



## The Growing Demand for Industrial Internet Sensors

The “Industrial Internet” is a term originally coined by GE, but now widely used and embodies the concept of industrial environments that are automated using sensor networks and machine-to-machine (M2M) communications. The Industrial Internet is also closely associated with concept of the Internet-of-Things (IoT). Indeed, the Industrial Internet could be thought of as the IoT restricted to industrial situations, acknowledging that these situations have special needs. Although there is no accepted applicability of “Industrial Internet,” NanoMarkets think it reasonable to assume that Industrial Internets will increasingly be found in factory automation, commercial building automation, the energy industry and public transport of various kinds.

These are different settings in many ways, but NanoMarkets believes that they are all increasingly share a need for rugged networks that connect up complex machines with the purpose of enhancing efficiency, profitability and safety. The hidden assumption behind Industrial Internet concept is that a common platform with similar sensor infrastructure could serve for these many different applications.

### Opportunities for Sensors in the Industrial Internet: Large and Growing

Granted this assumption, NanoMarkets believes that the opportunities for sensors in the Industrial Internet are both large in number and fast growing:

- To ensure their main objectives Industrial Internets must collect many different kinds of information from machines and their environment making the sensor industry a key beneficiary of the rise of the Industrial Internet. For example, GE’s new battery factory in New York contains more than 10,000 sensors spread across 180,000 square feet of manufacturing space
- The Industrial Internet opportunity for sensor makers is not just large; it is growing. Cisco estimates that sensors currently are installed on fewer than 1% of Internet devices. By 2020, Cisco expects 50 billion devices to be interconnected

**Transition to specialist sensors expected:** Initially, NanoMarkets believes that such deployments will make use of conventional industrial sensors, so the Industrial Internet. This will mean a surge in revenues for established industrial sensor makers. However, NanoMarkets believes that this “surge” will be driven primarily by the absence of sensors that are specifically tailored to the needs of the Industrial Internet. In other words we believe that there is the likelihood of a new kind of sensor emerging to meet the needs of the emergent industrial Internet.

At first such needs will not seem qualitatively different from the needs of sensors in *any* industrial setting. However, we believe that the circumstances in which Industrial Internet sensors are going to deployed will – within a few years – impose requirements on Industrial Internet sensors that will shape a new generation of sensors. These requirements and likely developments are shown below.



Summary of Requirements for Industrial Internet Sensors			
Requirements	Driver	Challenges	Possible Solutions and Opportunities
Low-cost	Billions of sensors in aggregate can add up to a large capital expenditure	Making sophisticated sensors low cost	Printed sensors, smart dust. Manufacture in low labor cost geographies. Possibly new materials
Low-power	Billions of sensors deployed need to be powered	Although individual sensors may not need much power in aggregate they soon add up to enormous power demands. Also conventional batteries may need frequent changes	Energy harvesting technology can reduce power generation needs, while thin-film batteries can reduce the frequency with which batteries need to be changed.  Meanwhile, new sensor designs (including designs for electronics) as well as new materials can reduce power needs of the sensors themselves. Moore's Law can also help
Ruggedness and reliability	Industrial sensors – whether part of the Industrial Internet or not – need to be able to withstand heat, cold, dirt, EMI, RFI, etc. Obviously, these requirements are quite different from the consumer IoT		New materials. Also adapting the manufacturing traditions and materials already established in the industrial sensor business
Appropriate communications interface	Standardized interfaces to the Internet suitable for real time communications	IPv6 compliance Too many standards – ZigBee, Wi-Fi, Bluetooth, EnOcean, etc.	New standards options continue to appear, but the market can be expected to sort out this issue in the next few years. The Industrial Internet may adopt different standards to the consumer IoT
Security	Depending on the industry that the Industrial Internet serves, sensors data may contain important competitive or privacy-related information	Billions of sensors everywhere are a security breach waiting to happen	Industry security standards for IoT are just beginning to emerge, but are fairly mature for IPv6 and networking technology. Multilayer security will be essential. Regulation and industry security standards are likely here
Software	Need for real time information, security and interface with standard cloud and “big data” environments seems to suggest opportunities for novel software packages	Complex software of this kind always takes a long time to develop and fix for bugs. This process has not really started yet.	Usual patterns of software development – new iterations of software over time – V.1.0, V.1.1, V.2, etc,



## The Industrial Internet May Remake the Sensor Industry

But the question then gets raised: what kinds of firms are likely to make the most of the opportunities that we have outlined so far? NanoMarkets believes that there are both short-term and long-term answers to that question. In the short-term we think that it will be the huge firms that coined the term “Industrial Internet” to begin with. In the longer term, we imagine more entrepreneurial opportunities opening up,

**Giants rule for now:** NanoMarkets believes that the giants of industrial automation, electronics and communications will be initially the firms that make waves as far as Industrial Internet deployment goes.

There is nothing especially controversial about such an insertion. GE, Cisco, Intel and other such firms are *already* the pioneers in the Industrial Internet stakes. They invented it, so to speak, and they have the financial resources and appropriate customer base to make the Industrial Internet happen.

Most of these giant firms could not really be considered sensor firms as such. Rather, for now, these firms are the customer base for firms selling industrial sensors. In our opinion, these sensor firms can now reasonably expect to see their sales of relatively conventional sensor products begin to ramp up significantly as the Industrial Internet becomes a reality.

It is not just the volume of sensors *in aggregate* that represents the opportunity for sensor firms as the result of Industrial Internet deployments, it is that in the with the Industrial Internet the manufacturers of machine tools, backbone communications equipment and the like will be supplying in their equipment the ability to monitor many more factors impacting their equipment. It may, for example, become standard for equipment to alert users to when it is beginning to wear out, is exhibiting erratic performance, or is just operating below par. The Industrial Internet implies a future with machinery of many different kinds that can self-optimize, self-configure, self-diagnose, and intelligently support workers.

The bottom line here is that equipment makers will need more sensors and of different kinds that are currently used.

Quite a lot of money is at stake here. For example, GE already has an Industrial Internet product for the aerospace industry that is designed to maximize a jet’s fuel burn while monitoring carbon emissions. According to one report, this equipment would save an airline \$90 million over five years. If embedded sensors in a piece of equipment and using them effectively can save this much money, then sensors are should be considered as highly valued within the context of the Industrial Internet.



**Entrepreneurs and ecosystems:** If in the early days of the Industrial Internet, the large electronics and automation firms are the “front men” for the Industrial Internet and the sensors used are fairly standard issue, it seems likely that these larger firms will capture much of the value that is inherent in Industrial Internet sensing.

But we think this will change. As we see in Exhibit E-1, the current generation of industrial sensors are not really well suited to Industrial Internet applications and this opens up the market to a new breed of industrial sensors firms who cater to the Industrial Internet from the get go. The very high potential volumes that these sensor firms are chasing after make it at least possible that venture capitalists would be attracted to this kind of opportunity.

There are two caveats here, however:

- More than just novel sensor products would be required from smaller more entrepreneurial firms to be funded. First, there will need to be a business model in place that make sense in the new era of the Industrial Internet. This most likely means that Industrial Internet firms will have to establish a so-called business ecosystem or become part of one. This would leverage the skills of the sensor firm itself in combination with firms that have strong software knowledge, strong distribution/marketing channels, etc.
- The other caveat is that the Industrial Internet catches on as a concept. It seems like a good idea, but there can be no guarantee of its success. Factory networks, for example, has had a mixed history as far as being actually being deployed. The problem with factory networks was that it was very hard to really *prove* benefits and in harder times the ROI case for deploying them is harder to make.

As far as the second bullet point is concerned, we note that the advocates of the Industrial Internet are making some fairly big claims. Not only are Industrial Internets supposed to move industrial automation to a stage where managers can be proactive, they are actually supposed to take manufacturing to the next stage where its management can be *predictive*.

That this might be possible should be considered encouraging in many types of industrial environment. However, that the Industrial Internet may not take off commercially is a threat that needs to be built into the plans of any actual or prospective supplier of sensors to the Industrial Internet market.

**From the NanoMarkets report, “[Markets for Sensors in the Industrial Internet](#)”**