Stationary-systems based relaying: Relay definition

IEEE 802.16 Presentation Submission Template (Rev. 8.3)

Document Number:

IEEE C802.16j-06/018.

Date Submitted:

2006-05-~~04.~~

Source:

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Venue:

IEEE 802.16 Session #43, TelAviv, Israel

Base Document:

None

Purpose:

Descriptions of some common relay scenarios and the relay characteristic and frame structure derived from these scenarios.

Users' stationary-systems based relaying Relay definitions

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Scope

- Starting from a relay deployment scenario we derive the most suitable relay characteristics and frame structure
- The relay deployment is based on users' stationary systems
- Taking advantage of WiMAX stationary and mobile features

Rational

- Operators can use their base of deployed stationary-stations as relays and provide service to mobile stations and remote stationary-stations
- Examples of stationary stations at fine locations: DBS subscribers, Multi-tenet buildings, Municipals, Utility
- **No location rental fees**
- Opportunity based relay deployment (activation of stationary station) Dedicated relay deployment as last option

We need to be able to add the relay functionality to a stationary station at a low added cost

Outline

- DBS operator scenario

  ➔ Stationary station with added relay functionality

- Relay characteristics

- Radio planning

- Frame structure

DBS - Massive rooftops presence

WiMAX used for uplink channel and non-broadcast downlink channels

WiMAX transceivers located on the rooftop and signals are multiplexed to the set-top box via the coax.

Relay-definition driving factors (1)

High density of DBS subscribers per-area

AND

Most DBS subscribers have rooftop antenna

AND

Many rooftops have a good link to BS (LOS, Near LOS)

RESULT IN

- Adding relay capabilities to DBS subscribers antennas dramatically increase coverage (if user cannot detect BS) and capacity (if user cannot receive BS with high QAM)
- Added relay capabilities need to be low cost

Relay-definition driving factors (2)

Relay functionality is piggybacked on the subscriber equipment

MEANS

Relay belongs to the user. Not to the operator

THAT IS

User may unplug the power of the antenna

RESULT IN

Redundancy of relays is a must!

Relay station requirements

- Low cost

  ⇒BS/RS task partitions that minimizes RS cost and traffic overhead

  ⇒Centralized scheduling and MAP building at BS

  ⇒Message tunneling

BS/RS Task partition 1

- RS⇔MS traffic is fully controlled by the BS
- No scheduling and policing is done at the RS
- Relay (whether functions as relay or not) constantly performs channel quality measurements and detects CDMA code and other uplink data as indicated by the BS
- Relay reports to the BS
- BS uses this information to change receiving responsibility (uplink rout) of a given MS and in traffic engineering in the scheduler

BS/RS Task partition 2

- Messages and data are generated at the BS, delivered encapsulated to the RS, stripped and send to the MS
- Data can be relayed in the same frame or in a later frame depending on the relay capabilities.
- If a data is to be sent simultaneously by more than one relay, the BS multicasts the data to all relevant relays
- The header of the tunneled message indicates where and how the RS should send it (subchannel, symbol, FEC, modulation, STC format, etc.)
- The content of the tunneled message is the data sent by the RS to its MS

Scheduler

- The price paid for opportunity based relay deployment is a more complex scheduler at the BS
- The BS continuously gather information regarding quality of all the links MS⇔BS⇔RS⇔MS, RS⇔RS.
- Scheduler determines the best routs and best diversity to use in each part of the frame for each user
- Scheduler build the BS and the relays' frames (and MAPs)
- Relay-frames are sent as encapsulated MAC messages to the relays
- Maximizing BW utilization while keeping QoS

Relay vs. BS radio planning 1

In BS-only system

- MS communicates to BS it receives best
- BS radio and power planning

In mixed BS/relay system

- Relay location and operation are less controlled
- Station can be masked by a nearby relay and communicates to a BS since it has the same link quality as the relay

Relay vs. BS radio planning 2

Relay masking handling:

⇒PUSC provides some relief …

⇒Tradeoff between

1) Relay not transmitting preamble, FCH, MAP and
2) User relayed at twice the BW cost

BS and relays' preamble, FCH, and MAP are transmitted together although relay can be half-duplex

⇒BS sends MAPs to relays (as dedicated messages or as Sub-MAP) at a location indicated in previous frames

⇒The relay powers up as user, synchronize to BS and identifies itself as relay capable. When activated as relay it keeps synchronizing without BS preamble

Relay vs. BS radio planning

BS only system	BS & RS system
MS communicates to BS it receives best	MS may communicates to the BS while masked by nearby RS
BS power planning	RS coverage area overlap Large fringes area
BS static coverage	RS coverage changes with RS availability

Roadmap

- Relay defined performs simple tasks
- Small set of MAC messages for RS⇔BS needed
- Most complications are in the BS SW

☝ In the proposed relay definition the relay can be developed and supply early and future upgrades are confined to the BS SW

Thank you