INVENTION DISCLOSURE

1. Invention Title.

A method for a CM to optimize initial ranging of multiple channels for DOCSIS 3.0 in a plant with strong linear distortion

2. Invention Summary.

Similar to storing the power level, this invention proposes storing the pre-equalization coefficients along with upstream channel ID in non-volatile memory at the CM This invention proposes a mechanism for DOCSIS 3.0 CMs to optimize the performance of initial ranging in a strong micro-reflection environment when multiple channels are supported by applying the pre-equalization values extrapolated from the first channel in the ranging request for the subsequent channels as long as there are no stored pre-equalization coefficients. In the case of re-initialization of the modem, if the upstream channel has not changed, using the stored pre-equalization should be given precedence over the values used for the first channel. A benefit of this proposed mechanism is to reduce the burden on the CMTS in massive outage situation as the modems are brought back on-line. An added benefit of this mechanism is in reducing the time for the cable modem to achieve high fidelity transmission in both scenarios: massive outage or normal CM initialization process. The same approach is also valid in the case when the frequency of a channel in a MD-US-SG is changed or a new channel is added to the MD-US-SG.

3. Invention Description.

a. Describe the invention in detail and/or attach a description, drawing(s) and/or diagram(s), if available. Please include flow charts for descriptions of software processes, and block diagrams for descriptions of hardware systems. Include the description/attachments in electronic form if possible.

When multiple channels are supported using D 3.0 modem, the current approach is for the modem to range on the first channel according to the transmit channel set in the MDD message. The CM sends a ranging request for the first channel according to the Bonded Initial Ranging process and receives a ranging response from the CMTS providing the pre-equalization parameters to adjust for plant distortion. CMTS provides minor adjustments after the channel is ranged and operational to correct for distortion. This initial process of sending the ranging request and receiving the pre-equalization coefficients is repeated in the “Continue US Ambiguity Initial Ranging” process for the other channels. Instead of sending the ranging request without pre-distortion for the subsequent channels, this method proposes that the CM reuse the pre-equalization coefficients stored in the non-volatile memory (if available) or extrapolated from the first channel coefficients. With this approach the subsequent channels “INIT-RNG-REQ” messages are pre-distorted, thereby reducing the time taken to achieve high fidelity transmission. Such an approach can optimize the time it takes to converge because the

CMTS would only need to make minor adjustments. The method considers the pre-equalization extrapolation scenarios for when the widths of the multiple channels are same or different in an environment where there is negligible frequency dependence of the micro-reflection. Two processes are defined below to determine the required pre-distortion:

Step 1: Selecting the reference channel to use for pre-distortion with the following priority:

a. An already ranged channel C1 that is closest in frequency AND matches channel width
b. An already ranged channel C2 that is closest in frequency

Step 2: Pre-distortion Calculation Process

If the selected channel belongs to category (a) in Step 1 then use the pre-equalization coefficients of C1 either directly or with minor adjustments due to internal distortion.

If the selected channel belongs to category (b) in Step1, then adjust the coefficients to account for both frequency shift and channel width change.

See the attached paper for more details on the algorithm.

b. Why was the invention developed? What problem(s) does the invention solve? How is it better?

The pro-active maintenance model was developed to define a method that members can use to localize fault by using the tools in DOCSIS. During these discussions we realized that the process of ranging multiple channels after one channel is ranged can be optimized by applying the pre-equalization parameters for the first channel to the other channels before transmitting a ranging-request.

c. Briefly outline the potential commercial value and customers of the invention.

Operators are planning to deploy US Channel bonding feature defined in DOCSIS 3.0 for offering higher and symmetric data rate services. The current approach for ranging on multiple channels can be optimized so that the channels can become operational faster. In some cases, it is possible to apply the corrections used in the first ranged channel to the other channels and decrease the time to bring the modem operational on all the channels. The value is in reducing the processing done at CMTS to calculate the values by starting with a reasonable approximation and making minor updates.

4. HOW is your invention different from existing products, processes, systems? Please list the closest publication(s), product(s), method(s), patent(s), etc. to your invention. <u>For each item, how is your invention different?</u>

This disclosure uses the analysis defined in the previous disclosure and applies it to improve the time required to activate multiple channels, a feature defined in DOCSIS 3.0. This is specific to DOCSIS feature and we are not aware of other patents on this topic.