NEXT GENERATION CABLE NETWORKS WITH DOCSIS® 3.1 TECHNOLOGY




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Modern cable networks are continuing to evolve at a rapid pace, driven by consumer demand for new interactive services. This is driving a convergence between traditional broadcast video and Internet video, as well as the need for higher capacity broadband networks. At the same time, Radio Frequency (RF) transmission technology has continued to evolve, offering the opportunity to utilize the resources of the cable network more efficiently and cost effectively. The needs of network evolution, combined with the opportunity of new technology, recently resulted in the development of a new version of DOCSIS® technology, the DOCSIS 3.1 specifications.

DOCSIS 3.1 technology was developed based on the requirements of MSOs (multiple system operators) to ensure the technology would meet their needs for years to come, utilizing the expertise of equipment manufacturers to ensure it was practical and could be built, and with the leadership of CableLabs to help pull it all together. The DOCSIS 3.1 specifications introduce a number of advancements, including: orthogonal frequency division multiplexing (OFDM) to improve network flexibility and utilization; large channel sizes (up to 192 MHz) to improve cost effectiveness at higher bandwidths; low density parity check (LDPC) FEC to improve performance; and adaptive modulation to adjust to different network conditions. Collectively these advances enable a roadmap to downstream data rates of 10 Gb/s and upstream data rates of 1 Gb/s.

The DOCSIS 3.1 specifications were initially released to the public in October, 2013. Since that time equipment manufacturers have been steadily working to turn those specifications into reality. This past December, CableLabs hosted the first DOCSIS 3.1 interoperability event, during which several equipment manufacturers demonstrated DOCSIS 3.1 technology with their products. There have been demonstrations at trade shows as well, and by the time this article is published, more interoperability events will have taken place.

In light of the rapid development of DOCSIS 3.1 devices, the Cable Networks and Services Subcommittee of IEEE ComSoc has organized this Feature Topic to provide more insight into this emerging technology, consisting of four papers.

The first article, titled "DOCSIS 3.1: Scaling Broadband Cable to Gigabit Speeds," describes the building blocks of DOCSIS 3.1 technology and highlights the specific capabilities that will help broadband cable systems scale to support gigabit per second network speeds. This tutorial article also identifies a set of open issues that represent challenges and opportunities for academic researchers to explore.

The second article, titled "Bit-loading Profiles for High-Speed Data in DOCSIS 3.1," describes a key new feature in the DOCSIS 3.1 specifications: multi-tone modulation with different bit-loading per subcarrier, to adapt the transmission to specific conditions as the Signal-to-Noise ratio (SNR) conditions vary for different cable modems (CMs).

The third article, titled "An Experimental RF Noise Cancellation Analysis for Cable Access Systems," describes the design of an experimental RF noise cancellation system to reduce interference signals from Long Term Evolution (LTE) or other RF devices that overlap with the DOCSIS or cable TV spectrum. The designed system is able to achieve an optimal noise cancellation result by adjusting the amplitude and phase of the reference signal to minimize the interference signal transmitted in the coax cable.

The fourth article, titled "Active Queue Management in DOCSIS® 3.1," describes an Active Queue Management (AQM) algorithm providing good application layer quality of experience when multiple applications share a network connection. A variant of the Proportional Integral controller Enhanced (PIE) algorithm, called DOCSIS-PIE, is required for DOCSIS 3.1 cable modems.

We hope the readers find the articles informative, and that this feature topic will contribute to better understanding of the current issues and challenges with DOCSIS 3.1 technology. We would like to thank the authors of all the articles submitted to this special issue, and the reviewers who have given their time generously, providing valuable feedback and comments on the papers to make this feature topic a reality.

BIOGRAPHIES

MEHMET TOY (SM) (Mehmet_Toy@cable.comcast.com) is a distinguished engineer at Comcast, involved in network architectures and standards. He received his B.S. and M.S. degrees from Istanbul Technical University, and a Ph.D. from Stevens Institute of Technology. He has held management and technical positions at well-known companies, and tenure-track and adjunct faculty positions at universities. He has contributed to research, development, and standardization of various technologies, authored five books, a video tutorial, and numerous articles, and he has four patent applications.

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