10 THINGS

LEADERS SHOULD KNOW ABOUT THE INDUSTRIAL INTERNET OF THINGS

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1 BIG OPPORTUNITY

Moore's law is unleashing low cost, high power, tiny chips that can be put into anything from a power outlet to a hydraulic cylinder; these processors have nearly the same computing power as PCs from just a few years ago.

Wired and wireless networking technology is lowering the cost of communications to the point where most "things" can be connected inexpensively via Ethernet, 2G, 3G, 4G and even TV Whitespace technologies such as Neul, Sigfox™ and Weightless™.

Free clustered SQL databases, big data databases, node clustering technology and cheap infrastructure services make the cost of storing highly available (HA) industrial data trivial compared to even two years ago.

It is estimated that the Industrial Internet will account for 16% of global GDP by 2020. Manufacturing companies will grow their spend on enabling technologies from $20 billion to over $500 billion in a race to capture over **$1 trillion in new value and ROI.**

In 2012, the cost of computer chips, communications and big data storage hit a tipping point where IT spend on the industrial Internet was $20 billion and the value returned was $23 billion or 15%.

This figure will continue to grow to a **2020 ROI of 150%** as technology forces push an aggressive drop in the price of computing and communication.

Put simply, anything that has economic value in being connected and analyzed, will be. Your customers and workers 35 years of age and under have spent their entire adult lives with access to a web browser and the Internet– **connectivity is expected**.

Sources: General Electric, Wikibon

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2 VAST APPLICATIONS

In manufacturing, there is an almost unlimited amount of use cases and applications for the industrial Internet ranging from machine control and monitoring to autonomous supply chains.

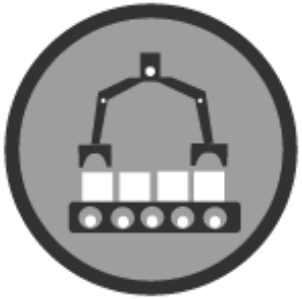
Powerful applications will link disparate assets together to create self-managing operations. For example, a diesel generator can check a nearby fuel tank, and then automatically dispatch a GPS-tracked truck to retrieve the fuel and deliver it. The truck's engine data can notify fleet maintenance that preventative action is needed. These kinds of blended sensing and workflow applications are possible today with test budgets that fit nicely on a credit card, versus the six-figure endeavors of just two years ago. It is estimated that over 5 million unique connected industrial apps are coming.

Unlike past IT revolutions, the Industrial Internet will materialize subtly due to the rollout constraints of the physical world. Many expect it to parallel the trajectory of smart phones and tablets from 2008 to today—the change was not overnight but to many it felt that way.

NEW SERVICE REVENUE

Customers of industrial products and systems want low TCO experiences just like IT buyers do. They are willing to pay for better products and advanced services that make their lives simpler.

OPTIMIZED SUPPLY & SERVICE CHAINS



Most companies carry 30% or more spare parts than are actually needed by assets and their technicians. Furthermore, 20% of most first-fix attempts fail due to incorrect failure analysis, wrong technician skill set and other factors.

IMPROVED PRODUCTIVITY FOR ALL

Smarter operations and processes free labor from reactive fire drills so they can focus on core, value-added activities—driving dramatic impacts in productivity, culture and morale.

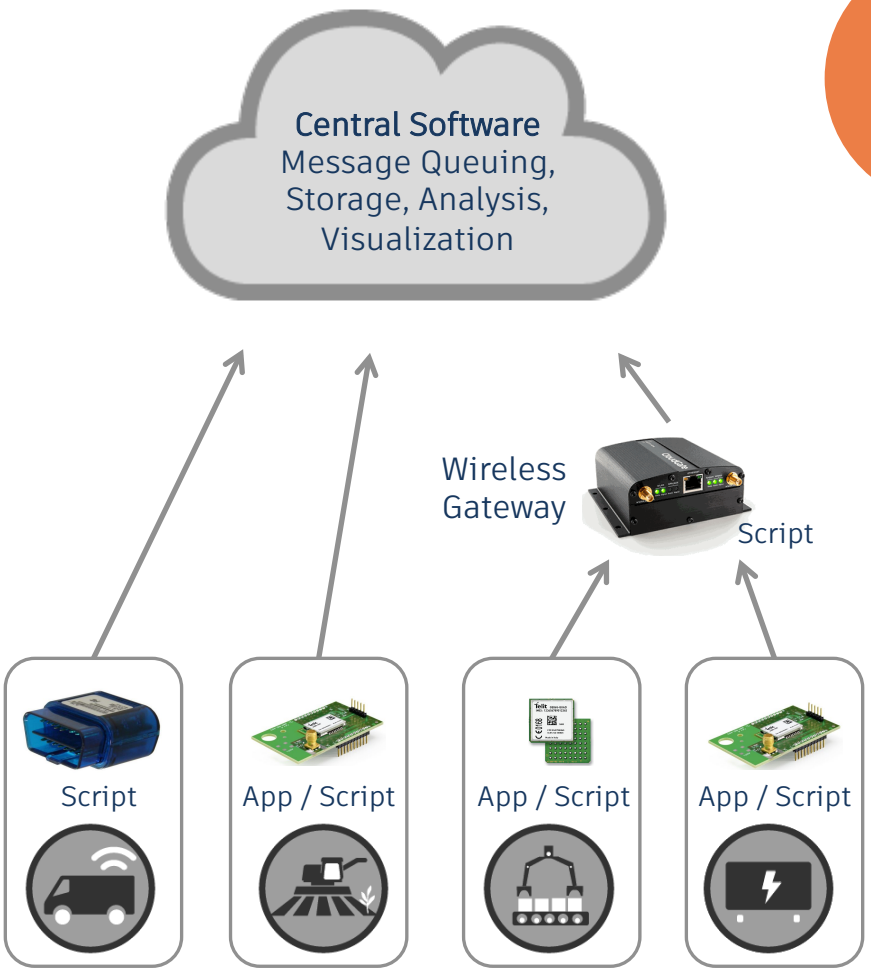
Source: M2M Alliance

3 PROVEN ROI

Keeping the world up and running 24/7/365 is the underlying goal of most Industrial Internet solutions. New connected asset services are announced and launched every day.

Today, 95% of companies are engaged in at least one project. Of those, 42% of projects are generating at least $1 million in incremental revenue with early adopting customers. 17% of companies have already built Industrial-Internet businesses that are generating $10 million or more in revenue. Interestingly, 55% of projects involve completely new business and customer engagement models.

Internally, companies that consume Industrial Internet technologies and solutions generally see a 30% or better reduction in hard operational costs related to asset, equipment and facility management.



Assets have embedded processors or aftermarket devices attached to them. Some devices may have their own modem or routing technology for communicating directly to other Internet machines and systems. Others use a WAN gateway to get data onto the public Internet.

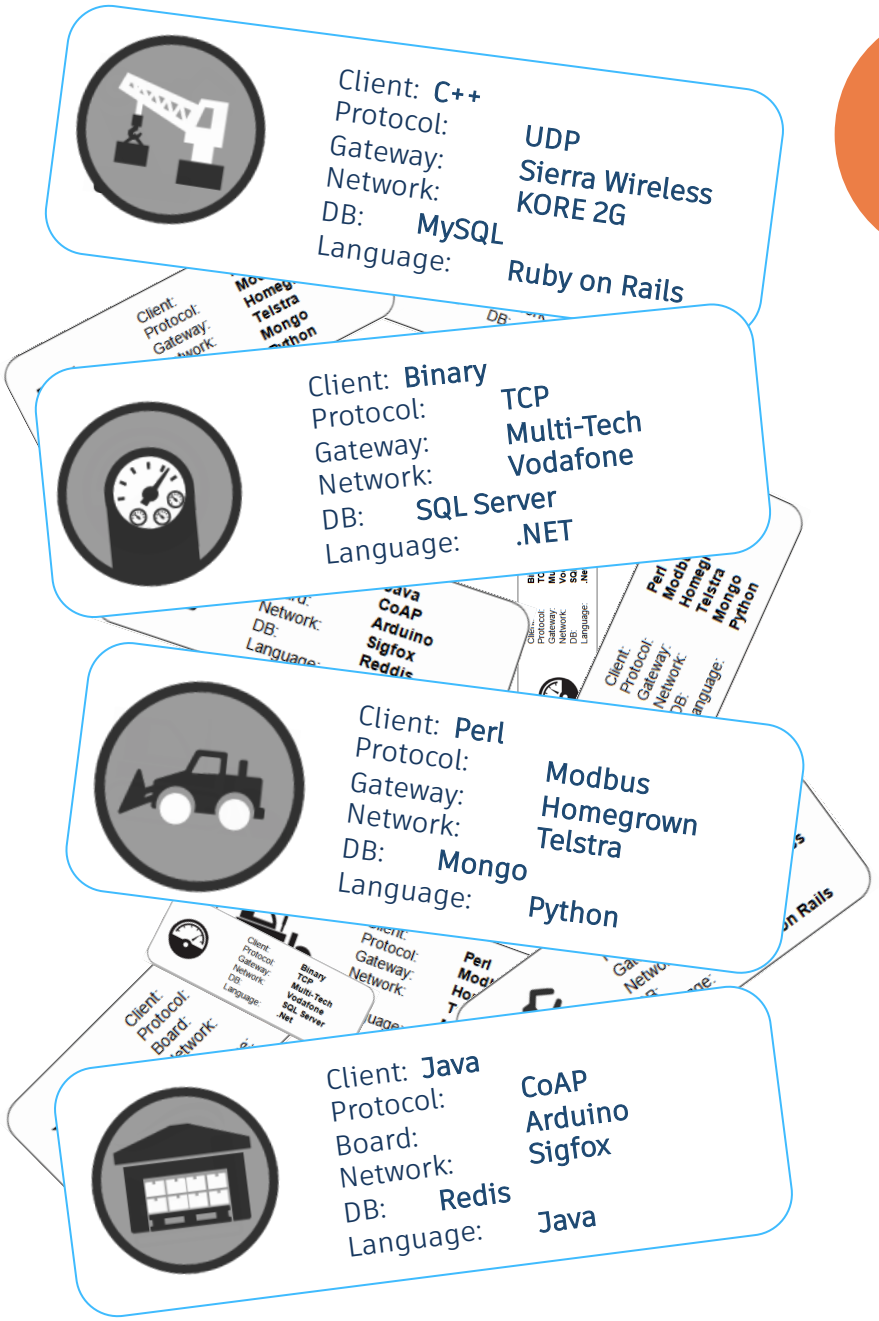
4 COMPONENTS OF A SOLUTION

M2M Solutions are functionally very similar to corporate Smartphone and tablet deployments:

- An “app” runs on a machine to gather and/or analyze data; the app must be developed carefully as device CPU and RAM resources are constrained
- The data is packaged and sent via wireless or wired connection
- If the connection is wireless, the machine has an internal modem or it locally networks to a WAN gateway that handles two-way communication
- Data is logged on a central Internet-based server for relay to ERP systems or to m2m solutions for instant analysis and action

Enterprise management requirements are similar:

- Devices consume bandwidth and often have cellular data plans where variable expense management becomes a requirement
- Rogue and defective devices need to be identified
- Firmware distribution and management is required at scale
- A device lifecycle management solution is useful for large deployments



5 WHERE AND HOW IT'S HAPPENING

Most Industrial Internet and m2m projects today are at the edge of company operations. Typically, a key customer has demanded an advanced connected asset or product service from a local sales rep and product management.

Fast time-to-launch pressure forces the business unit to find a local solutions integrator who knows machine-to-machine (m2m) solutions. These persons or companies help with selection of client languages, protocol stacks , security, wireless gateways, wireless networks and more. The same or other consultants then help with technology selections for app, db and central software development. Most m2m solution integrators are freelance professionals or small 5-20 person companies.

Initiatives originally planned as pilots can grow quickly to commercial service offerings with a life of their own. These projects inject new device populations into the enterprise.

But unlike Smartphones and the relative simplicity of BYOD (bring your own device) management, m2m embedded and aftermarket devices present complex protocols, client language and communications decisions and integrations.

Source: Fusion Connect Surveys

6 PROTOCOLS

Device communication protocol selection is an extremely important aspect of any project. Protocols have an impact on:

1. Size of packet payload and thus bandwidth used
2. Available security options
3. Central software design and hosting

The most commonly used m2m protocols are HTTP, TCP, UDP and Modbus over TCP–whether over Ethernet or Wireless. Newer protocols used in m2m are CoAP and MQTT. The two protocols that best lower bandwidth consumption and work well in with constrained devices are UDP and CoAP. UDP only manages data one-way while CoAP does a great job of compressing data.

Ideally, when evaluating embedded or aftermarket m2m computing technologies you can select from an open system that is Linux-based and supports at least two communication protocols. Yet, many vendors only officially support a single protocol and do not offer robust security solutions –leaving security concerns for the customer to solve internally.

Central server software and the firewalls around it need to be designed and equipped to deal with traffic from any given protocol.

7 LANGUAGES AND SCRIPTS-THE “APP”

Language and script selection of the field client “app” is as important as the protocol. Languages also impact data payloads, security and central software infrastructures.

The most commonly used language on m2m devices today is C and C++. The C varieties closely model an actual CPU found in devices and compilers are available from most device vendors. Java is growing in use and is deployed to devices that have more CPU power and memory resources. Due to its open source and customizable nature, the Android OS and SDK (Java, XML, JavaScript) environment is finding its way in to more and more industrial products where processing power is high. The verbosity (or amount of symbols and words required to execute instructions) of the code/script will have an impact on packet sizes and bandwidth used, as will developer skill.

Device language has a strong impact on server side development. In an ideal world a Java client would talk to a Java system for simplicity and supportability goals. However, in multi-vendor and enterprise-scale device deployments this become almost impossible so a central data storage, brokerage and normalization capability is typically needed.

8 WIRELESS COMMUNICATIONS

A common feature of Industrial Internet and m2m deployments is the use of wireless communications. Most projects involve communicating with assets that are behind a far-away customer firewall. Or if the project is operationally focused, the goal is to bring distant assets and sites into real-time view and control.

There are many choices of communication technology and most of the time, device selection drives network selection. Very few m2m devices have the ability to communicate with multiple network technologies like modern phones and tablets do. In fact, very few m2m devices even offer dual-mode Wi-Fi and cellular connectivity—which has the benefit of keeping device costs low.

Depending on the global region, wireless telecom carriers and dedicated m2m MVNOs offer varying levels of device-friendly plans. Some carriers offer pooled plans where large populations of machines with SIMs can share minutes in a single account. Others do not. Consulting with an m2m specialist who knows the carriers will help your project teams avoid vendor lock in of both devices and telecom expenses. Unlike phones, remote asset-based devices are difficult to uninstall from the field.

9 SECURITY

Most m2m deployments today are not secure by traditional enterprise IT standards. At best there is a private VPN between device populations and central servers—which is costly to implement and maintain.

Like all aspects of an m2m solution, security options are a function of other chosen components. Java, for example, provides excellent security options at multiple levels of a solution from device to data center. However, Java may not be available for the required devices and sensors. Thankfully, next generation embedded systems and m2m product CPU designs are building security options and toolsets in at the processor and then transport levels. DTLS in particular is a technology that is showing strong signs of becoming an m2m standard and chip vendors are designing it into their products and SDKs. It can also be "retro"-designed in to any custom project.

At the central software level, most m2m deployments grow from hastily-programmed pilot solutions and do not typically follow security norms for use of SSL, strong passwords, database level password encryption, role-based access privileges and other standard enterprise IT requirements.

10 TRULY BIG DATA

Most of the data created on the Internet today is from consumers—pictures, audio, video, social networks, business websites and more. Given that there are 10 times more machines than people, and that medium complexity machines can generate 1 GB of data per day or more, it's safe to say the Industrial Internet's data will dwarf the consumer web.

One interesting aspect of industrial data is that most of the value is from automatic action on machine information—ordering a spare part, sending a 3rd party technician a work order, etc. Those actions are enterprise spending decisions. Spending decisions should be time-stamped, auditable and ACID-compliant—which means relying on proven SQL technology. Yet off-the-shelf SQL generally hits a performance or data management limit.

Planning an extensible architecture with a useful fusion of proven technology and newer noSQL technology is key. Frequently m2m projects start with a handful of devices but steadily scale to thousands. At first the data appears manageable but can quickly grow to terabytes and beyond. Ideally m2m shouldn't require rebuild or redesign down the road as the device count grows since it is difficult to change where device data "reports to".

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