INVENTION DISCLOSURE

1. **Invention Title.**

Method for detecting bandwidth demand for a modem in low power mode

2. **Invention Summary.**

This invention describes a method by which the CMTS can determine that a CM should be moved out of a low power state.

3. **Invention Description**.

The DOCSIS 3.1 system under development supports a DOCSIS Light Sleep (DLS) mode of operation in which modems that do not presently require a high data rate, and that can presently tolerate a higher packet transmission latency, can be put into a low power (energy saving) mode that results in a significant reduction in power consumption. The expectation is that modems that are not actively being used by the customer would fall into this category. The common transmissions for modems in this "low power set" might be made much less frequently than for modems in the other sets. For example, transmissions may be made on the order of every few hundred milliseconds as opposed to every few hundred microseconds. In the interval between common transmissions, the modems in this set can turn off their receiver circuitry in order to save power, while the CMTS buffers any data transmissions for these modems until the next common transmission time.

For this low power mode of operation to be effective, the CMTS would need to automatically move modems into the low power set when it determines that they presently do not require a high data rate, and automatically move modems out of the low power set when it determines that they presently do require a high data rate.

Data forwarding rate (and recent history) can be used along with defined thresholds in order to trigger a modem to enter/exit the DLS mode. However, this may result in sluggish exit behavior. In particular, the TCP algorithm utilizes a "slow-start" mechanism in which it ramps up sending rate in an attempt to determine the channel capacity without causing excessive congestion. As a result, the packet forwarding behavior in DLS may interfere with the slow-start algorithm such that TCP stabilizes at a sending rate that remains below the exit bit rate criteria. For example, during DLS the CM's sending rate and MAC access frequency are artificially low, and as a result it is likely that a TCP session (as it ramps up its congestion window during slow start) will experience premature packet loss, which signals TCP to back off and to seek a transmission rate that can be accommodated by the DLS forwarding behavior.

This invention utilizes additional information derived from the traffic pattern in order to detect that the modem should exit DLS. Specifically, the CM or CMTS monitors TCP SYN packets (upstream and downstream) to detect establishment of new TCP sessions, and it monitors queue utilization and packet loss to detect slow start ramp up and premature packet loss. A heuristic decision would then be made to exit DLS based on the presence of TCP SYN packets, the levels of queue utilization and any packet loss events caused by queue exhaustion. As a result the decision is made not just on the amount of traffic that is being sent by the device, but by detecting the desire by applications to send more traffic than the DLS mode allows.

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

This invention would allow CMs to remain in a DLS low power mode for a greater percentage of time while minimizing the user impact of such a mode. By quickly recognizing TCP activity and

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responding to the TCP congestion avoidance algorithm, bit rate thresholds can be set at higher levels so that quiescent, background traffic doesn't falsely trigger the modem to exit DLS.

4. **How is this invention different from existing products, processes, systems?**
DOCSIS 3.0 defines bit rate triggers for entry/exit from Energy Management 1x1 Mode.