Project	**IEEE 802.16 Broadband Wireless Access Working Group** <http://ieee802.org/16>	
Title	**Frame Structure for Relay and Femto Cell Support in TGm**	
Date Submitted	**2008-01-16.**	
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Re:	IEEE 802.16m-07/047: Call for Contributions on Project 802.16m System Description Document (SDD) (2007-12-17), Proposed IEEE 802.16m Frame Structure with special attention to legacy support.	
Abstract	This contribution proposes a frame structure to support Relay station and femto cell. It is related to the CP length, uplink synchronization, and random access for network entry.	
Purpose	Adoption of proposed text into SDD	
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Frame Structure for Relay and Femto Cell Support in TGm

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ETRI

Purpose

The purpose of this contribution is to propose a frame structure to support Relay station and femto cell.

Relationship between CP length and uplink synchronization

OFDMA symbol duration consists of the cyclic prefix time and the useful symbol time. The FFT window for data demodulation can start from any point in the CP region where there is no ISI caused by the previous OFDMA symbol to the point where the useful symbol starts (see Fig. 1).

The reason why the FFT start point does not have to be exactly aligned with the start of useful symbol time is that the cyclic shift by FFT window sliding can be completely equalized by channel estimation and correction.

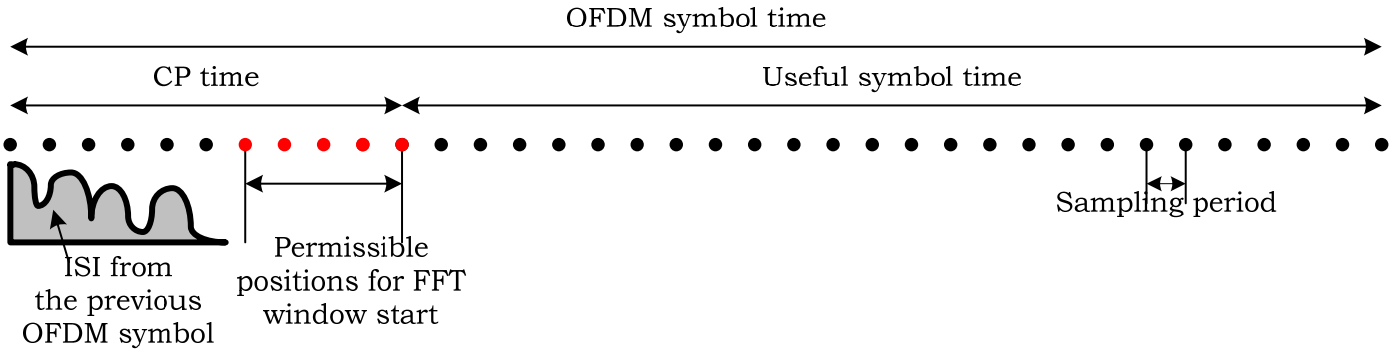

Fig. 1. Permissible positions for FFT window start for data demodulation.

In the legacy system, MSs acquire the frame and OFDMA symbol synchronization using downlink preamble, but each MS has different timing reference depending on its location in the cell. In order to resolve these timing differences between mobile stations, the legacy system has specified uplink synchronization (ranging) procedure. For the same reason, the uplink synchronization is also necessary in the Relay Zone and Femto Cell.

The main purpose of uplink synchronization is to reduce overhead, imposed to CP due to round-trip delay caused by the distribution of MSs in the cell. In the Relay Zone, if we use the CP large enough to reflect maximum channel delay as well as round-trip, and the Relay station takes samples during the useful symbol time defined by the specification for FFT, we don't have to consider uplink synchronization anymore.

Since the transmission power of Relay Station and Femto Cell is small, the coverage of them is also small. Under the assumption of low transmit power conditions, round-trip delay as well as maximum channel delay is not large. Therefore, it's not much burden to allocate resource to CP large enough to exclude uplink synchronization in the Relay Zone.

Reflect the following text proposal to the SDD.

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Text Proposal

There are three different CP lengths for

- Non Relay Zone: use CP1 to combat large maximum channel delay
- DL Relay Zone: use CP2 to combat small maximum channel delay
- UL Relay Zone: use CP3 to combat small maximum channel delay and to exclude uplink synchronization

Generally $CP_1 \geq CP_3 \geq CP_2$, where $CP_3 = CP_2 + RoundTripDelay$ in the Relay Zone.

In case where the same CP length as in the macro cell is used in the Relay Zone $(CP_1 = CP_3 = CP_2)$, it is not necessary to define uplink synchronization in the Relay Zone.

A new class of small base stations, called femto cells, will provide indoor wireless coverage to MSs using existing broadband Internet connections like DSL with lower transmit power levels of 10-100 mW. In femto cells, the same CP length should be used as in the macro cells. Since this CP length is large enough to accommodate both the round trip and maximum channel delay, it is not necessary to define uplink synchronization in the femto cells.

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References

[1] IEEE 802.16m-07/002r4, TGm System Requirement Document (SRD)

[2] IEEE 802.16m-07/037r2, TGm Evaluation Methodology Document (SRD)