NETWORK TESTING SERIES

Ying-Dar Lin   **Erica Johnson**

Join the online discussion group for this Series Topic here:
http://community.comsoc.org/forums/commag-features-and-series

Our last call for this March issue was due on June 1, 2013, and received nine submissions. Among them we accepted three, with one from academia, one from industry, and one from an international hybrid team of universities, industry, and a research agency. We prefer to keep enough industrial flavor to this series. Although the writing quality and rigidness of industrial authors might be lower than the academic authors, we have tried to improve their presentation through the review process. The other six submissions were not included, mainly due to not enough interesting material on test methodologies or results, or not enough focus on testing. Again, the due dates for this series are June 1 and December 1 each year, with publication in the March and September issues of the following year. The turn-around time of the review process is kept within three months. We welcome submissions with a focus on test methodologies, and results on communications and networking systems.

In this issue, we have three interesting articles. The first article addresses an emerging scenario involving the impact of counterfeit and substandard cell phones, which account for 15–20 percent of the market in some developing countries. This is an issue seldom formally addressed in the literature. The second article compares the performance of TD-LTE and LTE FDD on a full-scale LTE testbed. Their results and observations should be valuable to operators and manufacturers. The third article is another system work combining an emulator and a simulator in order to test real protocol implementations on a simulated platform. This facilitates code debugging and result reproduction.

In the article on substandard cell phones, "Substandard Cell Phones: Impact on Network Quality and a New Method to Identify an Unlicensed IMEI in the Network," it first illustrates all possible impacts of counterfeit phones, that is, phones with cloned or invalid International Mobile Equipment Identity (IMEI) numbers, and substandard phones (i.e., phones do not pass the conformance testing of regulatory specifications of 3GPP). These phones often have lower receiver sensitivity and insufficient uplink transmission power, which lead to higher call drop rate, poor call quality, or frequent network access failures. Besides, slower uplink power control, insufficient filtering on inter-channel interference, inaccurate tuning of signal frequency and phase, and longer handover execution period result in lower speech quality, higher interference between subscribers, higher bit error rate, and increased call drop rate, respectively. The authors performed various tests to demonstrate these. They also developed a counterfeit identification technique that cross-checks device capabilities with a database obtained from all vendors. The capability list provided by a vendor could be used as the signature of a particular phone model to match against a phone trying to associate with the network. Operators could use this technique to identify and block counterfeit phones.

The article on TD-LTE and LTE FDD, "An IP-Based Packet Test Environment for TD-LTE and LTE FDD," compares TD-LTE and LTE FDD. FDD separates uplink and downlink channels into different frequencies to have better isolation, while TDD puts both in the same frequency to save spectrum cost. The authors tested both TDD and FDD UE devices from different vendors with one TD-LTE eNB and one TD-LTE and LTE FDD dual-mode eNB on a full-scale testbed. Given the modulation and coding scheme (MCS), sizes of frames, sub-frames, and frequency band, the article calculates the theoretical maximum throughput of both TD-LTE and LTE FDD, and compares them with the test results. It concludes that a single UE device can achieve 91–96 percent of its theoretical bound of the eNB throughput while multiple UE

devices can achieve 74 percent of the bound. Thus, in practice, 74 percent should be something an operator could expect. LTE FDD and TD-LTE latencies are 75 and 82–94 percent shorter than their counterparts in 3G (i.e., W-CDMA and TD-SCDMA), respectively, which is a significant reduction. LTE FDD outperforms TD-LTE in throughput, but not as significant in latency. Whether to choose FDD or TDD is a trade-off between cost and performance in an operator's business decision. It is also shown that TD-LTE uplink performance could be further improved by upgrading the MCS index.

Similar to the work on Estinet reported in the last issue, in September 2013, of this series, the work on testing real code over simulated networks ("DCE: Test the Real Code of Your Protocols and Applications over Simulated Networks") emulates the system/code under test and simulates the other components under the control of simulation clocks. Their objectives are the same (i.e., to seamlessly integrating the emulated code and the simulated network with reproducible results guaranteed by the simulation control). The major difference is that direct code execution (DCE) reported here does not have its own simulation engine. It integrates and utilizes ns-3 with the emulation part run on virtual machines. The authors use two case studies, an HTTP server implementation and a traffic generator implementation, to show how accurate the emulated/simulated results could be, compared to the pure simulation done by Mininet. With the strong need of academia and industry to test their protocol implementations in a reproducible controlled simulation environment, this track of effort shall continue to evolve.

BIOGRAPHIES

YING-DAR LIN [F'13] (ydlin@cs.nctu.edu.tw) is a professor of computer science at National Chiao Tung University (NCTU), Taiwan. He received his Ph.D. in computer science from the University of California at Los Angeles (UCLA) in 1993. He served as the CEO of Telecom Technology Center in Taipei during 2010–2011 and a visiting scholar at Cisco Systems in San Jose, California, during 2007–2008. Since 2002, he has been the founder and director of Network Benchmarking Lab (NBL, www.nbl.org.tw), which reviews network products with real traffic. He also cofounded L7 Networks Inc. in 2002, which was later acquired by D-Link Corp. He founded, in 2011, the Embedded Benchmarking Lab (www.ebl.org.tw) to extend into the review of handheld devices. His research interests include design, analysis, implementation, and benchmarking of network protocols and algorithms, quality of service, network security, deep packet inspection, P2P networking, and embedded hardware/software co-design. His work on multihop cellular was the first along this line, and has been cited over 600 times and standardized into IEEE 802.11s, IEEE 802.15.5, IEEE 802.16j, and 3GPP LTE-Advanced. He is currently an IEEE Distinguished Lecturer for 2014–2015 and on the Editorial Boards of *IEEE Transactions on Computers*, *IEEE Computer*, *IEEE Network*, *IEEE Communications Magazine* (Network Testing Series), *IEEE Wireless Communications*, *IEEE Communications Surveys and Tutorials*, *IEEE Communications Letters*, *Computer Communications*, *Computer Networks*, and *IEICE Transactions on Information and Systems*. He has also served as the Lead Guest Editor for several Special Issues, and Symposium Co-Chair of IEEE GLOBECOM '13 and ICC '15. He published a textbook, *Computer Networks: An Open Source Approach* (www.mhhe.com/lin), with Ren-Hung Hwang and Fred Baker (McGraw-Hill, 2011). It is the first text that interleaves open source implementation examples with protocol design descriptions to bridge the gap between design and implementation.

ERICA JOHNSON (erica.johnson@iol.unh.edu) combines business acumen and an in-depth understanding of complex networking technology to direct the University of New Hampshire InterOperability Laboratory (UNH-IOL). In this capacity, she oversees all aspects of the testing services the UNH-IOL offers for more than 20 unique data networking and storage technologies. Her strategic management of these services includes relationships with industry forums, high-profile test events, and UNH-IOL operations. In recognition of her ability to drive technical innovation, Fierce Telecom named her to the publication's 2011 Women in Wireline. Furthermore, in 2010, UNH awarded her the UNH Women's Commission Stephanie Thomas Staff Award in honor of her achievements in promoting and embodying the advancement of women in the sciences. Widely recognized as an industry leader, she was appointed co-editor of the Network Testing Series for *IEEE Communications Magazine* in 2010. In addition, she serves as an IPv6 Ready Logo Regional Officer, IPv6 Forum Fellow, and USGv6 Test Program lead. In her role within UNH, she engages daily with industry leaders, members of the local community, faculty, and students. She is an advisor for the UNH Broadband Center of Excellence (BCoE), a Director of the College of Engineering and Physical Sciences (CEPS) Alumni Society Board, and participates on the Electrical and Computer Engineering Advisory Board and the Computer Science Advisory Board. She takes great pride in using her entrepreneurial and technical skills to train the workforce's next generation of engineers, and often supports university researchers with grant proposals. She received her Master of Business Administration from UNH in 2011, and received a Bachelor of Science in computer science, also from UNH, in 2001. She joined the UNH-IOL in 1999 as an undergraduate student in computer science.