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The Ubiquity Of Bandwidth

The Foundation Of Today's IIoT Network

WHITE PAPER

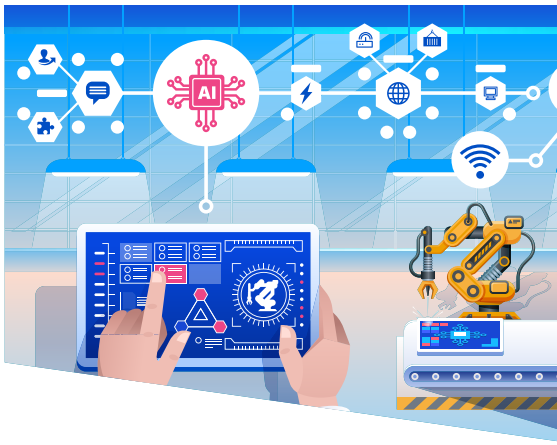
"The lightweight bandwidth and efficiency of IIoT technology make it possible for industry to greatly increase the amount of data being monitored or controlled."

Craig Resnick
Vice President, ARC Advisory Group

There are innumerable predictions on how IoT will impact our lives. Some aspects of IoT appear to be gaining traction, for example, voice-activated Internet (VAI) like Amazon's Alexa[1] and wearables. Others have not lived up to the hype, such as smart appliances[2] and the attention-getting Nest thermostat[3].

Steady progress of IIoT technology in less glamorous applications, such as tracking and status monitoring in factory applications, may represent the areas where IoT will have the biggest impact once businesses learn how to extract information from the data.

"The lightweight bandwidth and efficiency of IIoT technology make it possible for industry to greatly increase the amount of data being monitored or controlled. IIoT applications can leverage low-bandwidth and high-latency data links in areas ranging from monitoring wells in the oil and gas industry to controlling smart lighting systems," said Craig Resnick, vice president, ARC Advisory Group. "IIoT technology enables, for example, Message Queueing Telemetry Transport (MQTT), a machine-to-machine (M2M) data transfer protocol that functions as a low-bandwidth messaging protocol. MQTT is a lightweight publish/subscribe messaging transport used for connections with remote locations where a small code footprint is required and/or network bandwidth is at a premium. MQTT is used for mobile applications because of its small size, low power usage, minimized data packets, and efficient distribution of information to one or many receivers."



Tracking and status monitoring in factory applications may represent the areas where IoT will have the biggest impact.

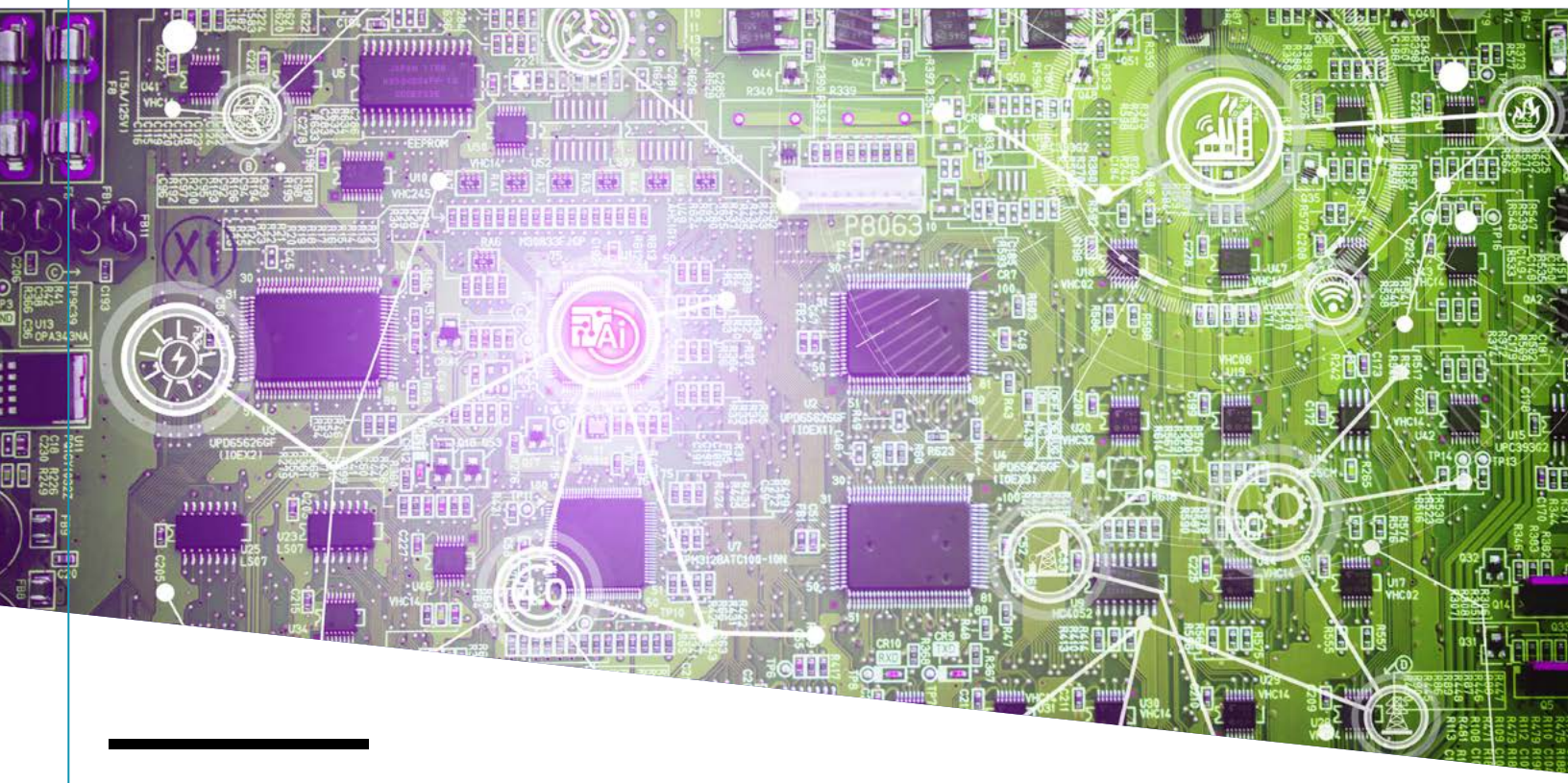
[1]Arjun Kharpal, (2017, March 10). "Amazon's voice assistant Alexa could be a $10 billion 'mega-hit' by 2020: Research."
[2]Parks Associates. (2016, July 20). "Less than 5% of U.S. broadband households own a smart appliance."
[3]C. Perlman, (2017, February 7). "Nest: Falling Into The Chasm," Digital Innovation and Transformation, Harvard Business School.

Why is IIoT Happening Now?

What has occurred to propel the IIoT into one of the most popular concepts in IT/OT?

- **Smartphone/Tablet** — Sensors like microelectromechanical systems (MEMS) accelerometers, gyroscopes, and inertial measurement units (IMU), have become small enough with a reduced cost, making wide deployment practical.
- **The Internet** — The Internet, or more specifically, the World Wide Web, is woven into our lives; it is no longer a novelty. We have become accustomed to having our devices access vast amounts of data or upload our personal data to the cloud.
- **Cost** — The cost of computing and communications has dropped to a level that makes IoT affordable.
- **Bandwidth** — We are used to the increasing speeds of our communication networks but there is another aspect of communications - bandwidth is everywhere.

The World Wide Web has helped the IIoT become one of the most popular concepts in IT/OT.



The Ubiquity of Bandwidth

At the dawn of the computer era, there was only one way to connect devices: wires. Times have changed.

Today, network connections can take many forms: DSL, cable TV plant such as FTTx and cable modem, wired Ethernet, Fibre Channel, or Industrial Ethernet for the factory floor. More impressive is the number of ways to connect wirelessly including Bluetooth, LTE, 5G, satellite, ZigBee, and Wi-Fi.

We now take these connections for granted. Today's smartphone seamlessly switches between the cellular data network and Wi-Fi. In addition, the smartphone may move a phone call from the cellular carrier's network to Wi-Fi when a user enters a building if the carrier's signal fades. A decade ago, it would have been unthinkable to see passengers on a commuter train passing the time by streaming their favorite TV program to their hand-held device.

Another aspect of today's communications links is that they are always on— ever present. Having to wait for the dial-up modems to train themselves and synchronize is ancient history.

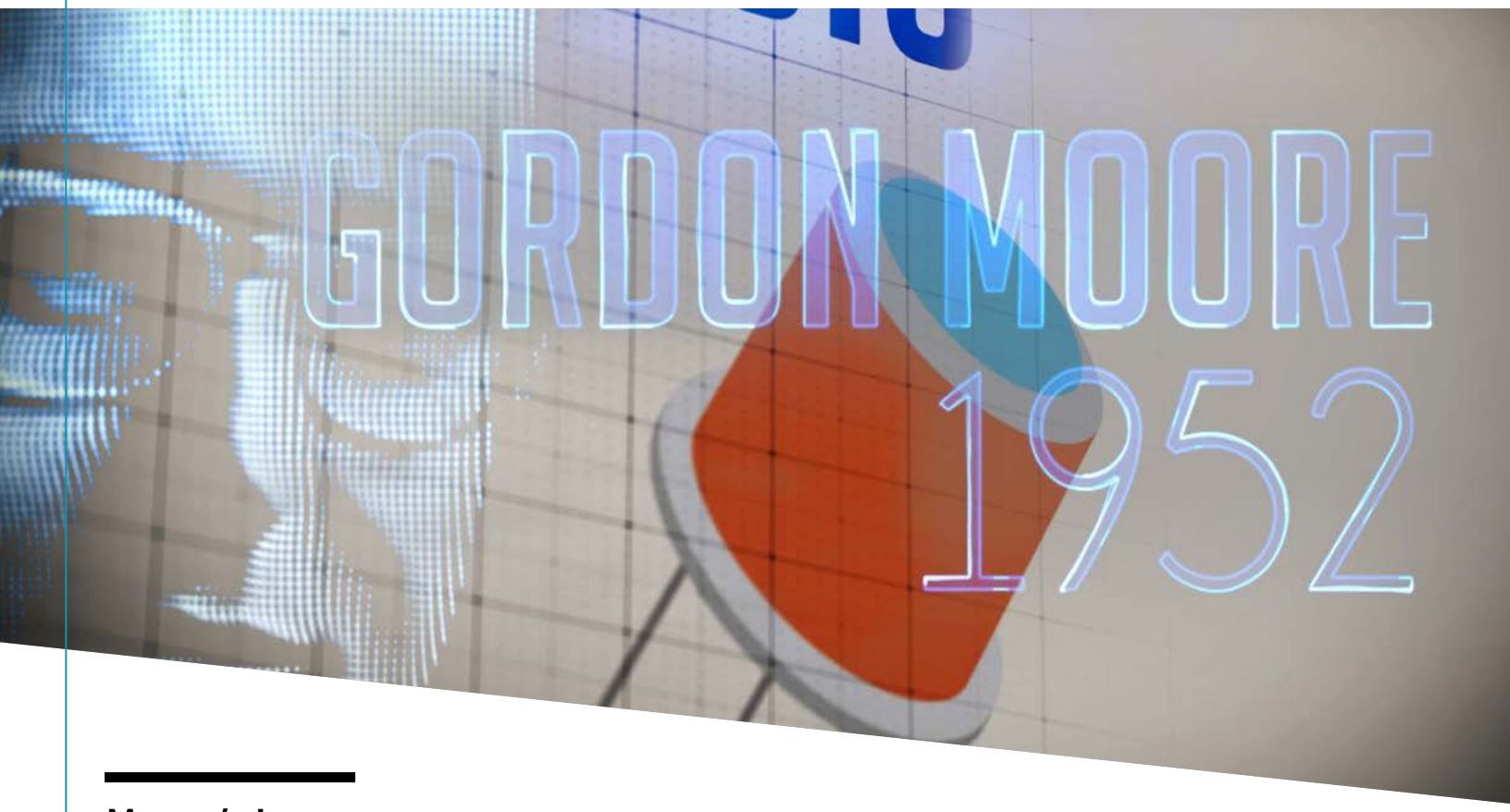
Bandwidth is everywhere. It is this ubiquity of bandwidth that is a necessary component for making the IoT possible.

Not only is bandwidth ubiquitous, it is fast, and getting faster. Every five to ten years, network speeds increase. Ethernet's 10 Mb/s in the early 80's to 100 Gb/s today (a 10K increase), or Wi-Fi's 500-fold increase from 2 Mb/s in 1997 to 1 Gb/s today, are just two examples of how connection speeds have grown. The regular availability of newer high-bandwidth connections has led to Nielsen's Law of Internet Bandwidth, which states, "A high-end user's connection speed grows by 50% per year."[4]

Nielsen's law is only possible because of another law...one that is more famous.

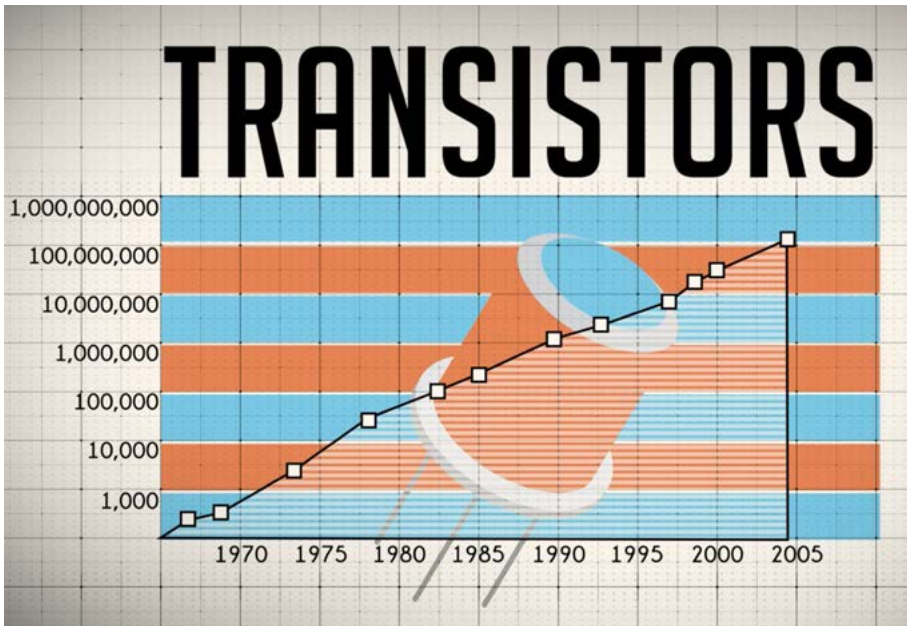
Wi-Fi has experienced a 500-fold increase from 2 Mb/s in 1997 to 1 Gb/s today.

[4]Jakob Nielsen, (1998, April 5). "Nielsen's Law of Internet Bandwidth." Nielsen Norman Group.

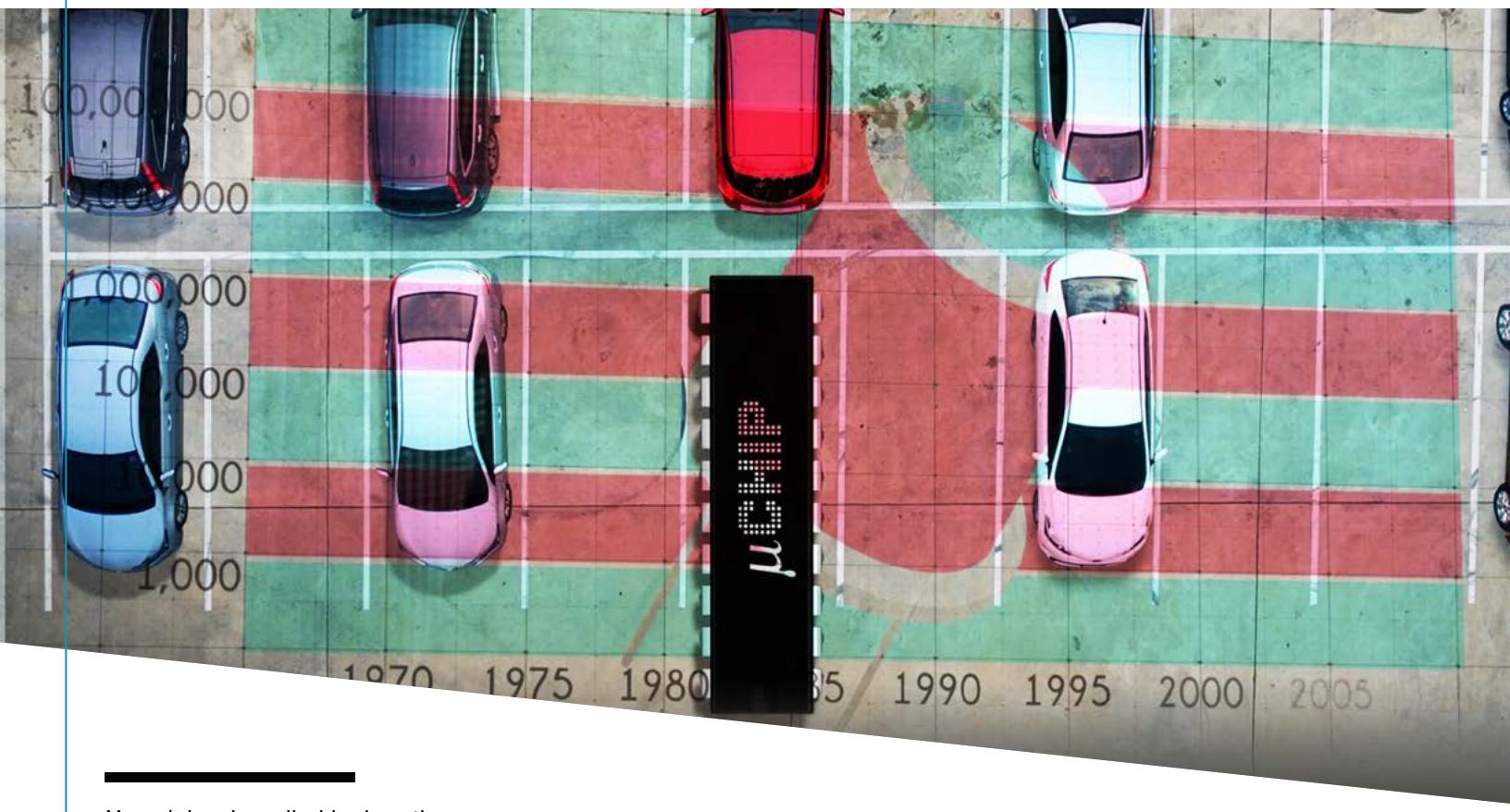


Moore's Law

Gordon Moore is best remembered as a co-founder of Intel. But while he was the director of Research & Development at his previous employer, Fairchild Semiconductor, he authored a paper in 1965 titled, *Cramming More Components onto Integrated Circuits*. In the article, Moore predicted that the number of transistors contained in a semiconductor will double approximately every two years.[5]



[5]Gordon Moore, "Cramming More Components onto Integrated Circuits," Electronics, volume 38, no. 8, 1965.

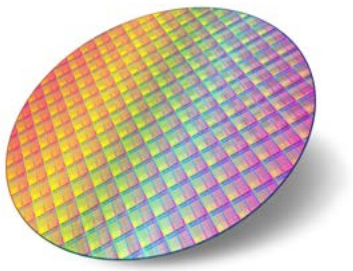


Moore's Law is applicable along three axes:

- **Cost —** The cost for many transistors drops by almost half with every reduction in the size of the transistors.
- **Performance —** Processor speeds increase because the smaller the transistor, the faster it can operate. Additionally, the transistors become closer to each other which reduces the latency between them.
- **Complexity —** For a given size, the number of transistors doubles with the reduction in feature size. This allows more complex implementations and circuitry.

Although all three aspects of Moore's Law are important, it is the ability to implement ever increasing complexity that might be the most important. For example, if a smartphone was built using the semiconductor technology available in 1971, the phone's microprocessor would be the size of a parking space.[6] In fact, the communication theories needed for ubiquitous bandwidth evolved in the late 40's and 50's. They could not have been implemented at that time, however, because it would have been impractical to build with vacuum tubes or discrete transistors.

[6]Julio Franco, (2015, April 20). "50 Years of Moore's Law: Fun facts, a Timeline Infographic and Gordon's Own Thoughts 5 Decades Later." Techspot.



If a smartphone was built using the semiconductor technology available in 1971, the phone's microprocessor would be the size of a parking lot.

IIoT

IoT has captured product developers' imagination. In the consumer space, it remains to be seen what applications will take hold, but wearables seem a certainty. It is a similar situation on the factory floor as numerous deployment scenarios exist, but we will need some history behind us to see which ones provide a suitable ROI. Tracking packages, monitoring, and alerting applications are one thing. Implementing advanced analytics and complicated algorithms to extract meaning from the data that has been gathered is something else.[7]

None of this would happen without the ubiquity of bandwidth.

For more information on the IIoT and automating the factory floor, visit **Panduit's factory floor landing page** on our website.

Subscribe to our blog at **Panduitblog.com** to access the remaining papers in this series and learn more about packet loss on the plant floor, real-time data, edge computing, and how they relate to the IIoT.

[7]M. Patel, et. al. (2017, May 19). "What's New with the Internet of Things?" McKinsey & Company.

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