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WHITE PAPER

4G: The Distributed Intelligence Revolution

BACKGROUND

Most machine-to-machine (M2M) connectivity is hosted on 2G networks today, including many SCADA and other remote monitoring and control deployments. The 2G networks are simpler and slower than more modern high-bandwidth cellular technology such as 4G LTE, and it actually costs more to move data over 2G—which is one reason carriers are gradually shutting down their 2G coverage.

The other side of the story involves the tremendous benefits that 4G provides in terms of speed, efficiency, capacity, and security. By shutting down 2G networks, operators can re-use that spectrum for the 4G technology that powers more advanced applications for consumers, business, enterprise, and other markets.

Utility and energy markets can benefit here as well. As security drives regulatory and policy requirements, 4G is powering solutions that help lower risk for verticals such as utilities and energy water and wastewater, oil and gas. All these industries use M2M to monitor transmission, loss, equipment performance, and other factors to help them refine operations and lower cost. Modern network technology provides the bandwidth and flexibility required by applications that improve system diagnostics and reduce downtime, making the business more predictable.

Smart devices, connected to the cloud and powered by intelligent applications, represent a technology convergence that is driving previously unimagined solutions. From smart grids to pipeline monitoring, these new devices are moving the decision-making process from legacy central operations centers to the very edge of the network, increasing efficiency along the way.

This white paper examines how we got where we are today, the paradigm shift that 4G makes possible, and what to think about when making the transition from older 2G to 4G-based technologies.

DIAL-UP: HUMBLE BEGINNINGS

Before the smart phone, before the flip-phone, before the first analog cell networks, remote monitoring applications used plain old telephone service (POTS) over copper lines just like everyone else. In the best case scenario, dial-up technology can transmit about 56kbps over phone lines. Factors such as wiring problems and line noise often reduce the transmission speed and reliability significantly. With latency of up to 300 milliseconds, dial-up would be considered a poor choice today for real-time applications such as remote monitoring and management.

The cost of data transmission over copper is extravagant when compared with modern wireless networking technologies, especially across state lines or internationally. Dial-up does not support always-on connections, and re-establishing a connection takes a very long time by today's standards. Still, a number of legacy monitoring applications still rely on dial-up to some degree.

2G: REMOTE MONITORING GOES DIGITAL

During the 1990s, 2G cellular technology was developed as a replacement for the first generation analog cellular systems. The first 2G networks used GSM digital technology mainly for sonic modulation of voice calls. As the decade progressed, GPRS technology enabled the transmission of data packets over the existing GSM network, laying the foundation for early wireless M2M communications. In fact, most existing wireless M2M modules still operate on 2G networks.

2G provides much higher bandwidth and lower latency than dial-up, at substantially lower costs. The most advanced 2G technologies achieve data transmission rates in excess of 200 kbps, roughly four times the speed of dial-up. Faster data

transmission means more sophisticated understanding of facilities, operations, and trends in a business or enterprise using M2M. With the rise of 2G, robust reporting and management applications became widespread, and reliable, low-cost 2G-capable components proliferated.

By today's standards, however, 2G is considered a low-bandwidth technology. For network operators, 2G is expensive in two significant ways. It costs more to move a given amount of data over a 2G network than it does to move the same data over 4G. More importantly, there's a limit to how much radio spectrum is available—devoting part of that spectrum to existing 2G networks results in a tremendous opportunity cost. As operators seek to use spectrum more efficiently, they must begin shutting down 2G networks.

Businesses that rely on M2M have their own reasons for moving away from 2G networks. In today's security-conscious world, the protection provided by 2G technology is simply no longer enough. For example, 2G only authenticates the device to the network, but not vice-versa, making it a prime target for impersonation attacks.

3G: AN IMPORTANT TRANSITION

Third Generation (3G) technology deserves a brief mention. Although it has somewhat higher latency than 4G and significantly slower data throughput, it was 3G that paved the way for true data applications on cellular networks. With data transfer rates up to 2Mbps, 3G made real-time video and other high-bandwidth applications possible.

3G remains in use today, and will likely not be phased out for a few years. For remote control and monitoring applications that require a long device service life, however, 3G may not be a reliable choice; carriers are likely to reclaim 3G spectrum in the future to deepen their investment in 4G.

4G: CHANGING THE WORLD

The development of 4G is nearly as great a leap forward as the change from dial-up to 2G. In low-mobility applications, 4G can achieve speeds over 2,500 times faster than 2G, or 10,000 times faster than dial-up. For the first time, a wireless technology is fast enough to be a true replacement for network cable. With its massive throughput, low latency and built-in security architecture, is the driver for an explosion of new technologies. The tidal wave of data spawned by a new generation of smart devices and transmitted over 4G broadband will spark a revolution of smart applications and software for data analysis.

For utility and energy markets, 4G is changing how M2M systems designed for Supervisory Control and Data Acquisition (SCADA) are able to help monitor and control generation and transmission, field engineering, inventory, and other critical aspects of the business. 4G-enabled M2M reduces data collection and transmission costs while providing the bandwidth needed for smart, cloud-connected applications at the edge.

As 4G modules begin to fall in cost, more and more M2M applications will adopt 4G for mission-critical applications.

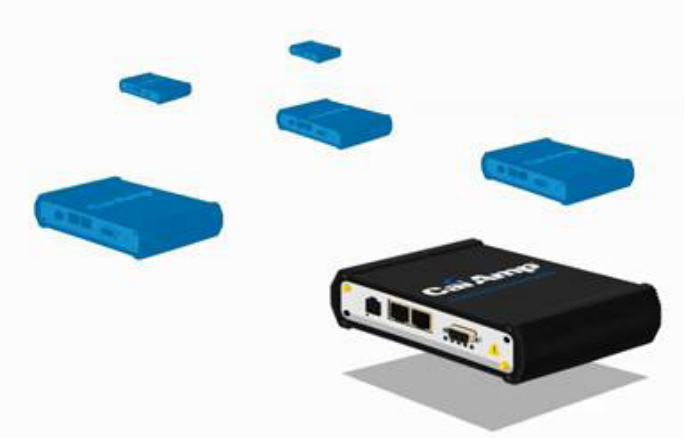
The important features of 4G are speed, security, and flexibility:

- Peak data rates over 500 Mbps with very low latency
- Strong cryptography and mutual authentication between network elements
- Ability to internetwork with other radio systems

These features, along with the latest 4G modems and routers, provide standards-based communication that enables interoperability between different types of devices for telemetry, monitoring, and control of diverse capital assets, including everything from video surveillance and remote smart devices to legacy equipment that requires a serial connection. In fact, 4G devices are connecting even these legacy components to the Internet of Things.

Updating a SCADA system to an intelligent 4G-based platform does more than lower cost. By automating and distributing system diagnostics and decision-making, system downtime is drastically reduced. Issues such as undetected leaks, inefficient service call routing, and unplanned shutdowns are nearly eliminated.

BUILDING SCALABLE, UPGRADABLE SOLUTIONS



The speed, flexibility, and secure architecture of 4G are only part of the equation. To build a solution that scales horizontally requires smart connected devices that distribute intelligence to the edge rather than relying on centralized operations management. Furthermore, to be upgradable, such a system must rely on over-the-air software and firmware management, including remote configuration and a development platform for custom applications.

The development platform is important because it provides an abstraction layer for designing a solution that can evolve along with the technologies and business needs of an organization, without breaking when equipment is updated or replaced.

For example, CalAmp Connect provides services for data storage, transmission, and analytics along with remote device and network management. CalAmp Connect abstracts device communications to a common set of API's across a range of wireless network technologies, providing a consistent, stable application interface that enables adopters to innovate and expand their IoT solutions as technologies and business needs evolve. As the needs of the solution change, the smart devices can be managed and updated remotely over the 4G network.

Powered by 4G, this distributed intelligence is already ushering in automatic, fine-grained decision-making to maximize operational efficiency based on analyzing robust, real-time data. At the same time, distributed intelligence further increases the usable network capacity provided by a 4G cellular network by reducing the amount of data transmitted to a central operations center.

With the CalAmp Open Developer Platform (ODP), developers can create distributed intelligence by building smart applications that run on 4G-connected devices. These applications can be both deployed and updated wirelessly, making them not only future-proof but effortless to maintain.

Smart applications running on cloud-connected devices create a unique convergence point, especially when coupled with a high degree of interoperability with a variety of systems. The ability to connect legacy serial-based equipment to a smart device and control it programmatically over standard IP-based networks is unprecedented.

It's now possible to build an entire solution without worrying about details such as the type of equipment in place. The old and the new can now talk to each other, make their own decisions automatically, and backhaul to a cloud-based management system that's accessible from anywhere.

As more and more utilities, agencies, and businesses realize the benefits of this convergence, switching to 4G becomes more and more attractive.

WHAT TO LOOK FOR IN A SOLUTION

When designing a 4G-based solution, there are a few things to look for that will help ensure reliability and maximum return on your investment.

Reliable carrier. Look for an operator that has deep and wide coverage in your area, with high performance and a spotless track record of uptime.

Experienced supplier. Get your modules from a vendor with experience helping organizations make the transition to 4G and good partnerships with carriers. The best suppliers have an integrated activation and provisioning process to get your devices up and running painlessly.

High-quality hardware. Only buy the highest quality components, preferably from a manufacturer with experience in as much of the stack as possible, from hardware and software to carrier relationship management. Be sure that the equipment has a long life span and is appropriately ruggedized for the conditions it will face in your environment.

Pick a vendor that provides you with high quality hardware and comprehensive data management solutions, while guiding you through the switch with minimal complexity and the lowest total cost of ownership. As a forward-thinking company, not only is CalAmp helping customers manage the transition from 2G networks today, it is ideally suited and committed to seamlessly and cost-effectively guiding its customers through inevitable future network and technology transitions as well.

RESOURCES

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About CalAmp
CalAmp is a proven leader in providing wireless communications solutions to a broad array of vertical market applications and customers. CalAmp's extensive portfolio of intelligent communications devices, robust and scalable cloud service platform, and targeted software applications streamline otherwise complex machine-to-machine (M2M) deployments. These solutions enable customers to optimize their operations by collecting, monitoring and efficiently reporting business critical data and desired intelligence from high-value remote assets.

For more information, please visit www.calamp.com.

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