1. **Invention Title.**

Method of Interference Avoidance on Cable

2. **Invention Summary.**

A wideband tuner detects interference on an occupied or un-occupied RF channel. MAC messages are used to instruct the controller to avoid this RF channel or to use more robust modulation or more powerful forward error correction.

3. **Invention Description**.

a. Describe the invention in detail.

Measure LTE interference with cable channel on a LTE frequency inside the CM or STB. If there is interference, send a MAC message back to the scheduler (CMTS, DAC, or DNCS) and the scheduler will not send content (data or video) on this frequency in the future. So the frequency could be in a DOCSIS downstream bonding group or a VOD frequency.

Currently there is no way to implement this, given the detection MIBS don't yet exist, or don't work well. Also, detection would need to occur on an already-occupied channel at a very low RF level. So this would require a detection method, such as instability in the downstream equalizer coefficients.

Another problem is no available tuner to check for interference on RF channels. This has been solved with the advent of full-band digital tuners. So a tuner could be created to hunt for interference. Statistics could be stored and forwarded from the CM or STB.

So the Cable system could automatically adapt to the subscriber bringing home a new wireless device. A Verizon customer would get a different forbidden frequency list than an ATT customer. Furthermore, the terminal device could track interference and report it. This would allow transmissions to be customized for time-of-day or day=of-week.

The good thing about this solution is that it is backwards compatible with deployed CM and STB devices, albeit with some frequency re-alignment on the system and new firmware download to the CM/STB. It would also work for non-LTE interference sources, such as UHF terrestrial broadcast or police radios, which will vary greatly in interference level, depending on location.

RF interference avoidance is known in the art. However new methods to detect a local problem, re-assignment of service frequencies and historical tracking may be novel.

Avoiding Interference from LTE Transmissions Using Spectrum Analysis Functionality in Terminal Equipment

Problem:

LTE (long term evolution) radios have been assigned off-air frequencies that are currently being used for cable systems. This causes a number of interference scenarios:

1. The transmission from a LTE handset gets into a STB (set top box). Interference with current boxes starts at about 10 feet, and the STBs are typically producing no picture at 3 feet.

2. Leakage from cable plant interferes with LTE reception at LTE towers.

3. LTE base stations interfere with STB reception. This problem also extends to other broadcast carriers, such as VHF/UHF 8-VSB broadcast TV pictures.

Solution:

Newer versions of CMs and STBs will have an ability to monitor a spectrum and measure the interference. Furthermore, the frequency that a STB uses to receive a signal, such as a switched digital video (SDV) or video on demand session (VOD), can be assigned with some flexibility. Furthermore, the addresses of where the STBs are located is known to the OSS (operation support system), and with a little research you can determine where the LTE cell sites and UHF broadcasters are located.

Our solution is to create a data base entry for each subscriber and each node to identify what potential interference is possible, and what interference has been experienced. For example, if a subscriber brings home a new LTE cell phone and it causes interference at 751 MHz, that information will be relayed to the OSS. The OSS will communicate to the video delivery system that this frequency should not be used for this MAC address.

Thus frequencies do not need to be abandoned except selectively. And customer quality of experience is improved. Furthermore, the system can automatically adapt to change, such as the installation of a new LTE cell tower.

It was mentioned above that a built-in spectrum analyzer function is being added to STBs and CMs. Other SNMP (simple network management protocol) MIBs (management information base) can also report interference, such as T3 and T4 timeout, flapping, high MER (modulation error ratio), unstable adaptive equalization coefficients, and high lost/impaired packet ratios.

An assurance system, in addition to re-assigning frequencies could also generate trouble tickets and integrate with leakage detection equipment.

Off-air interference problems are expected increase in the future.

b. Why was the invention developed? What problem(s) does the invention solve? How is it better?
LTE interference is a big problem and getting bigger every month.

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

4. **HOW is your invention different from existing products, processes, systems?**
One of the test equipment vendors has a proprietary method to “see” under an RF carrier by demodulating the carrier and subtracting its spectrum. Mostly this is used on the upstream.

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