NB-IoT NTN Band-Edge Attenuation/EVM Tradeoff with Real-System Verification

(Pt11) Cheng-Feng Li*, Jeng-Kuang Hwang**, Chingwo Ma***

**Department of Electrical Engineering, Yuan Ze University, Taoyuan City, Taiwan*

*** Communication Research Center, Yuan Ze University, Taoyuan City, Taiwan*

**** Institute for Information Industry, Taipei City, Taiwan*

s1068601@mail.yzu.edu.tw, eejhwang@saturn.yzu.edu.tw, chingwoma@gmail.com

***Abstract*—In 3GPP 5G narrowband Internet-of-Things (NB-IoT) non-terrestrial networks (NTNs) based on a satellite, a relayed gNodeB (gNB) base station orthogonal frequency-division multiple access (OFDMA) signal is required to meet the highly strict band-edge attenuation constraint and simultaneously maintain acceptable error vector magnitude (EVM) performance. Although these seem to be two conflicting goals, we pursued a favorable tradeoff between gNB band-edge attenuation and EVM by designing a two-stage interpolated finite-impulse response (IFIR) filter. We first follow the 3GPP NB-IoT specification to generate a standard gNB signal, and then we designed and optimized the filter for a relayed gNB signal and simulated its effectiveness. The proposed gNB TX design was not only verified through simulation, but also practically verified by the commercial vector signal analyzer (VSA). Hence, this work can be realistically applied to standard NB-IoT signals, making it a critical enabling technology for converting the original NB-IoT TN to NTN and can help NTN operators to flexibly allocate channels, improve overall spectrum efficiency, and avoid waste of spectrum resources.**

***Keyword*—Narrowband Internet-of-Things, Non-Terrestrial Network, Real-system, Spectral Edge**

Cheng-Feng Li received the B.S. and M.S degree in communication engineering from the Yuan-Ze University (YZU), Zhongli, Taiwan, in 2012 and 2014. He is currently working toward the Ph.D. degree in electrical engineering in YZU.
He was with Institute for Information Industry (III) and worked on the physical layer algorithm for 3GPP LTE/LTE-A and NB-IoT. His current research interests include wireless communications, 4G LTE, NB-IoT, 5G new radio (NR), ultra-reliable low latency communication (URLLC) and non-terrestrial networks (NTN).

Jeng-Kuang Hwang was born in Taipei in 1962. He graduated with highest honor in electrical engineering from National Taipei Institute of Technology, in 1982. He received his Ph.D. degree in EE from National Tsing-Hua University, Taiwan, in 1991. Since 1991, he has been with the Department of Electrical Engineering of Yuan-Ze University (YZU), Zhongli, Taiwan. In 1997, he had been a visiting professor at AT&T Labs/Research, NJ. During 2008 - 2011, he served as the chairman of the Communication Eng. Department, and he is now the director of Communication Research Center at YZU. Prof. Hwang has conducted many research projects from both academia and industry, published over 150 papers and two books, and holds more than 20 patents. His current research interests include communication signal processing, vector signal generation and analysis for 5G NR, software defined radios, communication measurement systems, MIMO channel, and radar systems.

Chingwo Ma received the Ph.D. degree in electrical engineering from University of Southern California, Los Angeles, California, in 1989. Since then, he worked in various semiconductor companies as a SoC chip designer for multimedia (audio and video) applications in the Silicon Valley, Santa Clara, California. He joined the Via Technology working on Bluetooth and 802.11 WiFi modem design in Fremont, California in 2001. He was with the Institute for Information Industry, Taipei, Taiwan in 2010-2020. His current research interest is in NTN-IoT satellite communications.