Verizon 4G LTE: The Next-Generation Network

Introduction.

Long Term Evolution (LTE) is helping reshape the wireless industry. Not only does LTE expand the types of applications that can be used on wireless devices, but its implementation opens the networks to new and unique devices. LTE is the technology we’ve chosen for our fourth-generation (4G) wireless network. First generation was analog, second was digital and the third generation, or 3G, is multimedia broadband. 4G LTE is ultrabroadband.

Of the major U. S. wireless carriers who have chosen a 4G network technology, Verizon Wireless, AT&T and T-Mobile have opted for LTE, while Sprint has gone with World Interoperability for Microwave Access (WiMAX). LTE has a major advantage over WiMAX in that LTE is emerging as the global standard for wireless carriers worldwide.

Verizon 4G LTE is now available in over 117 markets and 98 airports, and is expected to grow to 175 markets by the end of 2011. We’re aggressively expanding our 4G LTE network to cover two-thirds of the U.S. population by mid-year 2012, and cover our entire existing nationwide 3G footprint with 4G LTE by the end of 2013.

The benefits of Verizon Wireless 4G LTE.

Verizon Wireless 4G LTE offers a number of benefits, including:

+ The speed to run data-intensive applications and stream video and other media in real time from mobile devices
+ A sophisticated backhaul network designed to handle the most demanding data loads from mobile devices and applications
+ Support for IPv6 Dual Stack for both future growth and backwards compatibility with existing IPv4 systems
+ The world’s first single, removable subscriber identity that allows you to share credentials between both CDMA and GSM devices
+ The world’s first implementation of Bearer Independent Protocol (BIP), which enables you to update devices and network programming quickly and easily via a secure Internet connection
+ The global mobile communication standard chosen by a majority of the world’s leading carriers, which means compatible network technology worldwide
+ Support for lower network-to-device latency for real-time applications
+ Low latency to support real-time applications (below 50 ms end-to-end round-trip delay)

<table>
<thead>
<tr>
<th>Real-world performance</th>
<th>Reliable network</th>
<th>Improved compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast uploads and downloads:</td>
<td>Consistent wireless environment where 4G LTE network is built</td>
<td>Service compatibility with disparate networks, including:</td>
</tr>
<tr>
<td>• 5 to 12 Mbps network to device</td>
<td>• Designed to handle demanding data loads</td>
<td>• Wireline</td>
</tr>
<tr>
<td>• 2 to 5 Mbps device to network</td>
<td>• Supports IPv6 Dual Stack for backwards compatibility with existing IPv4 systems</td>
<td>• Wireless</td>
</tr>
<tr>
<td><strong>Below 50 ms</strong> network-to-device (one-way) latency</td>
<td></td>
<td>• Fiber</td>
</tr>
<tr>
<td>More bandwidth and better throughput</td>
<td></td>
<td>• Private networks</td>
</tr>
</tbody>
</table>

A quick overview of Verizon Wireless 4G LTE benefits and improvements.
Verizon Wireless 4G LTE’s higher data rates and latency.

While actual network loads will impact performance, average user throughput speeds for Verizon Wireless 4G LTE are expected to be 5 Mbps to 12 Mbps from network to device and 2 Mbps to 5 Mbps from device to network, comparable to landline broadband speeds. Under this scenario, you could download an album’s worth of MP3 files or an entire audio book in about a minute at average throughput speeds. Verizon Wireless 4G LTE also features reduced network-to-device (one-way) latency, down from 120 ms in 1xEV-DO Rev. A to below 50 ms with Verizon Wireless 4G LTE.

<table>
<thead>
<tr>
<th></th>
<th>1xRTT</th>
<th>1xEV-DO Rev. A</th>
<th>4G LTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average user data rates</td>
<td>60–80 Kbps download, 60–80 Kbps upload</td>
<td>600–1,400 Kbps download, 500–800 Kbps upload</td>
<td>5–12 Mbps download, 2–5 Mbps upload</td>
</tr>
<tr>
<td>Latency</td>
<td>Approximately 120 ms</td>
<td>Approximately 120 ms</td>
<td>Below 50 ms</td>
</tr>
</tbody>
</table>

The evolution of the Verizon Wireless network.

Verizon Wireless 4G LTE security enhancements.

Verizon Wireless 4G LTE includes a number of security enhancements that make it even more secure than existing 3G technologies. The following chart describes many of the new security enhancements available in Verizon Wireless 4G LTE:

+ **Secure storage**: Verizon Wireless 4G LTE’s SIM card stores the user’s credentials and secure data needed to access network services, including data and applications.

+ **Mutual authentication**: In a 4G LTE network, the network authenticates the user identity and the user equipment authenticates the network credentials. Mutual authentication protects against attacks, including attacks from rogue base stations.

+ **Root key length**: Longer bit keys double the key’s strength and requires a greater effort to break through the security algorithm. All keys used for crypto-algorithms in Verizon Wireless 4G LTE are 128 bits in length.

+ **Security context**: Keys to encrypt signaling and User Plane (UP) data are created for data session on the Verizon Wireless 4G LTE network. These keys are retained for an active session, but get deleted in idle mode or a handover to another Verizon Wireless 4G LTE cell site. Handover to another cell site occurs only after security is activated.
Integrity protection: Integrity protection is used to verify the signaling has not been modified over the radio access interface and that the origin of signaling data is the one claimed. Essentially each signaling message is appended with an integrity key, and only upon verification of the integrity key by the receiving end is the message accepted.

Airlink encryption: In the Verizon Wireless 4G LTE network, three encryption options are used between the network and the user equipment before communications take place. The order of negotiation is AES, SNOW3G and then Null.

Verizon Wireless 4G LTE devices and applications.

Verizon Wireless 4G LTE can help spur the development of new, innovative devices designed to take full advantage of the network’s increased performance, reliability and improved compatibility. Plus, it helps to improve the performance of a wide array of business applications in use on today’s 3G networks, such as:

<table>
<thead>
<tr>
<th>Mobile Office</th>
<th>Sales Force Automation</th>
<th>Field Force Management</th>
<th>Smart Metering</th>
<th>Telematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take the office on the road.</td>
<td>Automate the mobile sales process.</td>
<td>Improve field worker efficiency and productivity.</td>
<td>Automate meter reading.</td>
<td>Vehicle data collection and service delivery.</td>
</tr>
</tbody>
</table>

Going forward, Verizon Wireless 4G LTE establishes a base from which new business models, products and services can be launched. Applications such as rich multimedia content, “on-demand anything,” real-time video collaboration, streaming media, “everything as a service” and more are now made possible.

Conclusion.

Verizon Wireless 4G LTE can help change the way you do business. Your business depends on data and data access, sharing information and fostering a collaborative, connected work environment. Verizon Wireless 4G LTE amplifies the strength of business teams and groups by improving individual performance, enhancing communications and finding innovative ways to exchange business information.

Verizon Wireless 4G LTE’s real-world performance, network reliability and improved compatibility mean that you can run greater bandwidth-intensive applications than ever before on a mobile device. High-definition video. Real-time video conferencing. Video telephony. Voice over Internet Protocol. Telematics and telemetry. The technology limitations that have kept many applications immobilized are now history.

For business, the Verizon Wireless 4G LTE network represents a powerful evolution of an already great 3G network. As business needs evolve and change, the Verizon Wireless network will continue to evolve, change and become more powerful. Today, Verizon Wireless 4G LTE represents the culmination of a new level of service that can unlock the potential of every individual contributor with a great new business idea.

For a more in-depth overview of the Verizon Wireless 4G LTE network, please reference the white paper titled LTE: The Future of Mobile Broadband Technology.

To learn more about Verizon 4G LTE and what it can do for your business, go to verizonwireless.com/4glte or speak with your Verizon Wireless business specialist.