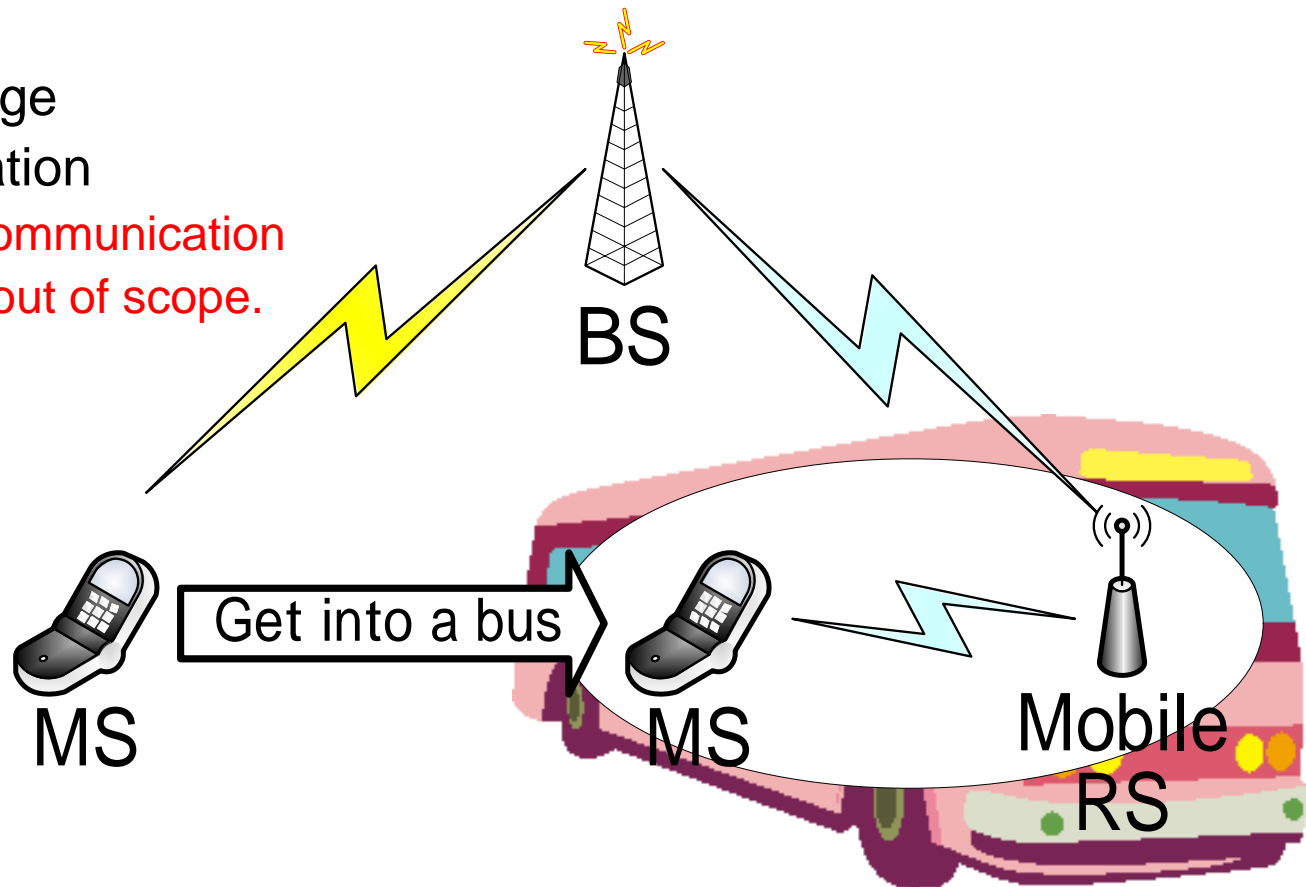
# Concept of Proposed Relay mode

(cont'd)

- Mobile RS for infrastructure relay

- Mobile RS is located within BS coverage
- Optimal route change according to a situation

**NOTE :** Inter-SS/MS communication like ad-hoc network is out of scope.



# Distinctions

- Current Mesh mode in Std 802.16-2004
  - No compatibility with PMP mode
    - PHY Different frame structure (not compatible to PMP mode), OFDM only (for both licensed and unlicensed bands)
    - MAC Different Network Entry procedure (not compatible to PMP mode)
  - No support for TGe MS (no a fast route change for MS)
- Main differences between **Proposed Relay mode** and the Mesh mode
  - Efficiently provide Relay connection to SS/MS
  - Support OFDMA as well as OFDM PHY mode
  - Backward compatible to PMP mode
  - One of the end of relay path should be at BS

# Tentative Schedule

- Starting new Study Group / Task Group

Year	Month	802.16 session	Actions
2005	July	#38 Plenary	Propose to form SG – Approved
	Sept.	#39 Interim	SG: the 1st meeting
	Nov.	#40 Plenary	SG: the 2nd meeting
2006	Jan.	#41 Interim	SG: the 3rd meeting – Complete a PAR
	Mar.	#42 Plenary	802 EC endorses PAR approval
	May	#43 Interim	TG: the 1st meeting
	July	#44 Plenary	TG: the 2nd meeting
	Sept.	#45 Interim	TG: the 3rd meeting
	Nov.	#46 Plenary	TG: the 4th meeting



# Summary

- Propose a new SG of Relay mode for fixed / mobile terminal
- Working scope
  - PHY: Enhance normal frame structure
  - MAC: Add new protocols for the Relay networking
- Main features
  - Tree structure: one of the end of relayed data path should be at BS
  - Efficiently provide Relay connection to SS/MS (with small number of hops)
  - Support OFDMA as well as OFDM PHY mode
  - Backward compatible to PMP mode
  - PMP & Relay modes : share a same band, or use different but adjacent bands
- Considered RS types
  - Fixed Infra RS, Nomadic Infra/Client RS, Mobile Infra. RS
- ❖ dot16 “forum” website: <http://dot16.org/forum/>