INVENTION DISCLOSURE

1. **Invention Title.**

TDM for OFDM with DOCSIS Secondary Downstream Channels

2. **Invention Summary.**

This invention proposing doing Time Division Multiplexing to allow OFDM signals to share the same downstream spectrum being used by DOCSIS 3.0 secondary sing-carrier QAM downstream channels.

3. **Invention Description**.

a. Describe the invention in detail.

DOCSIS 3.0 defines two types of downstream channels: primary and secondary. Each modem is assigned a single primary downstream channel, which it uses to receive timing/synchronization information, MAC management messages, etc. In addition, each DOCSIS 3.0 modem can be assigned 1 or more secondary downstream channels, which are used for receiving data but not for synchronization. Further, DOCSIS 3.0 defines the concept of "partial channel mode", where if one or more secondary downstream channels are lost the modem will continue to operate on the remaining downstream channels (which could be as few as just the primary), and will continue to attempt to re-acquire the secondary downstream channels in the interim. It will also notify the CMTS that it is in partial channel modem if it is configured to do so. Because the modems do not use the secondary downstream channels for timing, upstream operation is completely unaffected when the secondary downstream channels are lost.

This invention proposes taking advantage of the above to allow a DOCSIS 3.1 CMTS to use the same spectrum used by those DOCSIS 3.0 secondary downstream channels to transmit OFDM signals to DOCSIS 3.1 modems.

For example, let's say that CM1 is a DOCSIS 3.0 modem that is receiving on 8 downstream channels (1 primary and 7 secondary). CM2 is a DOCSIS 3.1 modem that has OFDM receive capability, set to receive across 200 MHz of spectrum that overlaps with the secondary downstream channels received by CM1. The CMTS is a DOCSIS 3.1 CMTS that transmits both OFDM and DOCSIS 3.0 bonded single-carrier QAMs. During time period 1, the CMTS transmits to CM1 using the 8 bonded single-carrier channels (covering 42 MHz for J.83 Annex B for 7 6 MHz channels), and to CM2 using the remaining 158 MHz of spectrum. Then during time period 2, the CMTS stops transmitting on the 7 secondary downstream channels, but continues to transmit on the primary downstream channel, and transmits the OFDM signal across the full 200 MHz. The CMTS can dynamically switch back and forth between these two states as needed; it can also adjust the number of secondary channels that are removed at any given time based on need.

When the secondary downstream channels are removed, CM1 will enter "partial channel mode" where it will continue to stay online (because the primary downstream is still present) and attempt to re-acquire the secondary downstreams. If configured to do so, the CM will transmit a status message to indicate that it lost those downstream channels

INVENTION DISCLOSURE

(although presumably this would be turned off to avoid messages that don't represent a true error – during this time, because the CMTS knows these channels are turned off, it will not transmit data to CM1 using the secondary downstream channels, so notification is not needed). When the CMTS re-establishes transmissions on those secondary downstream channels, the modem will reacquire and be prepared to start receiving data again.

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

The need to incrementally add DOCSIS 3.1 OFDM bandwidth to existing DOCSIS 3.0 bandwidth pushed us in the direction of requiring packet based channel bonding between the OFDM and SC-QAM PHYs, which adds complexity. However, this was based on an assumption that because DOCSIS downstream channels are "broadcast" in nature, it would not be possible to switch them on and off in time. However, this invention proposes to leverage the nature of secondary downstream channels to overcome this issue, and thereby avoid the complexity of packet based bonding.

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

This invention could be included in the DOCSIS 3.1 specifications, which could have very large commercial value.

Additionally, as an extension of this same concept, if a single headend device transmitted both DOCSIS and EPoC, this could be used to share spectrum between DOCSIS 3.0 devices and EPoC devices.

4. **HOW is this invention different from existing products, processes, systems?**

This invention is specific to sharing spectrum between DOCSIS downstream carriers and OFDM, specifically leveraging the nature of DOCSIS 3.0 secondary downstream channels to do so.