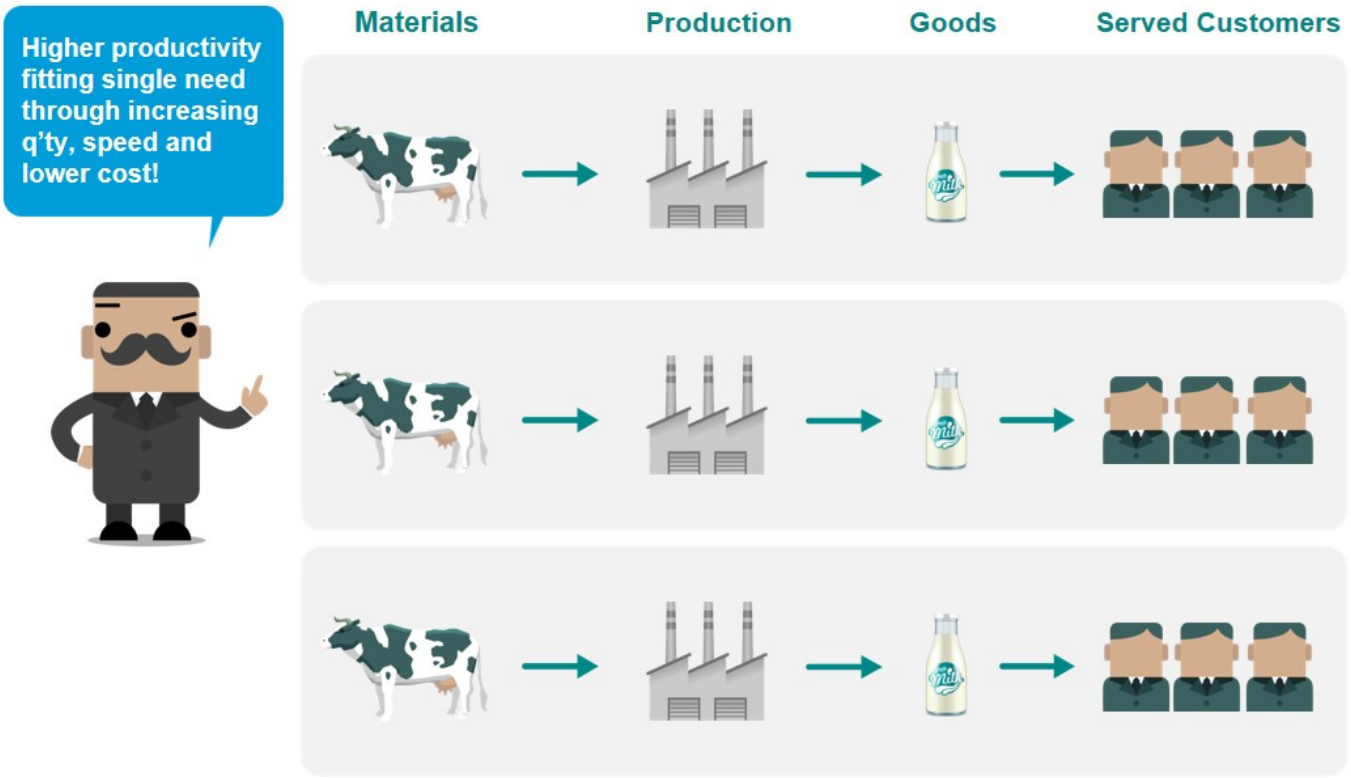
# How Time-sensitive Networking IS Revolutionizing Smart Manufacturing

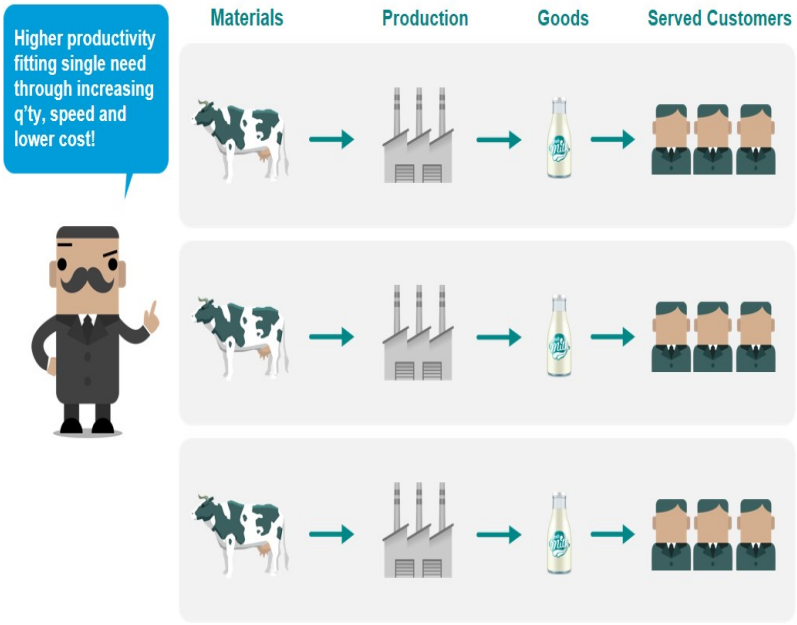
**A new age in digital transformation is requiring manufacturers to rethink theri rexisting business models and corresponding infrastructure. To remain relevant and cometitive in the age of industry 4.0, manufacturers need to do more than simply adopt digital technologies and delpoy predefined processes in isolated islad of automation as they have done in the past. The future of industry rests on understanding what is driving this new wave of digitization, how our current model of indsturail automation is changing and embracing what the future holds.**

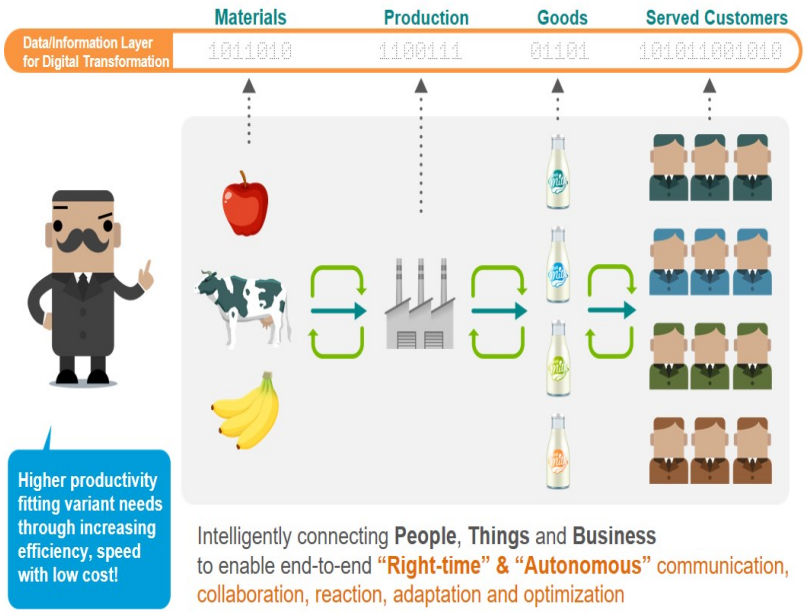



## A Vision for Smart Manufacturng: Service- and Demand-oriented

Manufacturing strategies are always evolving. With increasingly diversified customer demands, companies are constantly looking

for ways to cater to customers needsm while also increasing operational efficiency. In the past cmpanies would plan their
production based on the sales forecast and get their product on the sevles as soon as possible.To keep up with an increasing
production quantity, companies would duplicate the same production lines as a means to efficiently and quickly satisfy the rising
demand. This method works well when mass producing a single, defined product. But what if customers want different cariations
of the same product? How can companies address these dynamic, fast-changing customer needs? These conditions call for
rethinnking existing manufacturing strategies. Companies increasingly aim to achieve higher productivity while fulfilling the various
needs of their customers at the same time. In response, manufacturing methods are slowly evolving from mass producing a
single product with set specifications to an on-demand manufacturing approach based on customer´s requirements.



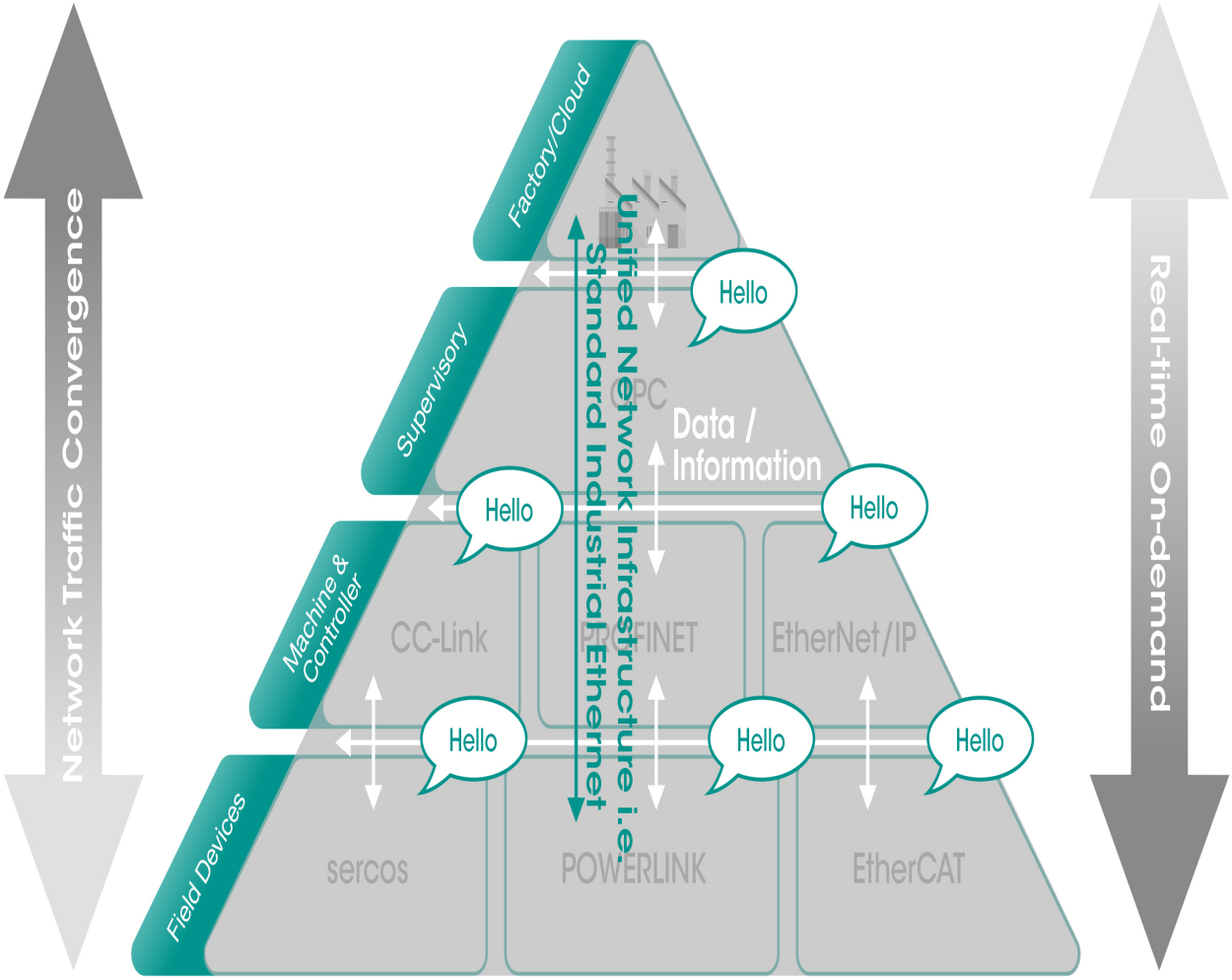



The vision of tomorrow´s smart manufacturing is one of intelligently connecting people, things, and businesses to enable time-
sensitve and autonomous end-to-end communication, collaboration, reaction, adaptation and optimization.

**Envisioning the Future: The Purdue Model of Tomorrow**

The traditional Purdue model, as represented by the "automation pyramid", outlinse different layers of network communication
that remain fragmentary and are both costly and difficult to maintain throughout a system´s entire life cycle

Calls within the industry have been made to transofrm the current model into an "autonomous pyramid" that is capable of
responding to market and business conditions in real time. In this newly envisioned architecture, isolated island of automation
and network data flows are able to communicate with each other through a common semantic and seamlesslyconnected
infrastructure.




By implementing the autonomous pyramid of the Purdue model, manufacturers can realize their vision of smarkt manufacturing
through one unified network infrastrucutre. However, several fundamental challanges arise. For instance, in a unified network
infrastrucutre where all data flows through a single channel, network administrators need to make sure that this increased
transparency does not impact deterministic data processing. Additionally how can administrators guarantee the correct flow of
information so that the right decisions and actions can be taken in time?

This is where TIme-sensitive Networking (TNS) comes in.

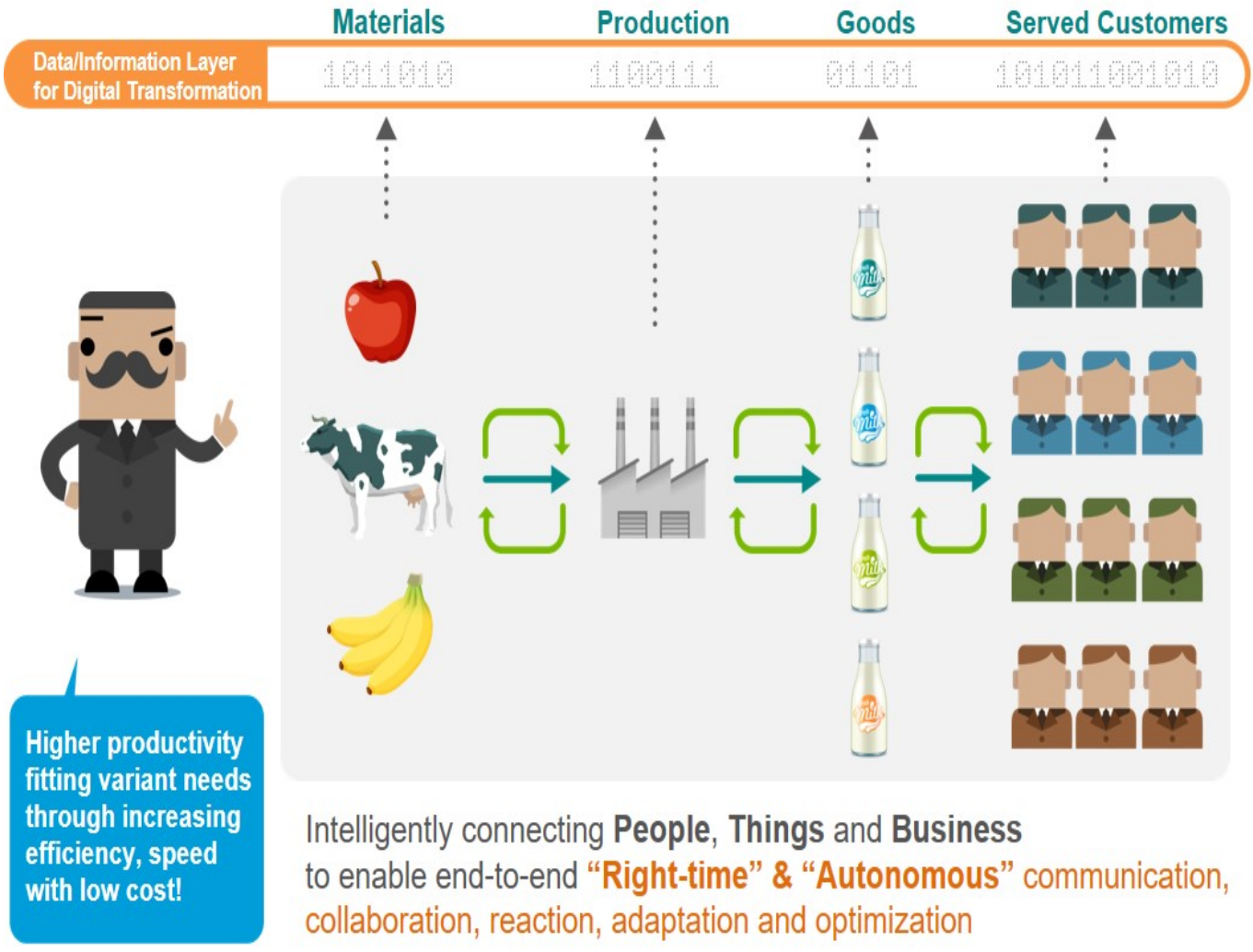
**Determining Time-sensitive Networking**

To realize truy converged and interoperable networks that can simulatneously process critical and noncritical application data in a
single industrial environment, the Time-sensitive Networking (TSN) Task Group of the IEEE 802.1 Working Group is defining a set

of standards for enabling the deterministic transmission of data over standard Ethernet networks. This added layer of functionality
future-proofs longstanding Ethernet Technology and extends its use in a vast array of new applications

As a collection of standards, the concept of Time-sensitive Networking is more like a tool box than an all-in-one solution; you
need to understand what "tools" are available and how each tool works in order to determine which tools are appropraite for your
application

Depending on the application requirements, various combinations of these tools can be put together to build infrastructure for
specific need or purposes. For example, one TSN profile being defined by the IEC/IEEE 60802 Joint Project aims to provide a
guidline on what standards to choose from the toolbox and how they can be used in industrial auttomation applications



From an overarching perspective, all standards in the toolbox can be categorized into one of the following apsects of TSN:

1. Time synchronization
As the name suggests, "Time-sensitive Networking" focuses on stablishing a common time reference between all devices within
a unified and interoperable infrastructure, which forms the foundation of its entire operations.

2. Bounded low latency
By adopting the concept of non-negotiable time period allocation for end-to-end transmissions, these components ensure
deterministic data transmission over the network.

3. Ultra reliability
To implement and maintain all aspect of a deterministic networking environment, a set of components has been defined to
ensure optimal reliability and security

4. Resource management
When the network and applications become more converged and larger in scale, additonal tools are requried for provide better
manageability and visibility

Besides providing the standard Ethernet hardware for creating unified infrastructure that conform to TSN standards, Moxa has
been actively participating in cross-vendor TSN plugtests and testbeds around the world, such as the ones hosted by the Edge
Computing Consortium (ECC), Labs Network Industrie 4.0, the Industrial Internet Consortium (IIC) and the Allience of Industrial
Internet (AII). Moxa is also one of the initial supporters of the OPC Foundation Field Level Communications (FLC) initiative to
promote the development of TSN technology. TSN is briningn together many different industry organizations and market leaders
under a common goal to realize the full potential of Industry 4.0 and the promise of digitization.

For more information about TSN and its applications, download our white paper.