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Verizon 4G Network Down for Two Days

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In December, 2010, Verizon Wireless inaugurated its much-touted 4G wireless service, beating AT&T and other providers to be the first major wireless carrier in the U.S. to introduce a 4G network.

Verizon's 4G service started with a bang. By the end of April, 2011, it had sold over 250,000 of its first 4G smart phones, the HTC Thunderbolt, which runs on the Android 2.2 operating system. By this time, Verizon had 4G services in 39 cities; and it announced that 4G would be available in 59 other cities by the end of 2011. It plans to upgrade its entire 3G network by the end of 2013.

Happy customers raved about the significantly increased speeds of download and upload. Verizon bragged about its "always reliable" network.

Then disaster struck. Verizon's revered 4G network went down for almost two days.

Almost 4G

Before we get into what happened, let's review what 4G is. Simply put, it is the fourth-generation wireless network. About every decade, wireless technology is upgraded to a new generation. The 1G network was introduced in 1981 and used analog transmission of signals. The 2G network followed in 1992 and replaced analog transmission with much improved digital transmission. Wireless technology was improved by moving to spread-spectrum communication in 2001, giving rise to our current 3G networks.

The next generation 4G network specifications are now nearing completion. The 4G network will use true IPv6 packet-switching technology. It will provide secure, IP-based mobile broadband communication services for laptops, smartphones, and other mobile devices.

But true 4G networks, complying with the new 4G specifications, are not yet here. The 4G specifications call for transmission rates of 100 megabits/sec. for high-mobility users (those in cars or trains, for instance) and for one gigabit/sec. transmission rates for low-mobility users, such as pedestrians or stationary users. But today's "4G" networks can handle only transmission rates in the order of ten to twenty megabits/sec.

To accommodate the transition, a Long Term Evolution (LTE) specification lays out the path from 3G to 4G. The industry has agreed that a service can be called "4G" if it is packet-based and if it provides a substantial level of improvement in performance and function over the initial 3G systems.

Therefore, LTE networks are an important precursor to full 4G networks. One might more accurately think of today's 4G services as "3.9G" services. The best is yet to come.

LTE Advanced, the advanced form of LTE, maps the evolution path to full 4G. An LTE Advanced compliant network is indeed 4G.

4G networks are not backwards compatible with 3G networks since they use different technologies. However, LTE Advanced networks, when they come, will be backwards compatible with today's LTE networks.

The Outage

About 1 AM on Wednesday, April 27, 2011, people started to complain on their blogs and on Twitter that they were not getting Verizon 4G service. Even worse, they were not being reverted to 3G service, which is supposed to back up the 4G network (though 3G and 4G are not compatible technologies, the Verizon phones can revert to 3G if needed).

This came at an embarrassing time for one key Verizon executive. Just two days prior, Verizon VP Nicola Palmer told mobile executives, "Frankly, I expected some speed bumps [in the launch of 4G]. The surprise to me is that the speed bumps were very few and far between, and they didn't do any damage to the undercarriage." Forty-eight hours later, the undercarriage took a terrible blow.

In a 1:30 PM statement on the day of the failure, Verizon said that it was aware of the 3G, 4G, and LTE network problems. It said that it had identified the cause of the outage and was working to fix the issue. It said that customers should be able make calls from 4G phones, but data downloads might be very slow or not even possible. In fact, 4G customers were being serviced by the old, slow 1XRRT network.

Furthermore, customers wouldn't be able to activate new LTE devices until the failure was resolved.

Verizon made no comment on the cause of the outage or its estimate of service restoration. Finally, late Thursday afternoon – almost two days later – service was restored to most but not all cities.

What Happened?

On the day that service was restored, one industry analyst, Simon Leopold, suggested that the outage was caused by a Nokia Siemens Networks (NSN) element in the IMS (IP Multimedia Subsystem). The IMS forms the core of the 4G network. Leopold's suspected network culprit was the HSS, or Home Subscriber Service system.

The HSS is the system that manages subscriber activity on the network. It holds all of the user information related to preferences, subscriptions, location, and authorization so that users can be managed by the network as they move around in the 4G network. Without an operating HSS, users cannot be authenticated by the network and therefore are not able to connect to the network.

The HSS is similar in function to the Home Location Register (HLR) found in 3G networks. There have been numerous 3G network outages due to HLR failures, many of them being HLRs supplied by NSN.

Verizon made no comment with respect to Mr. Leopold's supposition. However, almost a month later, on May 19th, Verizon's CTO, Tony Melone, issued a fairly detailed statement describing to

some extent the source of the outage. He confirmed that a software problem within the network core, IMS, shut down Verizon's mobile 4G broadband network. The software problem rapidly escalated and affected the core's backup systems, eventually shutting down access to the entire network.

The network is implemented so that when customers move out of 4G coverage, they move into the 3G network but are still handled by the 4G core (by IMS and the HSS). But when IMS went down, customers could not be connected to the 3G network even though it was operating properly. This is the reason for the many user complaints that 3G access was unavailable when they lost access to 4G.

According to Mr. Melone, the problem was detected quickly; and a fix was rapidly determined. However, Verizon elected to bring the network back up slowly to ensure that there would be no further problems.

Mr. Melone specified neither the network element nor the vendor. Verizon uses equipment from multiple vendors in its 4G core. Predominant among them are Alcatel-Lucent and NSN. The analyst, Mr. Leopold, perhaps hit the nail on the head. At least, he came pretty close.

Summary

Verizon made the mistake that so many service providers make when they have an outage. They become unapproachable. Verizon shared precious little information about its efforts to restore its nationwide service. There was nothing posted to its web site. There were no press releases or even information given to the press. Google searches on the outage only found blog complaints. The only information came over Verizon's Twitter feed when the outage first occurred and later when service was restored.

This lack of forthcoming information only blackened Verizon's black eye further. Many other companies have learned the lesson of crisis communication the hard way and have set up digital dashboards that maintain a current status of all of their services. This is an avenue that Verizon should perhaps aggressively pursue.

AT&T and T-Mobile (which recently was acquired by AT&T) will roll out their LTE networks soon. It is inevitable that they will suffer occasional outages in their 4G networks. Let us see how they communicate the outage status to their customers.

Acknowledgements

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