Proposed enhancements to IEEE 802.16 MMR PAR and Five Criteria

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Base Document:

None

Purpose:

This is a response to http://ieee802.org/16/sg/mmr/docs/80216mmr-05_026.pdf (call for comments and Contributions: IEEE 802.16's Study Group on Mobile Multi-hop Relay) to present some discussion material.

Proposed enhancements to IEEE 802.16 MMR PAR and Five Criteria

Intel Corporation

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Phased Approach to Developing MMR Standards

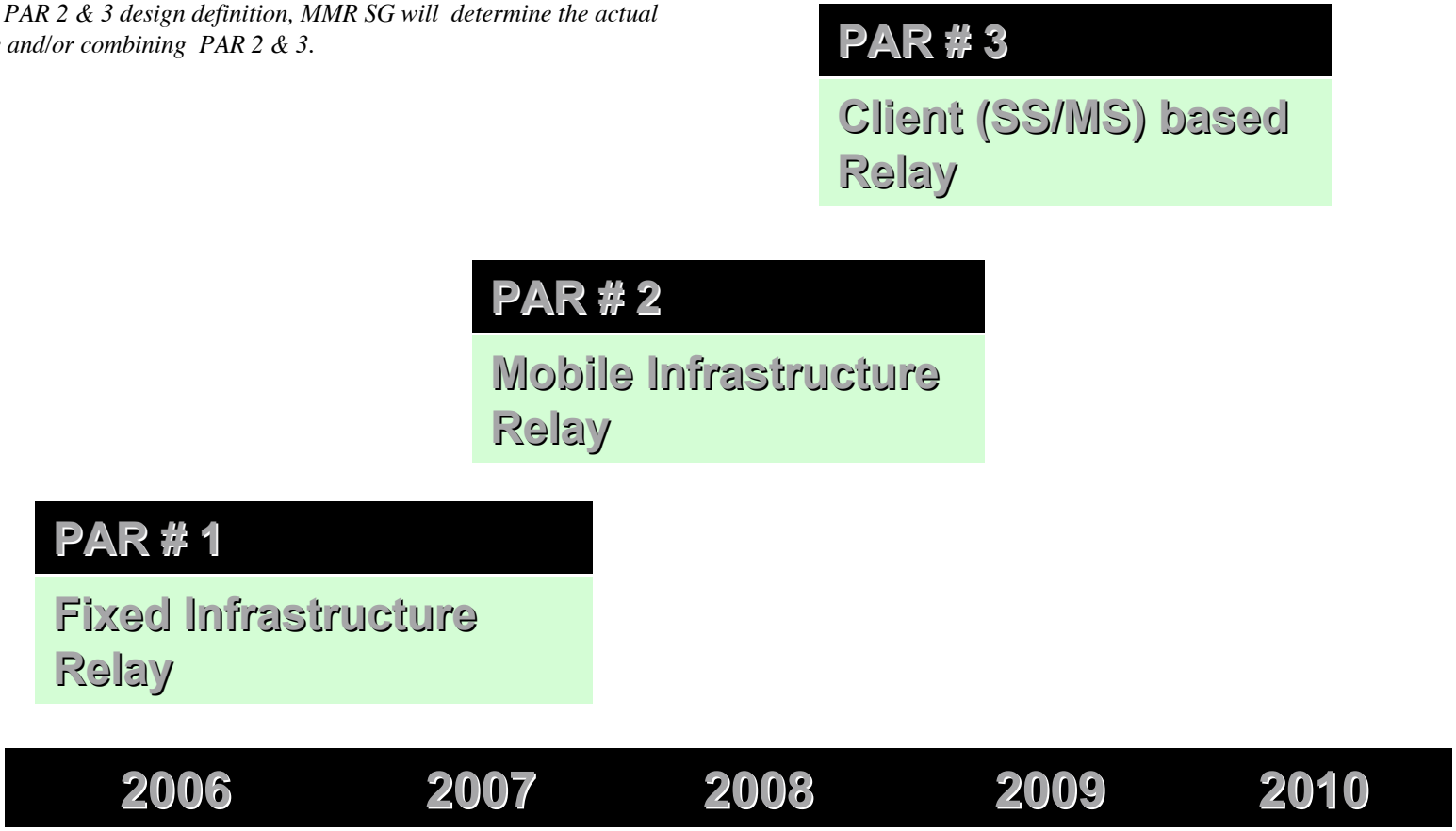
- **Approach**
  - Define and develop MMR standard as series of distinct phases
  - Each phase captures a set of 'complementing' system level requirements on the MMR RAN
  - Each phase developed as a separate project (separate PAR)

- **Rationale**
  - Projects have more specific scope
    - Better chance of timely closure
    - Allows incremental technology adoption and efficient product development
  - Innovation is not artificially limited
    - Advanced features are specified in later phases

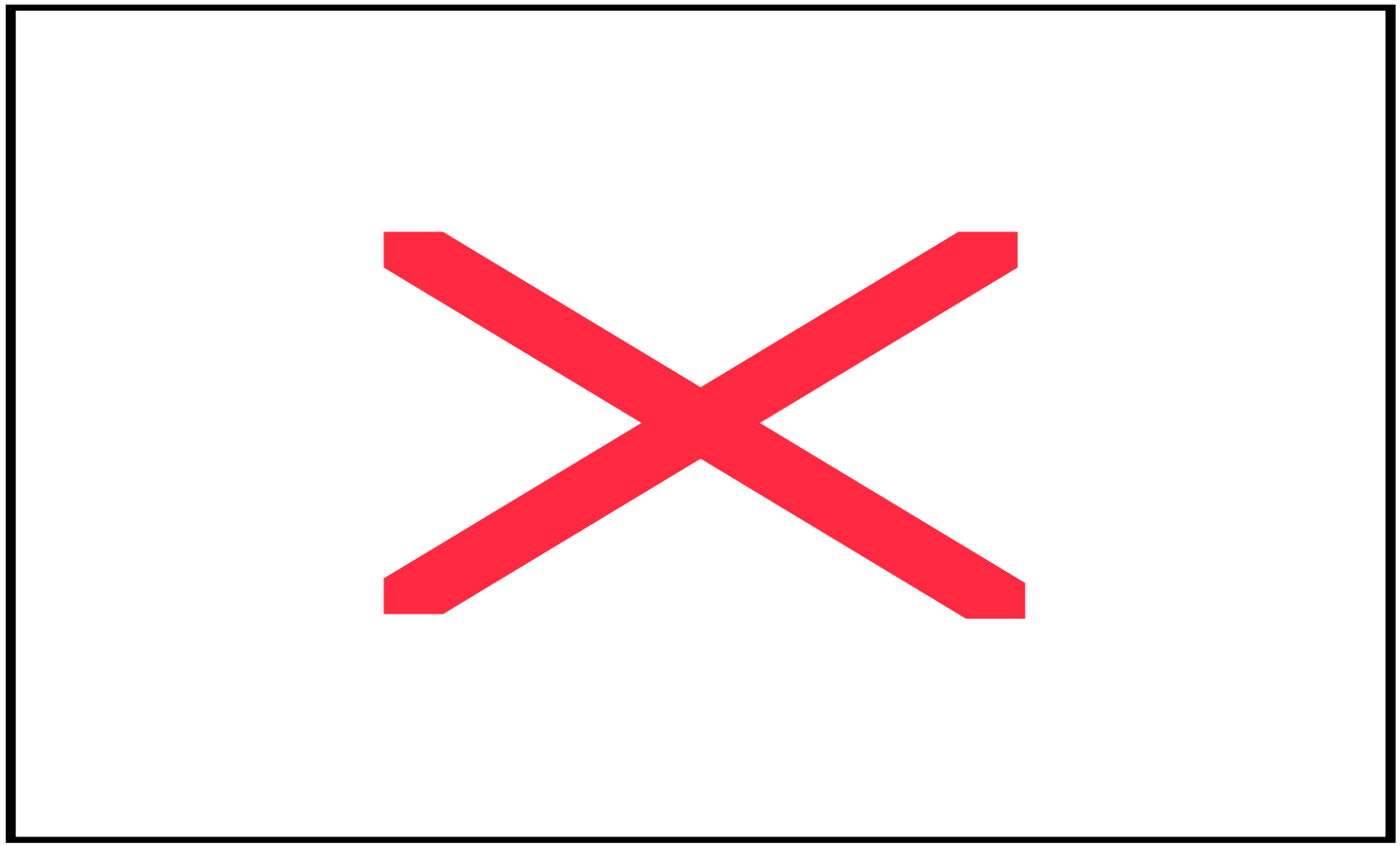
Roadmap to MMR Standards Development

Note :

- *Timeline below are proposal for start date which illustrates the phased approach concept . Actual start dates will be determined by MMR SG based on a clear design definition of PAR 2 & 3.*
- *Based on PAR 2 & 3 design definition, MMR SG will determine the actual start date and/or combining PAR 2 & 3.*



Phase 1: Fixed Infrastructure Relay



Phase 1: Fixed Infrastructure Relay

- Define extensions to OFDMA PHY/MAC to support
  - Enhancement of BS to support MMR
  - Definition of fixed (not mobile) Relay Station (RS) PHY/MAC to support MMR
- Backward compatibility with IEEE 802.16 OFDMA SS/MS
  - 802.16 OFDMA SS/MS must interoperate with MMR RAN with no modification to the SS/MS.
  - 802.16 OFDMA SS/MS must realize all benefits of MMR

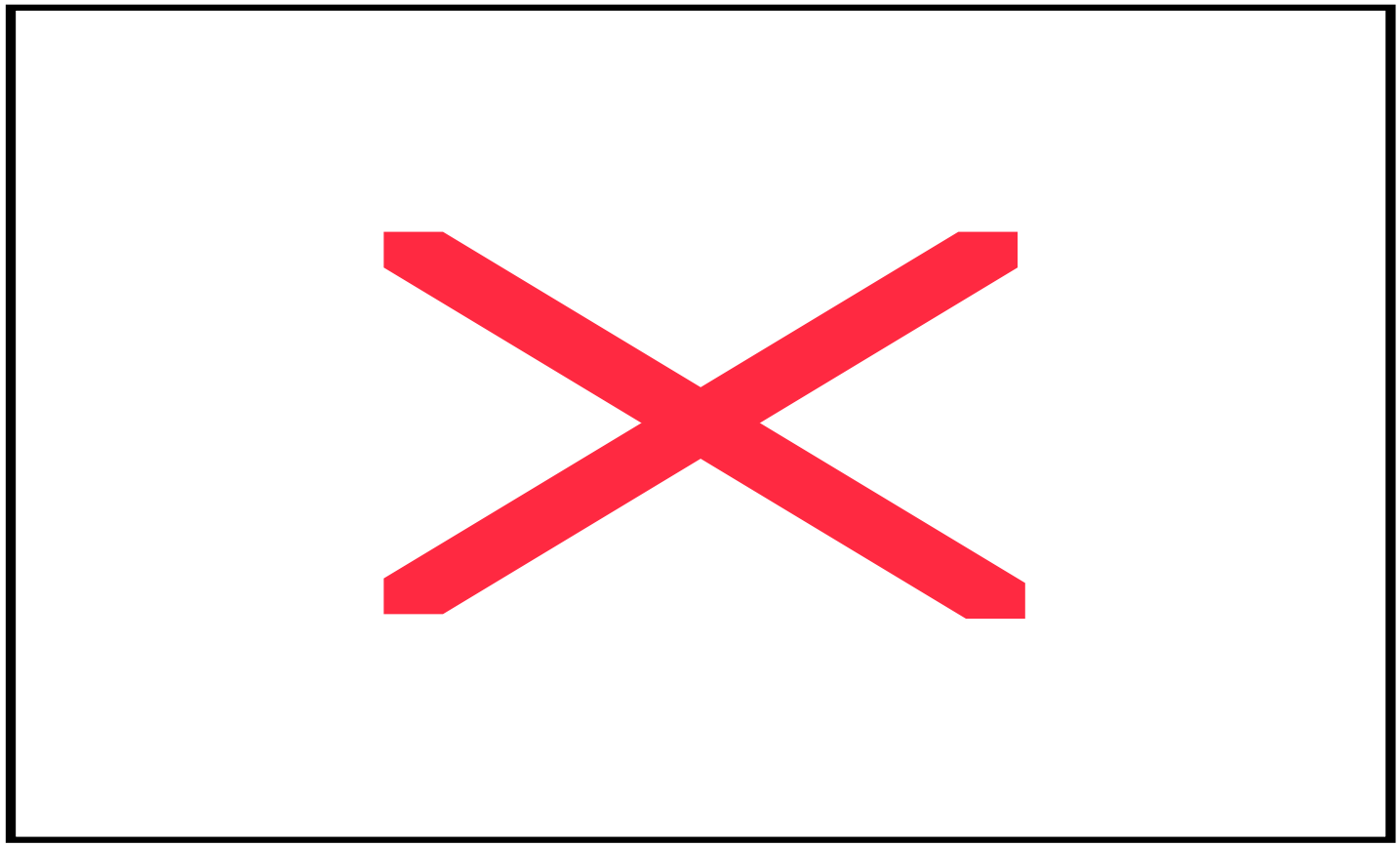
Why Start with Fixed Infrastructure Relay?

- Use of fixed relay stations provides gains in range and capacity
- Backward compatibility with clients will allow service providers to selectively upgrade infrastructure
- Limit the complexity in the first phase
  - The current PMP air interface design is not well suited for client-client relay. In order to support client-client relay, there will be a large amount of work to just define the protocol, especially on the client side
  - Client relay requires additional functions to be supported at client

Why OFDMA-based MMR?

- We propose to limit the scope of MMR to a single OFDMA-based PHY-layer implementation
- Such focused effort shall facilitate the completion of the standard within a shorter time period
- OFDMA has already been adopted for .16e
- OFDMA provides much higher flexibility in terms of utilizing the frequency resources compared with OFDM-based approaches
- OFDMA enables opportunistic scheduling of the users based on their channel quality and improves network sum rate due to multi-user diversity gains
- OFDMA supports wider channel required for Relaying

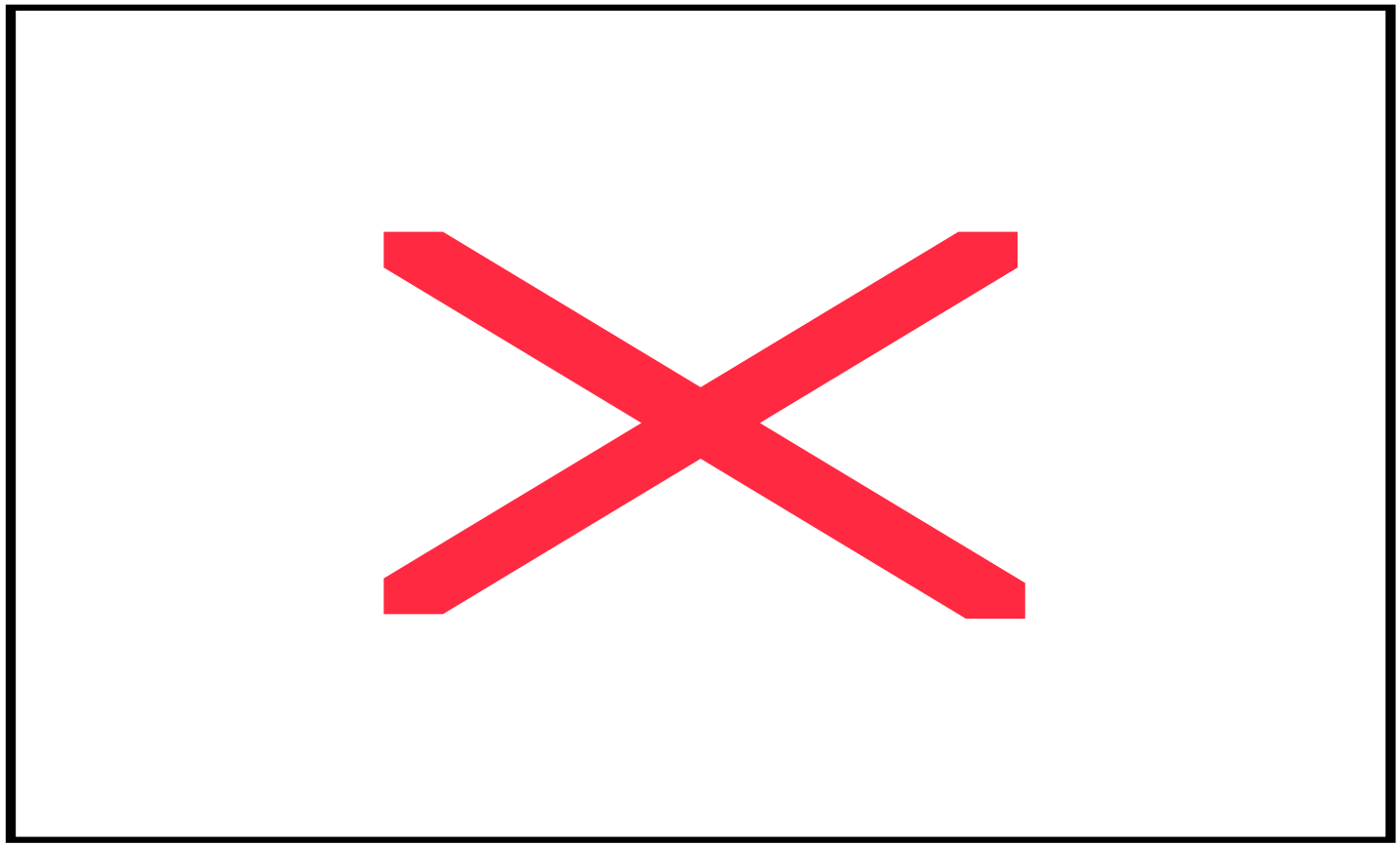
Phase 2: Mobile Infrastructure Relay



Phase 2: Mobile Infrastructure Relay

- **Mobile relay stations**
  - Centered on infrastructure not on client
- **Rationale**
  - Unlimited power supply unlike client
  - Dynamically grow. Add and remove the capacity coverage based on the operators dynamics.
    - Example: Trains, Public Safety, Emergency, Disaster Relief, Government or Military communication.

Phase 3: Client Based Relay



Phase 3: Client Based Relay

- **Client based relay (fixed / nomadic / mobile)**
  - No SS-SS direct (infrastructure free) link shall be considered
  - Multiple SS nodes can cooperatively transmit to RS or BS or receive from RS or BS
  - Potential performance enhancements from multi-hop and cooperative communication across multiple client relays
  - Cross layer design for OFDMA PHY/MAC of SS/MS

- **Rationale**
  - Useful for emergency, disaster relief, military communications
  - Throughput and coverage improvement
  - Client based relay can use cooperative diversity to improves link reliability against fast fading and shadowing variations
    - Open loop (virtual STC) or closed loop (distributed beam-forming) based cooperation both provide significant performance gains

PAR Enhancements

- **Scope Section** :
  - This document provides enhancements to IEEE Std. 802.16 by proposing multi-hop relay techniques between base stations and fixed infrastructure relay stations. Modifications to the OFDMA PHY and MAC layers will be specified. Subscriber stations operating according to the existing standard shall be capable of operation with relay-enhanced infrastructure with no modifications.

- **Compatibility Section** :
  - The proposed amendment will allow IEEE 802.16e (P-MP mode) clients to continue to operate in 802.16 network.

- **Additional explanatory notes Section** :
  - This project is envisioned as the first state in the development of standards for mobile multi-hop relays. The intent of the first phase (as proposed in this document) is to define standards that allow base stations and fixed relay stations to operate in a multi-hop relay configuration, while not requiring any changes in 802.16 OFDMA subscriber stations and mobile stations. Future phases are expected to enable additional capabilities including mobile relay stations and client based relays.

Summary

- MMR standard development as series of distinct phases. Each phase captures a set of 'complementing' system level requirements on the MMR RAN
- Initial focus on infrastructure (RAN) based fixed relay
- Limit the scope of MMR to a single OFDMA-based PHY-layer implementation