

Introduction to IoT and M2M: What Technologies and Connectivity Options Are Right for You?

Aeris White Paper



Let our experts lead the way

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INTRODUCTION

The uses for Internet of Things (IoT)/machine-to-machine (M2M) services are expanding at breakneck speed as businesses are seeing their value in sectors including healthcare, transportation, utilities, home automation, security, and consumer automotive services, to name a few.

According to Harbor Research, the total number of cellular IoT / M2M connections is increasing dramatically worldwide, by more than a factor of four in five years, from 200 million devices in 2011 to an estimated 900 million devices by 2016. This growth is distributed around the world, with North America, Europe, and Asia-Pacific about equal in the number of cellular deployments.

This growth occurs as businesses are recognizing the value of IoT / M2M applications to produce new types of data, gain efficiencies, harness intelligence from a wide range of equipment, improve operations, and increase customer satisfaction.

For example, an in-home healthcare provider can help a diabetes patient by connecting a self-monitoring blood glucose meter that easily transmits regular health updates to doctors and avoid hospital care that otherwise may cost thousands of dollars.

Or truck fleets can comply with government mandates by measuring pressure of tires on their vehicles automatically before their drivers set out and in the process save tens of thousands of dollars otherwise spent on manual inspections.

Or farmers can use “smart” irrigation systems to reduce water use by automatically adjusting sprinkler schedules according to weather conditions.



Applications like these are among the many IoT / M2M uses transforming the way companies are conducting their business. This report introduces you to the essential concepts of IoT / M2M, the underlying technologies, and the best options for your business to deploy a successful IoT / M2M solution.

WHAT IS IOT AND M2M?

Definitions of IoT and M2M may vary, but in practice, the terms are used interchangeably when talking about the collection of data from sensors and devices in the field and the transporting of that data on wireless or wired networks to database application that processes the data so it can be used to make informed decisions.

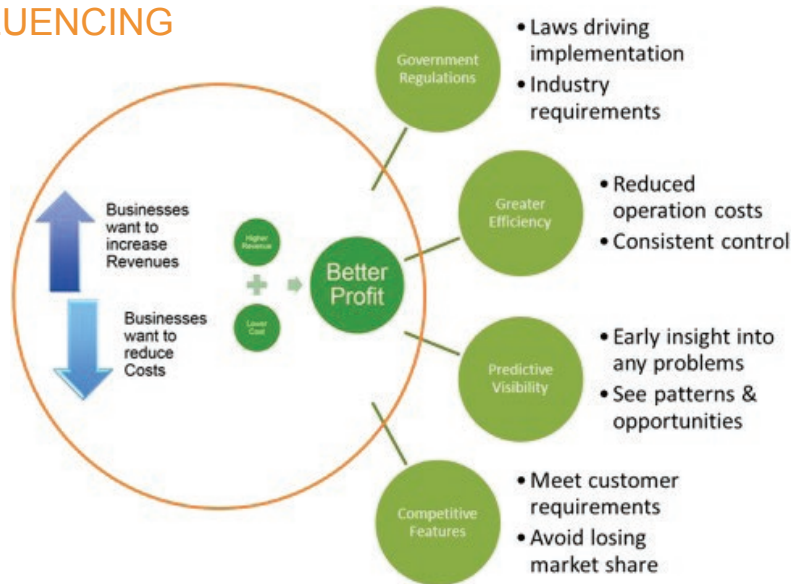
ESSENTIAL CONSIDERATIONS

To plan and deploy a successful IoT / M2M project, you first have to analyze your needs. It is important to make sure to outline a full plan that accounts for the processes, the methods, and the design principles for a deployment. There are many factors to consider.

You might have a specific problem related to transportation costs that you want to reduce. You might want to receive alerts and signals from an alarm device. You might desire a global deployment because you want to gather data from around the world.

Once you have identified your needs, you should then evaluate the best practices for your M2M implementation. Considerations may include regulatory requirements, operational costs, and customer requirements.

FACTORS INFLUENCING IOT / M2M

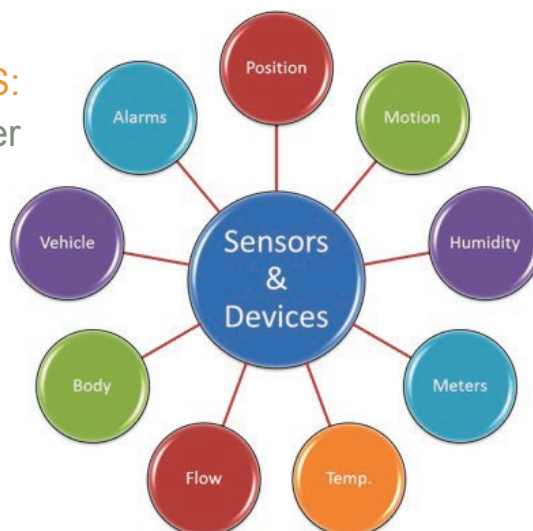


To select an IoT solution provider, you should consider several factors to help you make the best choice. For example, how reliable is the provider's network, does it have redundant data centers, what are its setup fees, and what kind support services does it offer?

SENSORS AND DEVICES

Once you have developed an initial plan based on your needs, one of the next steps in developing an IoT / M2M solution is the selection of the sensors and devices you will use to pick up and transmit the important data you need to take action on your business.

AN ABUNDANCE OF CHOICES:
Many sensors available to gather information



The kinds of sensors and devices that companies are deploying out in the field include position sensors, motion sensors, and meters for utilities. In the medical field, healthcare organizations are now gathering information about patients to whom these sensors are attached. Obviously, vehicles are a natural use of sensors as automotive OEMs have launched connectivity solutions for their vehicles, providing everything from an enhanced customer relationship, safety and security applications, to infotainment. IoT / M2M alarms systems provide access control, manage loss prevention, reduce property vandalism, increase employee and/or customer security, reduce liabilities, and increase employee productivity.

There are sensors and devices that you can attach to just about anything you might want to monitor. It's a remarkable industry that has grown up over the years and now provides low-cost sensors that you can use to gather any type of data.

Once you have sensors and devices, the next thing you'll need is data transport, and this step is critical for the short and long-term success of your program.



CONNECTIVITY OPTIONS

WIRED CONNECTIVITY

Some machines still use land lines (POTS, DSL, cable) to connect to an IP network. With wired connectivity, you will have connectivity fees for Internet access at that location. The customer may have a cable modem service with an Internet service provider (ISP) for receiving and transmitting data from their local computers inside their house or business to the ISP. More often than not it works reliably, however, wired solutions may require additional efforts to ensure the network is in place. You need to ensure your customers understand that this network will be the transport mechanism for their IoT / M2M solution.

High bandwidth is often available, particularly abroad, where broadband initiatives have brought high-speed Internet access to most homes and businesses. In the U.S., rural areas may still have concerns about network access.

An important issue is the level of availability and quality of services provided by the ISP. Sometimes, extra effort is required to ensure service. For example, if you operate a chemical processing facility, the plant may not be wired for network connectivity, and you may have to develop network services with an ISP. A good, working relationship with the ISP is important to ensure high quality of service to minimize problems such as outages.

Finally, if you're selling a consumer product, opening up access on a network with wired connectivity may not be easy. You have to go through firewalls, and you might have to do Wi-Fi setups. These are issues that might need more support from the product manufacturer that is deploying those units than you might anticipate because the network is not under your control, and you have to walk people through the particular setups.

WIRED NETWORKS:

Used for fixed-location IOT and M2M applications

Characteristics

- Costs “shared” with Internet access
- High bandwidths often available at locations
- More immune to noise & wireless capacity issues

Concerns

- Requires ISP service or other LAN
- Network availability & quality depends on ISP
- Consumer setup not necessarily simple

While wired connectivity is more limited and expensive than wireless, it is less susceptible to radio frequency (RF) noise that sometimes occurs in a wireless solution when wireless space is shared with other people. Generally speaking, most people who sign up for wired access will get the bandwidth that they expect from the ISP.

In summary, wired connectivity is optimal for fixed location IoT / M2M applications and makes sense under certain conditions, which will be addressed later in this report.

WIRELESS CONNECTIVITY

Cellular and satellite connectivity is usually required for any kind of long distance, physically mobile application. With such applications, service availability is generally excellent. You can get coverage just about anywhere.

Cellular coverage in cities and highways in the U.S., Europe, and most developing countries is quite good. There are multiple generations of cellular technology that you can use because handset use has ensured the availability of cellular towers that can be used for IoT / M2M deployments.

CELLULAR & SATELLITE:

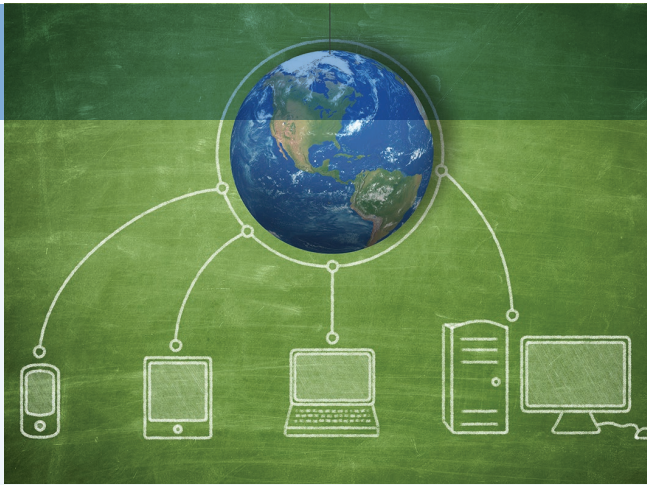
Required for physically mobile applications

Characteristics

- Service availability is generally excellent
- Cellular coverage in cities & highways is excellent
- Satellites provide coverage beyond cellular

Concerns

- Radio module costs can be high
- Multiple generations of Cellular technology
- Cellular technology longevity driven by handsets



Network changes, however, can impact the applications you use, and you should understand these changes and be able to react to them. For example, you will encounter network changes that may seem obvious to the carriers who provide those services, such as the removal of 2G wireless technology services. But the impact on IoT / M2M applications that rely on the presence of that network is significant. It's an issue that you have to understand, and you need to be able to compensate for it by either making sure your product lifecycle allows for it or that you can change out the radio transport portion of your application down the road.

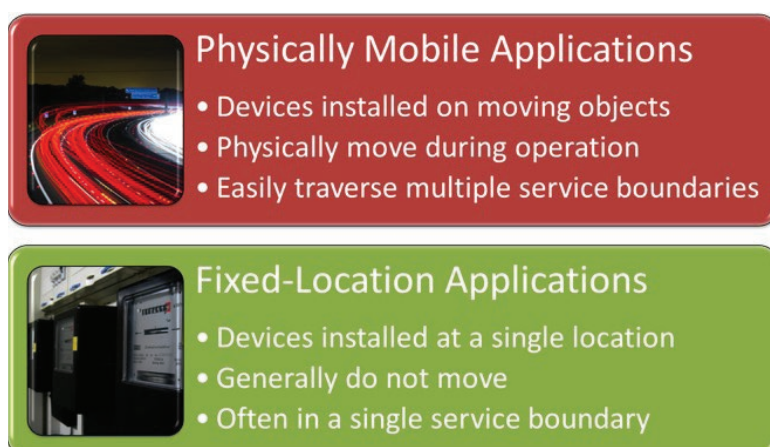
For extremely remote locations where cellular connectivity may not be available, satellites may provide a solution. And if there is a need for transmitting when you're outside cellular coverage, a hybrid application using satellite connectivity may make sense.

MOBILE VS. FIXED APPLICATIONS

We like to categorize IoT / M2M applications into two basic sets because they have different criteria that can make a difference as to which technology you will select.

There are physically mobile applications and fixed location applications. With physically mobile applications, devices are installed on moving objects such as truck fleets and are expected to move during normal operations from one location to another. They might traverse multiple service boundaries narrowly within the technology they're using, or, if they have multiple technologies, they might change from one technology usage to another as necessary. They're in motion not just physically in space but through the technology that you're using.

IOT APPLICATION CATEGORIES: First step to technology selection



MOBILE APPLICATIONS

When you have a physically mobile application, it's natural for a wireless network to be used as your transport. A wired application makes sense when you're going to unplug at one location and go somewhere else, but it doesn't make sense when you're frequently moving. In that case, you're going to need wireless.

Cellular and satellite solutions for long-range networks are common. You need a wide-area network if you're going to get that data back to a central facility, and you'll want a method for mobility management. In other words, while a device may work in one location, when it moves as a natural part of performing of its function, does it have access to that same network or the same technology or a different technology? You need to understand the limits and opportunities for mobility management for your mobile devices.

FIXED-LOCATION APPLICATIONS

Fixed-location applications can be installed in a single location and generally don't move. They might not be physically attached to a wall, but they're located in one site. For example, a medical device may move around a patient's home, but it remains in the same house.

Different types of wired connectivity can include data transport over Ethernet, cable modem service, or a dedicated IP circuit.

Those fixed-location devices typically tend to use wired connectivity, but they may also use wireless. Physically mobile applications can be hybrids. You could use short-range technology such as Bluetooth and Wi-Fi, as well as medium-range technologies, such as cellular.

CELLULAR TECHNOLOGY OPTIONS

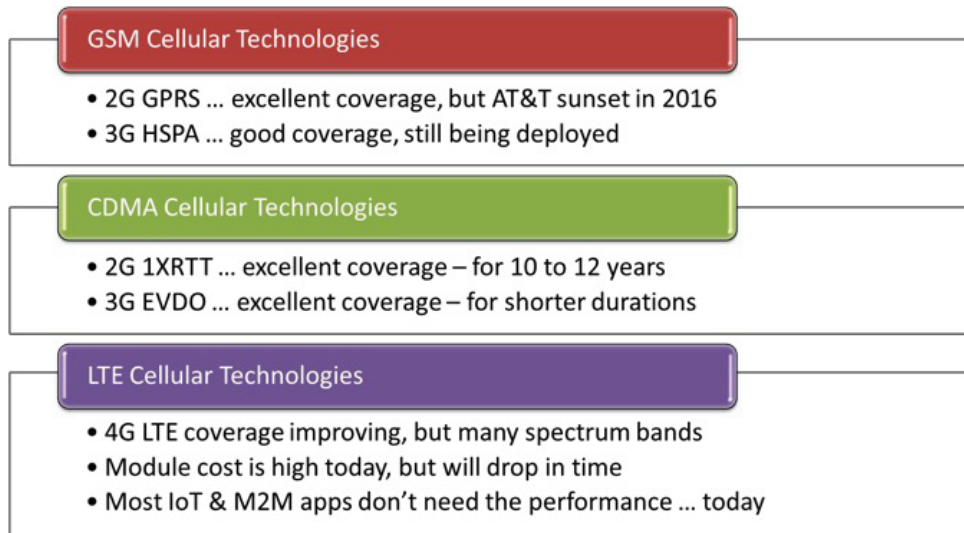
The standards and technologies for wireless mobile communications are rapidly evolving to offer ever more advanced and efficient cellular services. Mobile cellular carriers, including IoT / M2M service providers, can no longer be sure the two dominant worldwide cellular standards—GSM and CDMA—will remain unchanged and in place permanently.

In fact, both GSM (Global System for Mobile Communications) and CDMA (Code Division Multiple Access) are giving way to the faster and more spectrum-efficient cellular standard—LTE (Long-Term Evolution). The shift to LTE, however, will not occur quickly or easily. There are many issues for carriers to consider in the coming years as they evaluate their cellular network service deployment strategies.

In the U.S., AT&T has announced a shutdown of 2G GSM services by January 1, 2017, and T-Mobile USA is expected to reduce 2G GSM services as well. As a result, carriers must find alternative deployment strategies. The 2G GSM sunset does not apply to CDMA, which remains the predominant standard in the U.S. market. Carriers providing 2G CDMA services have said they will provide CDMA services through the end of this decade and as long as five years into the next decade. M2M providers can count on CDMA for years to come as they plot their long-term migration strategy.

In the U.S., AT&T has announced a shutdown of 2G GSM services by January 1, 2017, and T-Mobile USA is expected to reduce 2G GSM services as well.

CELLULAR TECHNOLOGY: Evolutions in cellular service, coverage, and technology availability



The following is a brief explanation of cellular technology options for M2M and IoT:

2G GSM – The GSM cellular technologies are 2G GPRS and EDGE. Many businesses used 2G GPRS for cellular M2M applications because it was sufficient for their requirements. The coverage in the U.S. is excellent and generally around the world is very, very good. Keep in mind that in the U.S., the AT&T sunset will eliminate 2G GPRS at the end of December 2016.

3G HIGH-SPEED PACKET ACCESS (HSPA) – 3G HSPA networks (GSM) continue to add users at a rapid pace around the world. Of the estimated 580 cellular operators that have deployed GSM cellular technologies, almost 550 have launched 3G HSPA data services, and more than two-thirds have also increased their data throughput with HSPA+ network deployments. This trend is likely to be faster internationally than in the U.S. In the U.S., rapid LTE coverage is required for data capacity needs and is growing more quickly. Availability of this service is more expensive, and radios using the technology are considered expensive.

2G CDMA – This technology has excellent coverage in the U.S. and is expected to remain available into the 2020s. On the other hand, 2G CDMA will eventually sunset, so you need to consider whether your product lifecycle can accommodate such a timeline. CDMA networks are available worldwide and compatible 2G 1XTT and 3G EVDO technologies are deployed by 314 carriers in 118 countries.

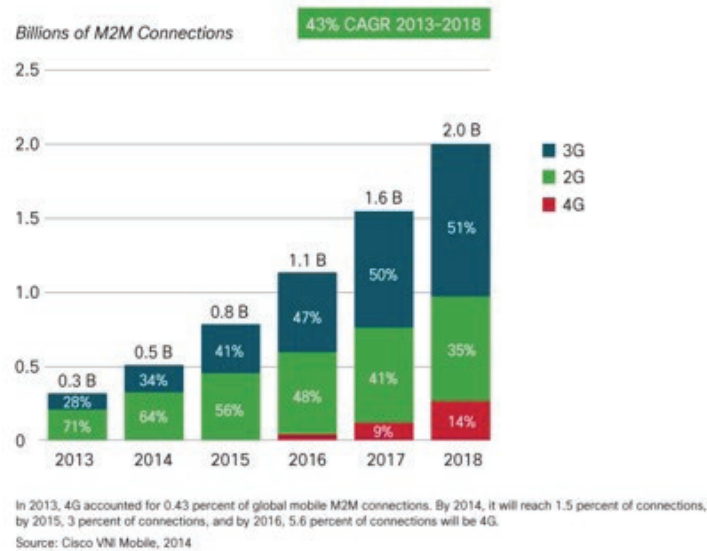
4G LTE – LTE network deployments are growing dramatically as cellular providers recognize the need to upgrade their infrastructure to accommodate high data traffic volumes and deliver services more cost-effectively. It is worth noting that the traditional cellular carriers are upgrading their networks to meet consumer demand for faster networks that carry more data. In the process, IoT and M2M deployments, which require much less bandwidth, will be forced to upgrade earlier.

There are many spectrum bands with 4G LTE, and your choice of radio may lock you into a particular carrier. On the other hand, multi-band, multi-spectrum radios are becoming available, but remain costly. Although we expect costs to drop over time, present costs are sometimes prohibitive for certain M2M applications. Today few IoT / M2M applications need the performance of LTE. In fact, some of the applications using 3G EVDO or 3G HSPA simply don't need that kind of bandwidth, and LTE is overkill for most of those applications.

Over time, application requirements will change, and costs will come down. The people deploying these applications will find new uses for the bandwidth that is becoming available in the LTE technologies. The transition from a 2G or a 3G cellular selection today to a 4G LTE selection will be driven more by your application needs, how much data you must transport, and whether it is worth the cost.

TRENDS

IOT / M2M CELLULAR WORLDWIDE: Predominantly 2G and 3G for the next few years | LTE starting ramp in 2017 ... accelerating

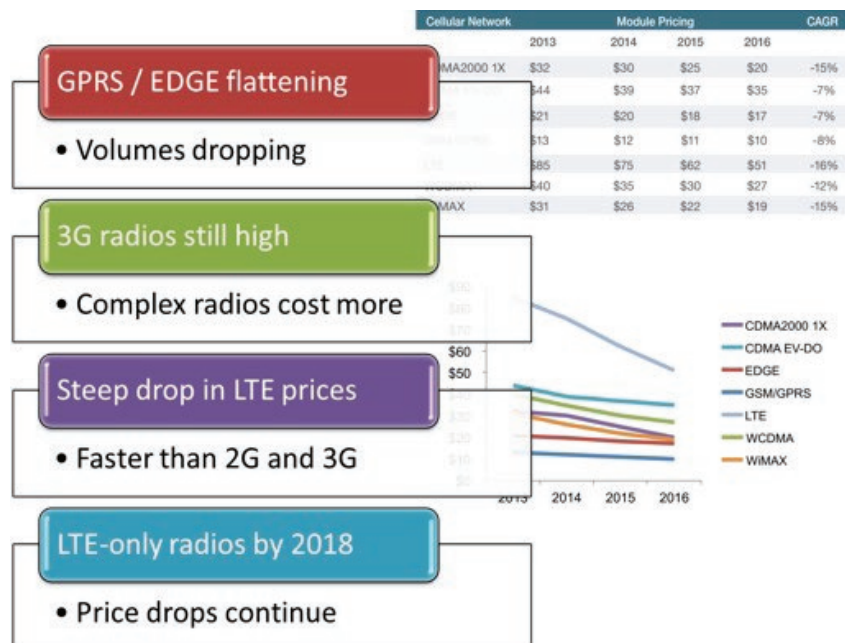


According to Harbor Research, 4G LTE will not start to ramp up until about 2017. At that point, 4G LTE growth will accelerate rapidly, which will coincide with lower use of 2G cellular around the world. In the U.S., 2G GSM cellular will not be as readily available on every GSM network, not only AT&T.

Clearly, 3G is going to grow quite dramatically and will remain the most-used technology.

RADIO COSTS

IOT / M2M MODULE: High volume sales price projections



In general, the costs for IoT / M2M radios and devices are flattening or declining over time.

Radio costs for GSM/GPRS and EDGE modules have dropped seven and eight percent from 2013 to 2016. At the same time, the volume of these modules sold has also declined due to concern about the longevity of those technologies. In contrast, prices for LTE modules are dropping steeply, by 16 percent from 2013 to 2016.

3G radios remain expensive today. These are the complex radios that generally cost more than those using 2G. Modules for CDMA EVDO for 3G, which cost \$44 in 2013, are declining only seven percent, to \$35, by 2016.

Prices for modules using 4G technology will drop significantly in the coming years, and these modules will eventually use only LTE technology. The handsets that deploy 4G/LTE today use multi-technology chipsets with LTE combined with either HSPA and 2G or LTE combined with CDMA. Around 2018, we should see a significant uptake in the deployment of LTE IoT / M2M radio modules, and that is when prices will drop substantially. Beyond 2018, LTE radio costs might drop even more substantially, as the use of 2G and 3G technologies lessen and LTE becomes widespread.

CONCLUSION

IoT / M2M is experiencing tremendous growth, with radio prices falling, new applications being deployed, and cellular use rising.

There are many technologies to choose from in building an IoT / M2M solution. When you're evaluating using a wide-area network, generally wireless technology will be used for satellite and cellular connectivity for most applications. At the same time, there is growth in the IoT / M2M space for short-range technologies, such as medical devices for self-monitoring that send information over Wi-Fi networks at home. But the minute you need a wide-area network, you're probably going to want to pick a cellular or satellite technology. That choice depends on the application. What do you need? Each application will have different requirements forcing a particular selection for transport.

At this point, LTE is in the early design phase, with few large-scale deployments for several years. Some applications, for example, those transporting video, will need the extra bandwidth available, but for most applications, LTE is overkill. 2G has a limited lifetime in the U.S. Around the world it will not be as readily available as 3G technologies, and then 3G technologies will eventually give way to 4G/LTE. If you can wait the two or three years to do an LTE application, you will enjoy lower prices for devices and connectivity and will get much greater product longevity for your IoT / M2M applications.

As this report shows, there are many factors to address before moving ahead with an IoT / M2M solution. But a thorough examination of these issues can put you in position to take advantage of the many opportunities offered by IoT / M2M applications in this rapidly expanding market.

ABOUT AERIS

Aeris is a pioneer and leader in the market of the Internet of Things – as an operator of end-to-end IoT and M2M services and as a technology provider enabling other operators to build profitable IoT businesses. Among our customers are the most demanding users of IoT services today, including Hyundai, Acura, Rand McNally, Leica, and Sprint. Through our technology platform and dedicated IoT and M2M services, we strive to fundamentally improve their businesses – by dramatically reducing costs, improving operational efficiency, reducing time-to-market, and enabling new revenue streams.

Our global headquarters is in Silicon Valley (Santa Clara, California). Our European headquarters is near London, UK. Visit www.aeris.com or follow us on Twitter @AerisM2M to learn how we can inspire you to create new business models and to participate in the revolution of the Internet of Things.

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