Homeland Security
Science and Technology

TechNote

U.S. Department of Homeland Security
SAVER
System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions.

Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective assessments and validations on commercial equipment and systems and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

For more information on this and other technologies, contact the SAVER Program Support Office.

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SPAWAR Systems Center ATLANTIC

LTE for Mobile Phones

Long term evolution (LTE) cellular services are the most technically up-to-date, commercially available wireless communication systems. Also marketed as 4G, or fourth generation, this broadband wireless technology service features advanced signal encoding and transmission techniques that enable a significant improvement in high-speed data communication. Introduced to the world's marketplace in December 2009, nearly two dozen wireless carriers now provide LTE service within the U.S., including major providers such as AT&T, Sprint, T-Mobile, and Verizon.

Technology Overview

While LTE networks retain accessibility and compatibility with older wireless systems, the advantages achieved by this new technology are only realized through LTE compatible user hardware. Among these advantages are enhanced security for data transfer and very low latency, thus the delay of information being transmitted is minimal. Furthermore, these networks have the ability to rapidly transfer greater amounts of data than previous systems. Two basic technical principles underlie these advantages. The first principle deals with how user information flows within the established communication links, and the second pertains to the actual establishment of a communication link.

LTE manages data flow using a packet-switched network versus a circuit-switched network approach. Developed in the late 1800s, circuit-switched networks establish a dedicated communication link between two specific users for data transfer. As illustrated in the top portion of Figure 1, this technique is an inefficient use of the communication link, especially for voice transmissions, since data gaps naturally exist within every conversation. In contrast, modern packet-switched networks, shown in the bottom portion of Figure 1, divide communication data from all users into small information packets. These packets are then assigned a destination location (address header) and are individually broadcast with no data gaps among many available communication links based upon the most efficient routing. Thus, multiple users can simultaneously use a single communication link versus having each link dedicated to a specific user pair. This greatly enhances the data throughput and user capacity on the available communication links.

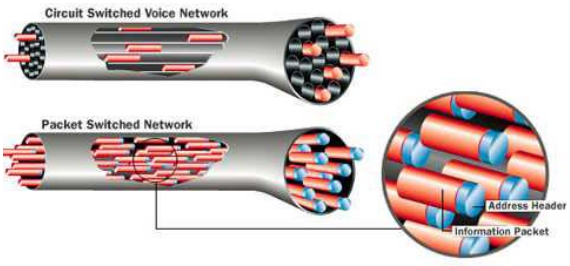

Figure 1. Circuit versus Packet Switched Networks[1]

To establish the communication link, LTE systems use a multiple-input and multiple-output (MIMO) antenna scheme for wireless connectivity. Figure 2 illustrates several commonly used antenna schemes, ranging from single-input and single-output (SISO) to MIMO. The MIMO approach simultaneously creates multiple connected communication links within the radio channel. Thus, providing many available pathways for the data packets and hence greatly improving the rate of data transfer.

Furthermore, different digital signal processing and modulation techniques may be used among the antennas to optimize the transmission connection. This results in a significant improvement in the quality of service and management of the communication link or radio channel.

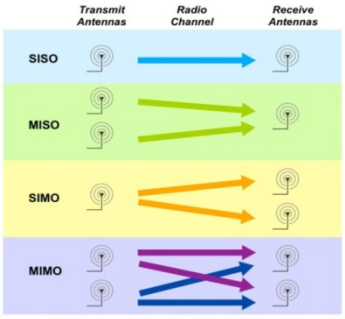

Figure 2: Antenna Diagram[2]

Performance Guide

During the latter half of 2012, more than 725,000 data samples were gathered from over 75 U.S. markets to assemble a detailed and comprehensive report on the performance of LTE systems.[3] Using information from this report, Table 1 summarizes a performance comparison for the average speed, measured in mega-bits per second (Mbps), of uploading and downloading data for LTE and Non-LTE networks of several major service providers. Data from the table illustrates that LTE networks are 4 to 16 times faster than Non-LTE networks. Market penetration is the only remaining challenge for utilizing LTE cellular service. Yet, this limitation is waning as market analysts forecast a compound annual growth rate of nearly 46 percent during the years 2012 through 2016.[4]

Table 1. LTE Network Performance Comparison

Average Network Speed (Mbps)				
Carrier	Upload		Download	
	Non-LTE	LTE	Non-LTE	LTE
AT&T	1.1	9.0	4.3	18.6
Sprint	0.7	4.4	1.6	10.3
Verizon	0.7	8.5	0.9	14.3

FirstNet™: Future First Responder LTE Network

Created by the Middle Class Tax Relief and Job Creation Act signed on February 22, 2012, and with a proposed 2014 budget of nearly $200 million, FirstNet will provide emergency responders with the first nationwide, high-speed network dedicated to public safety. Designed using LTE wireless technology and built to public-safety grade standards, FirstNet will deliver greater coverage, capacity, connectivity, cyber security, and resiliency than the current multiplicity of diverse public safety wireless systems.[5]

References

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[3] ROOTMetrics®, Patrick Linder, *Lightning-fast data speeds and expanding coverage A 4G LTE PERFORMANCE REVIEW*. http://rootmetrics.com/special-reports/lte-performance-review/. Accessed October 11, 2013.

[4] Research and Markets, Infiniti Research Limited, LTE Market in US 2012-2016. http://www.researchandmarkets.com/research/zf3j4k/lte_market_in_us. Accessed October 25, 2013.

[5] United States Department of Commerce, National Telecommunications & Information Administration, *About FirstNet*. http://www.ntia.doc.gov/page/about-firstnet. Accessed October 17, 2013.