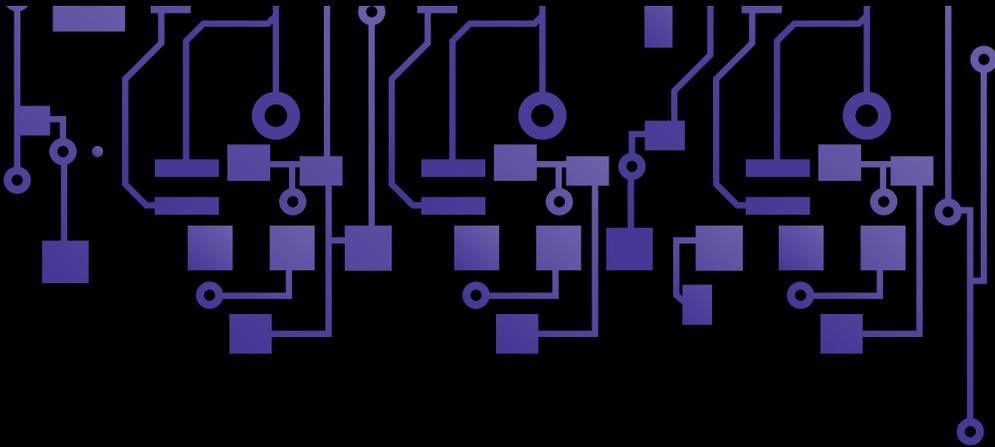
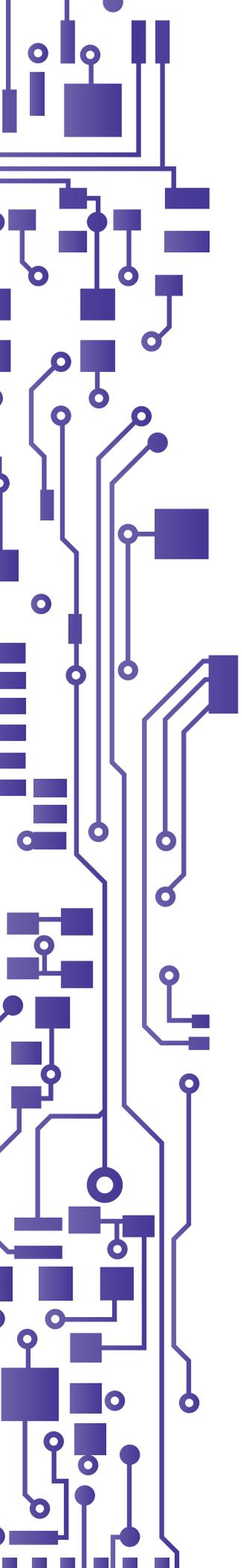


AT&T's 2G GSM Sunset





Introduction

There is an incredibly difficult challenge facing the Machine-to-Machine (“M2M”) industry. *In August 2012, AT&T announced that they plan to shut down 2G GSM services (including GPRS & EDGE packet-data) by Jan. 1, 2017 ... in a little over four years from the date of the announcement.*

This sunset requires replacing an estimated 10 to 14 Million GSM devices on AT&T’s network before the services are removed—and the deadline is now just over three years away! Some companies have started dealing with this sunset replacement requirement, but far too many have yet to address this issue meaningfully.

With the M2M industry facing this tough deadline, there simply isn’t any time to waste. Companies using AT&T’s 2G GSM services must act *now*—to rapidly create and fully execute a multi-year plan to replace devices and minimize disruption for their customers.

“Last year, AT&T stopped certifying new 2G GSM applications for deployment on its network.”

More Recent Events

Last year, AT&T stopped certifying new 2G GSM applications for deployment on its network. This meant that customers could not develop any more new GSM M2M products for use or sale in the United States.

Earlier this year, AT&T also stopped provisioning new Subscriber Identity Modules (“SIM”) for existing, certified, 2G GSM devices and applications. This means that customers cannot deploy any more 2G GSM devices into their existing M2M applications installed base.

These events are not surprising, since it is not in anybody’s interest to exacerbate the issue of device replacement when AT&T’s 2G GSM Sunset occurs at the end of 2016—particularly for M2M devices that generally require more complex procedures for installation and replacement than consumer handsets.

Regardless, it puts the companies using AT&T services for M2M in a serious financial bind—the cost of replacement (for devices, logistics, installation services, “truck rolls”, etc.) is expensive.

Why is AT&T Shutting 2G GSM (including GPRS & EDGE)?

The answer requires a more in-depth understanding of cellular technology, and the historical and business issues that drive the cellular industry.

The Analog AMPS Sunset in 2008

In the 1990s and early 2000s, the M2M industry deployed Analog AMPS cellular devices for many data transmission applications.

These devices underwent an “AMPS sunset” when cellular carriers began a transition to digital cellular. Carriers wanted to transition to all-digital cellular services as rapidly as possible to support their smartphone handset customers and the ever-growing data needs.

In the US, in February 2003, the Federal Communications Commission (“FCC”) set an AMPS Sunset date—customers using AMPS had five years (till Feb. 18, 2008) to migrate to digital cellular. The FCC required the carriers to support AMPS through that sunset date.

Digital Cellular Technology Choices

When North American carriers initially deployed digital cellular, they chose technologies with *incompatible* coding and data protocols. Some carriers chose CDMA cellular and others selected GSM

cellular after first deploying ANSI-136 TDMA¹. For simplicity, these are called the “CDMA carriers” and the “GSM carriers”.

As a result, companies deployed digital cellular M2M products and applications using two packet-data services: 2G CDMA 1xRTT and 2G GSM GPRS. The automotive and trucking industries chose CDMA for the higher data throughput and easy roaming into Analog AMPS in rural market areas, since ANSI-95 CDMA radios fully supported AMPS mode. More importantly, automobile design and production cycles drove a requirement for service longevity, for which CDMA was the best choice.

However, CDMA radios were 2 to 2.5 times more expensive than GSM radios. Cost-conscious industries, such as the residential and commercial alarm/security businesses, chose 2G GSM GPRS, since the far lower cost of radios was just too attractive to ignore. The simpler technology of the GSM protocol, combined with the scale and volume of GSM device sales in International markets, dropped radio prices rapidly.

Dramatic Growth in Smartphones

More recently, carriers have seen large increases in the number of smartphones and a dramatic rise in packet-data use. This has forced them to acquire spectrum to add capacity, *and* deploy more spectrum-efficient protocols in *existing* spectrum to improve capacity.

Because of the higher spectrum efficiency of the CDMA packet-data protocols, the CDMA carriers were under less business pressure than the

GSM carriers. They had time to deploy 3G EV-DO, which co-existed with 2G 1xRTT in the same spectrum bands and allowed handset customers an easier migration path to faster performance.

However, the GSM carriers who chose 2G GSM have had to deploy a *new* 3G technology, called UMTS, in new spectrum bands. UMTS uses a Wide-Band CDMA (“W-CDMA”) protocol that is incompatible with the TDMA protocol of GSM and cannot co-exist in the same spectrum. In markets where spectrum ownership is limited, this has restricted the rapid coverage growth of UMTS and the 3G packet-data protocols by the GSM carriers.

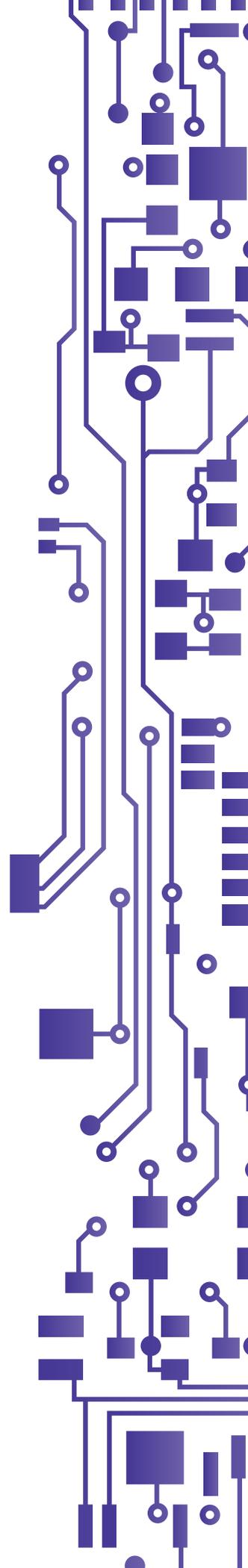
Over time, enhancements improved performance: EV-DO Rev. A (in the CDMA family) and HSPA, HSPA+, etc. (in the GSM family). The CDMA carriers deployed 3G EV-DO in their *entire* coverage footprint quite rapidly, but the GSM carriers have yet to complete their 3G deployment into many markets where they have deployed 2G GSM.

Dramatic Growth in Mobile Data Traffic

Over the past years, transmission of mobile data has increased dramatically and is not slowing down. A recent study, “*Cisco Visual Networking Index Mobile Forecast, 2013*” shows that mobile data traffic is projected to grow worldwide from 0.9 ExaBytes/month in 2012 to 11.2 ExaBytes/month by 2017, as shown in *Figure 1. Cisco Mobile Data Forecast*. This is more than a factor of 10, at a 66% Compounded Annual Growth Rate (“CAGR”).

Not surprisingly, the largest growth is from smartphones, laptops and tablets. Consumers want more and more data

¹ It is interesting to note that ANSI-136 TDMA and ANSI-95 CDMA devices could roam in AMPS mode on the “other” carrier. This capability was removed when ANSI-136 TDMA carriers switched to GSM (which does not provide AMPS support). Fortunately, this sunset did not have any significant impact on M2M, which did not use ANSI-136 TDMA devices.



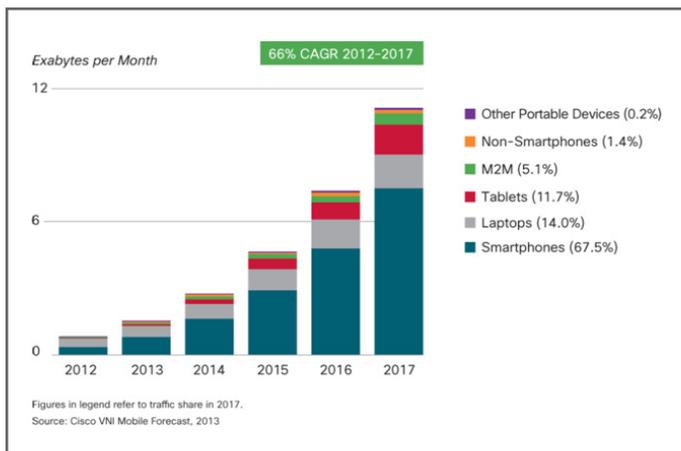


Figure 1. Cisco Mobile Data Forecast

for their mobile devices and applications, and they want it faster and faster. Carriers must provide for this dramatic growth in wireless mobile traffic.

Introduction of 4G

As smartphone deployment and usage increased, carriers needed to deploy even more spectrum-efficient protocols, such as OFDMA (as used in WiMAX and LTE). Since they had fully established their 3G networks, the CDMA carriers began deployment of WiMAX and LTE sooner than the GSM carriers who continued their 3G expansion in multiple technology steps (HSDPA, HSUPA, HSPA, HSPA+, etc.).

For 4G deployments, carriers have been using *new* spectrum to avoid disrupting 2G/3G services. However, AT&T is in a weak spectrum position in many markets. Thus, in 2011, AT&T attempted to purchase T-Mobile to acquire additional AWS spectrum licenses at 1700/2100MHz for their LTE deployment.

During negotiations, AT&T's VP Jean Marsh wrote what might happen if the acquisition was not approved:

"First, AT&T would promptly shut down its 2G GSM network—a network that currently supports tens of millions of devices [...] that customer base would be required to go purchase new mobile broadband (UMTS) handsets, which are generally more expensive."

As we know, AT&T did not receive approval for the T-Mobile acquisition.

Improvements in Spectrum Efficiency

Carriers can also deal with traffic growth by improving the efficiency of their existing wireless spectrum (i.e., in addition to acquiring new spectrum). Older, less-efficient technologies and protocols must give way to new, more-efficient technologies and protocols.

This measure of efficiency is called "spectrum efficiency"—i.e., the data throughput (bits/second) that can be achieved per unit (Hertz) of spectrum. In his book, *"3G, 4G and Beyond: Bringing Networks, Devices and the Web Together"*, Martin Sauter shows that the theoretical spectrum efficiency of 2G GSM/GPRS, even in a "five-slot" configuration (that is *more* than is usually used today), is much less than 2G CDMA, and *far* less than 3G and 4G cellular technologies.

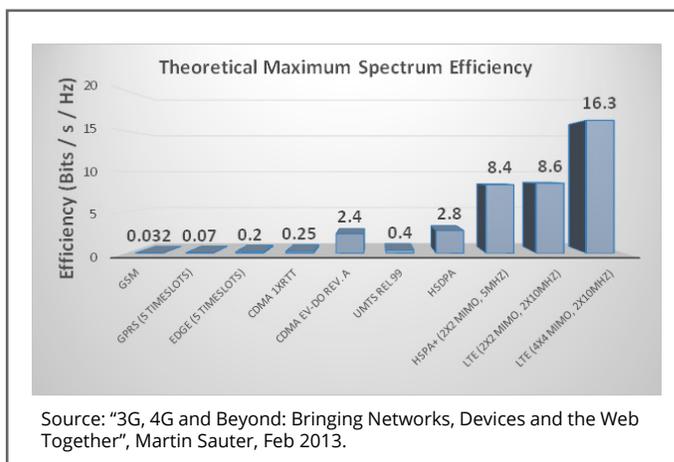
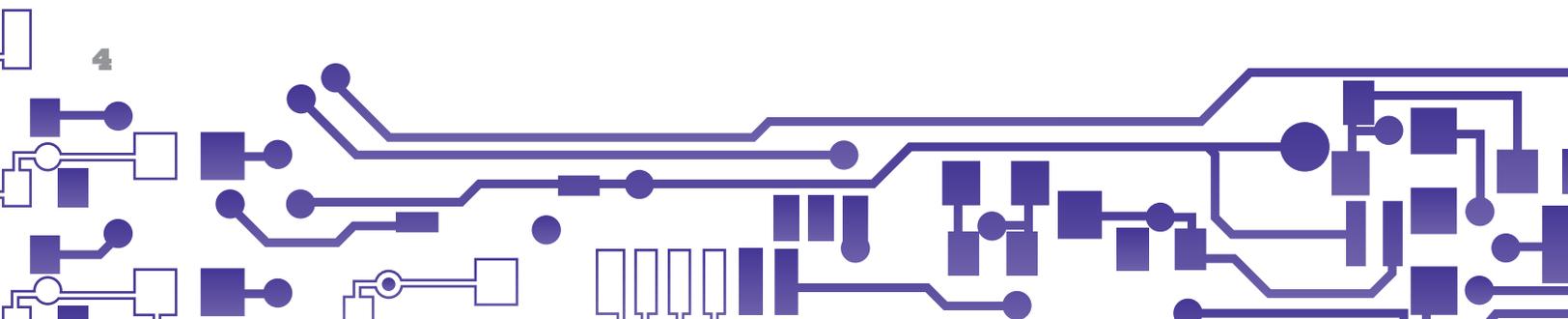


Figure 2. Theoretical Maximum Spectrum Efficiency

As shown in *Figure 2. Theoretical Maximum Spectrum Efficiency*, 2G CDMA 1XRTT is 3.6 times and EV-DO is 34 times more spectrum efficient than GPRS. The newer HSPA+ and 4G LTE technologies are 120 to 230 times more spectrum efficient than GPRS. Clearly, GSM carriers like AT&T, which have deployed 2G GSM/GPRS, are not using their current wireless spectrum as efficiently as they could for





the data throughput needs of their customers.

Competitive Pressure

Of the top U.S. carriers, AT&T is in the weakest position for spectrum ownership. Yet, as seen in, *Table 1. Cellular Devices for Top Carriers in US*, it must support nearly as many cellular devices as Verizon—with good throughput, coverage and service quality—to retain its customer base.

Table 1. Cellular Devices for Top Carriers in US

Carrier	Total Units (millions)	M2M Units (millions)
Verizon	118.2	8
AT&T	107.9	15
Sprint (includes Clearwire)	62.5	3.5
T-Mobile US	44.0	3.3

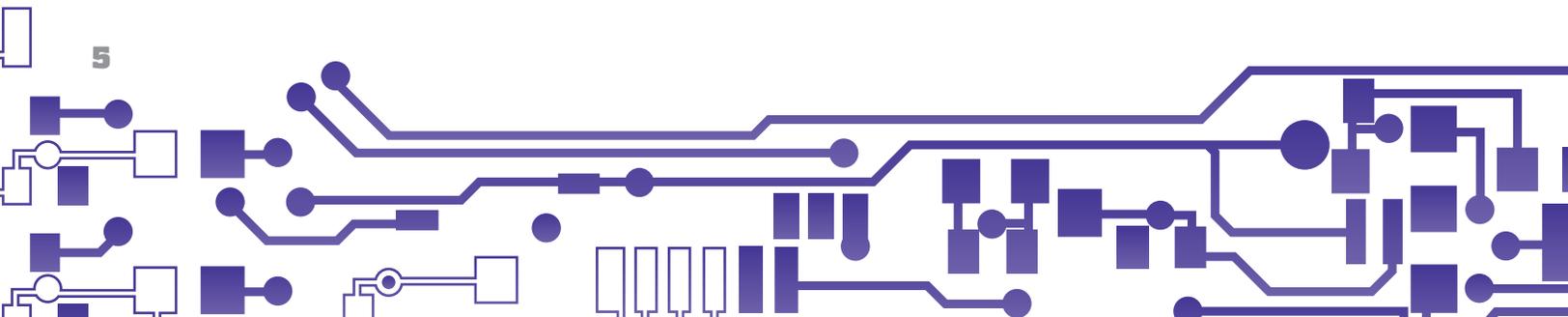
Source: Strategy Analytics, Based on Carrier Reports; FierceWireless Article.

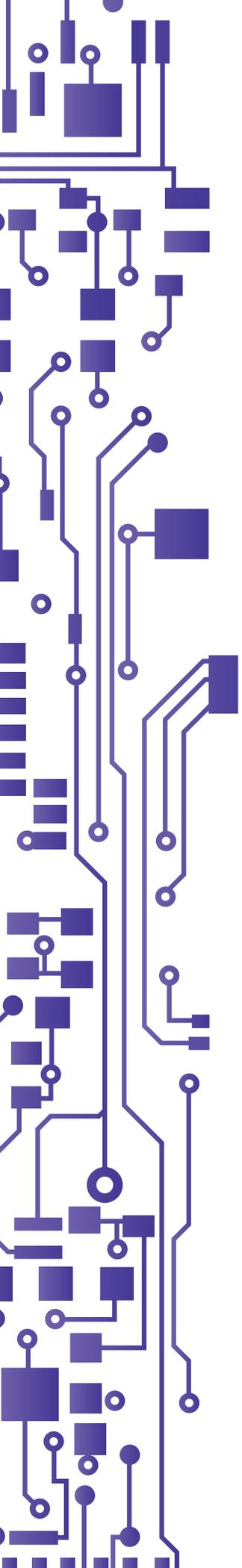
The recent T-Mobile merger with MetroPCS creates a stronger number-four carrier, with good spectrum holdings, that can compete effectively with AT&T using 3G HSPA+ and 4G LTE. Indeed, its spectrum ownership allows it to support its 2G GSM/GPRS network for a few more years than AT&T, since it has fewer customers using that spectrum.

Since T-Mobile is also actively selling the latest smartphones using the latest 3G and 4G cellular technologies, it can gain significant market share from AT&T now that the acquisition of MetroPCS is complete—indeed, the latest reports show that T-Mobile is adding customers faster than the other carriers.

Is the 2G GSM Sunset Date Firm?

AT&T needs to re-use its existing spectrum at 850MHz and 1900 MHz for 3G and 4G technology deployments. The combination of data growth, competitive pressure from other carriers, and the cost of adding new spectrum, has driven this sunset decision.





Regardless of the resulting difficulty faced by the M2M industry as a whole, their decision to remove 2G GSM service was not taken lightly.

Even if the sunset date actually changes a bit by the end of 2016, everyone must operate on an expectation that the announced date is firm and must plan accordingly!

Call to Action

The GSM sunset is a major issue for the M2M industry because such large numbers of GSM/GPRS devices have been deployed. To maintain service, an estimated 10 to 12 million 2G GSM devices must be replaced in *just* over three years (at the time of writing of this whitepaper).

Assuming 200 working days a year, the M2M industry must replace more than 17,000 devices per day, starting immediately.

To accomplish this, companies must rapidly develop and execute comprehensive plans, including new products from suppliers, detailed schedules, customer notifications, installer training as needed, recall plans, etc.

What are the Options?

Aeris Communications is focused on the best solution for each customer, not specific wireless technologies. Aeris supports the following four possibilities: The customer, not our technology, is at the center of our solution and so we offer an array of options for M2M deployments of every size, including:

- Change service to another 2G GSM carrier using the same 2G GSM device
- Replace the 2G GSM device with a 3G HSPA device

- Replace the 2G GSM device with a 2G CDMA device
- Replace the 2G GSM device with a 4G LTE device

Change 2G GSM Service Provider

It is possible to move service from AT&T to another carrier by swapping the SIM inside the devices. This requires logistical planning to schedule the swap, and could require a truck roll for fixed location devices. This is a good option for companies that need to extend their 2G GSM deployments for a few more years before implementing another option. Furthermore, (the other carriers in the US will also remove 2G GSM eventually). Thus, this option only delays the inevitable by three to four years; however, it provides additional time for implementing other options. Aeris GSM SIMs can be swapped for any AT&T SIM by simply reprogramming the APN and swapping the SIM.

Replace with 3G HSPA device

Device suppliers are making new 3G HSPA devices. However, the HSPA coverage footprint is much smaller than GPRS and, in time, the HSPA service in many markets will also be swapped for LTE. Thus, there is likely to be an eventual “3G HSPA Sunset” in about seven to eight years. This sunset would be worse, since the number of deployed units will be much higher.

Furthermore, in some markets where only 2G GSM / GPRS is currently operational, a new 3G HSPA device would operate in 2G mode for now (using backward compatibility ... and *could* unexpectedly shutdown in December 2016 if the 2G service is replaced with 4G LTE service only (i.e., without 3G HSPA service). This might occur in markets where AT&T does not have enough spectrum to deploy both 4G LTE *and* 3G HSPA.



Replace with 2G CDMA

This is likely to be the best option for many M2M applications. *It is important to recognize that the 2G CDMA service of the CDMA carriers is unaffected by the AT&T announcement*—indeed, CDMA carriers have committed to 10+ years of service longevity, and the 2G 1xRTT coverage in the USA is already better than GSM / GPRS. Some carriers are adding 2G CDMA services in new spectrum; for example, the Sprint Network Vision project adds 2G CDMA service into some of their 800MHz spectrum originally used for iDEN services.

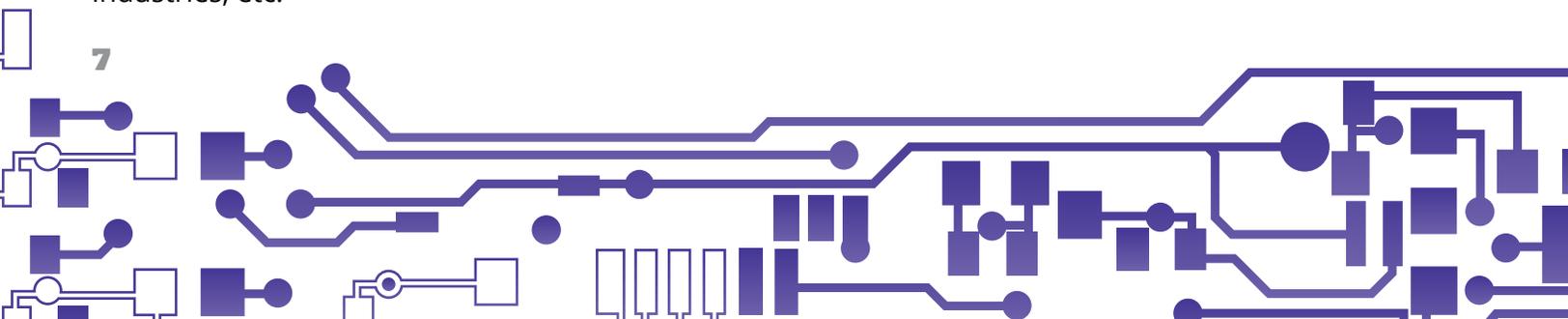
Given the lower cost of 1xRTT radios and the large number of deployed 1xRTT applications in many industries (notably automotive and trucking) supporting the technology, using 1xRTT for M2M applications makes sense. In particular, many M2M applications simply do not need the high throughput and higher radio cost of 3G HSPA and 4G LTE technologies. The proven 2G CDMA cellular service provides sufficiently good service for these applications. Going with 2G CDMA has advantages: technology longevity; better coverage; lower price; larger installed base in most M2M vertical industries, etc.

Replace with 4G LTE

Deploying LTE devices is not yet viable for many M2M applications *today*. The radio costs are very high—generally 5 to 10 times more expensive than 2G GSM and 2G CDMA radios, and coverage is not yet sufficient for nationwide M2M deployments. Both will improve in time, but not at a pace that makes 4G LTE a viable replacement option today—just when the need to replace 2G GSM is most urgent.

Most importantly, the spectrum fragmentation for LTE means that current generation LTE radios are single-band—i.e., dedicated for use on a single carrier in LTE mode. This is too restrictive, since these units can never be moved from one carrier to another. However, multi-band LTE radios are beginning to emerge – at a slightly higher cost – and this will eventually allow these radios on more than one carrier in LTE mode.

Finally, the top nationwide carriers have not yet worked on any LTE roaming agreements—these also will take time to complete and deploy to achieve true service choice.





Best Choice Today

Whichever path you choose, be aware of the impending deadline and the magnitude of this project. Executing a comprehensive 2G GSM/GPRS phase-out plan will take time, foresight and a detailed plan of action.

What Does The Future Hold?

We have experienced two cellular technology sunsets in the recent past (the ANSI-136 TDMA shutdown in the early 2000's and the AMPS Sunset in February 2008) and will undergo another one soon (the 2G GSM Sunset in January 2017).

Other current cellular technologies are also likely to change over time. The 3G HSPA services will work through the end of this decade at least, in the markets where they are available, and 2G CDMA will exist in the broad coverage to the early years of the next decade and longer.

Once fully deployed, 4G LTE will last a long time, but we should not assume that this will be permanent – carriers will continue to enhance performance and throughput for their consumer smartphone needs.

Faster and Faster Change

As in all technology fields, we must expect change more often, and M2M application providers must expect and plan for cellular technology changes and shorter product lifecycles. Since M2M devices usually operate for many years—*unlike* consumer handsets and smartphones—mechanisms to accommodate these changes are important.

For example, in the alarm and security industry, device manufacturers need to make a radio technology change as easy as a battery change by using a plug-in adapter or sled for the radio in the alarm equipment. This could allow residential and business owners to update their equipment relatively easily and minimize expensive truck rolls.

The 2G GSM Sunset Is Close

Finally, if any company with 2G GSM/GPRS devices has not yet begun replacing units, it is essential that they start as soon as possible. The AT&T 2G GSM Sunset is simply too close now to delay action any further.

Contact Aeris at info@aeris.net or **1-888-GO-AERIS** for more information.

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