Solution Blueprint
Internet of Things (IoT)

Automating Field Service with the Internet of Things (IoT)

Kontron* uses an intelligent gateway based on Intel® technology and the Salesforce1 Platform* to monitor factory machinery and quickly send machine failure data to the mobile devices of field service engineers, thereby minimizing repair times.

Driving a data revolution in manufacturing

Executive Summary

For many manufacturers, keeping factory equipment running 24x7 is critical to their bottom line. Even a small glitch in factory operation can cost millions of dollars and impact the ability to ship product to customers.[1] To help manufacturers minimize unplanned factory downtime and the associated revenue loss, Kontron* demonstrates how the Salesforce1 Platform* can be used to monitor factory equipment, quickly dispatch field service engineers, and provide them with detailed error messages.

The demo features the use of Kontron devices based on Intel® technology: Internet of Things (IoT) gateways that provide proven, cutting-edge connectivity capabilities, and embedded computers that deliver industry-leading computing performance. The following provides an overview of this end-to-end field service automation solution based on IoT technologies.

Table of Contents

Key Business Objectives

Increase uptime by more quickly dispatching field service engineers to fix machine failures.

Business Challenges

Machine data – in the right hands and at the right time – opens the door to all sorts of possibilities. It is not just a matter of collecting more asset data, but turning it into actionable information that can be distributed to the appropriate employees, suppliers, partners, customers, and field service engineers. In the case of factory equipment, failures can be recognized in real time, triggering alerts to the service team and providing reliability information to predictive maintenance software that can determine when to replace worn parts to avoid downtime.

But standing in the way of highly-coordinated, multi-party processes, much of the existing infrastructure is made up of many decades-old systems, and getting them all connected to an IP network could take considerable effort. Moreover, customized software applications are needed to connect the right groups together and allow them to communicate over a wide range of mobile devices and PCs.

Solution Benefits

IoT-based solutions from Intel, Kontron, and Salesforce* make it easier to build end-to-end solutions that enable data sharing from legacy and new systems with key stakeholders so manufacturers can reap the benefits of data-driven manufacturing:

- **Faster Repair Times**
  Manufacturers can quickly assign repair tasks to the most suitable field service engineers based on their skill set, availability, and location, and send detailed error messages so the engineers arrive with the right spare parts.
- **Easy Development Environment**
  The Salesforce1 platform allows for the rapid creation of apps that can work across Salesforce's sales, service, and marketing apps, as well as on top of its Force.com, Heroku*, and ExactTarget Fuel* platforms.
- **Secure Communications**
  Of critical importance is ensuring the factory network is protected, which is why Intel and Kontron incorporate multiple security mechanisms to create a chain of trust from factory device to cloud.
- **Predictive Maintenance Infrastructure**
  Manufacturers can reduce maintenance costs and downtime by taking prompt corrective action using data analytics to predict component failure.

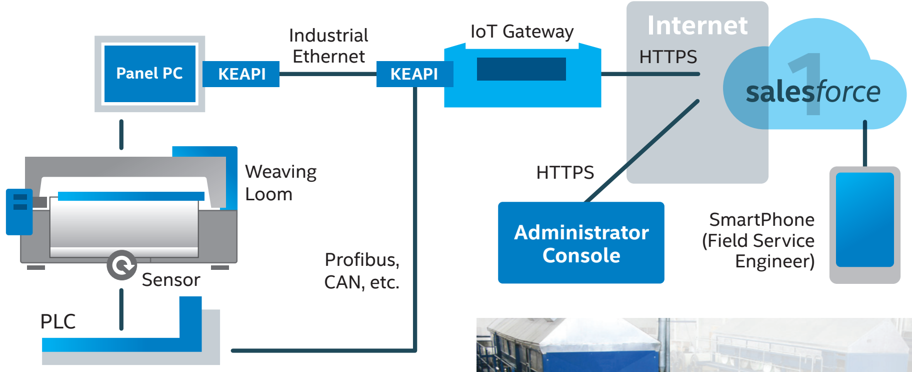


Figure 1. High-Level IoT Architecture

Solution Overview

The concepts from this remote monitoring and field service automation solution can be applied to any use cases where equipment data is collected and insights from data analytics must be shared among various stakeholders inside and outside the factory.

High-Level Architecture

Figure 1 shows a high-level IoT architecture that connects the manufacturing shop floor to field service engineers via cloud-based applications. It supports data acquisition, aggregation, and analytics workloads for machine data, and creates new opportunities for predictive maintenance and field service optimization.

Key Components

- **Weaving Loom:** Resides on the factory floor and is monitored for faults.
- **Panel PC:** Controls the weaving loom and provides a human machine interface (HMI) on the factory floor.
- **Application Programming Interface (API):** Makes it easy for software applications to access the hardware platform embedded in factory floor equipment.
- **Sensor:** Measures machine conditions or detects equipment faults.
- **IoT Gateway:** Collects data from sensors and the panel PC, and sends it to the cloud platform.
- **Cloud Platform:** Supports the development of the cloud-based applications and runs the application.

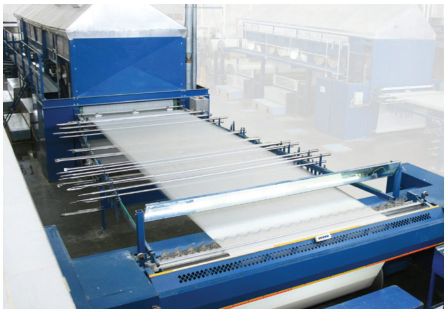


Figure 2. Weaving Loom

- **Administrator Console:** Provides the administrator interface to cloud-based applications.

Textile Manufacturing Use Case

Kontron demonstrated automated field service at a textile manufacturing company. Sensors were added to a weaving loom (Figure 2) to monitor its operation and track its performance. A failure can occur when the cloth being produced or transported inside the machine ruptures, typically caused by a bundle of fibers or foreign material. Such an incident will initiate the following actions:

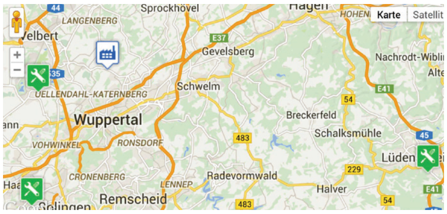
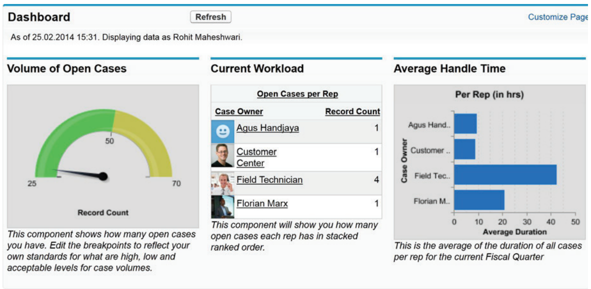


Figure 3. Locations of Failed Machine and Available Field Service Engineers

1. The sensor detects a rupture in the cloth being manufactured and sends a signal to the IoT gateway.
2. In response, the IoT gateway sends an error message to the Salesforce Service Cloud*.
3. A case is created and the information is sent to the application administrator's console.
4. The console identifies the company location where the machine fault occurred, the faulty machine, and the sensor that generated the error notification.



Dashboard

Refresh

Customize Page

As of 25.02.2014 15:31. Displaying data as Rohit Maheshwari.

Volume of Open Cases

This component shows how many open cases you have. Edit the breakpoints to reflect your own standards for what are high, low and acceptable levels for case volumes.

Current Workload

Open Cases per Rep

Case Owner	Record Count
Agus Handjaya	1
Customer Center	1
Field Technician	4
Florian Marx	1

This component will show you how many open cases each rep has in stacked ranked order.

Average Handle Time

This is the average of the duration of all cases per rep for the current Fiscal Quarter

Figure 4. Field Service Engineer Availability and Average Case Handling Time

5. The console shows a map (Figure 3) generated by the application, indicating the company location (blue) and the field service engineers (green) in the vicinity.
6. The administrator selects the field service engineer closest to the textile factory and opens a dashboard, shown in Figure 4, that indicates the engineer's availability.
7. After the administrator sees the amount of time required to handle the issue, and that the field service engineer has sufficient spare capacity, the engineer is assigned the case.
8. The application sends an email or SMS containing the error information to the mobile phone of the field service engineer, who accepts the service call and attends to the faulty machine.

Intel® IoT Gateway

Intel® IoT Gateway offers companies a key building block to enable connectivity in both legacy and new building systems. It integrates technologies and protocols for networking, embedded control, enterprise-grade security, and easy manageability on which application-specific software can run.

Intel IoT Gateway enables:

- Connectivity up to the cloud and enterprises
- Connectivity down to sensors and existing controllers embedded in the system
- Pre-process filtering of selected data for delivery
- Local decision making, enabling easy connectivity to legacy systems
- A hardware root of trust, data encryption, and software lockdown for security
- Local computing for in-device analytics

The solution streamlines development by allowing developers to focus solely on the application level.

Technology

This section describes the technology ingredients utilized in this automated field service solution.

Equipment Control and User Interface Devices

The Kontron Micro Client 3* touch panel computer, shown in Figure 5, is designed for production line optimization and supervisory control applications in industrial environments. It supports multi-touch functionality on a widescreen format and is shock and vibration resistant. Based on the Intel® Atom™ processor D2550, the Micro Client 3 delivers high computing performance and outstanding graphics performance with the option to connect a second display.

Figure 5. Kontron Micro Client 3* Touch Panel Computer

IoT Gateway

Kontron KBox A-201* mini Box-PCs provide IoT gateway capabilities, such as connecting machines to the cloud. Based on the Intel® IoT Gateway, they combine Wind River* Intelligent Device Platform XT 2.0 and the McAfee Embedded Control. Shown in figure 5, this product is available with either the Intel® Atom™ processor E3800 product family or the Intel® Quark™ SoC X1000.

For local data acquisition, the mini Box-PCs support a broad range of industrial interfaces such as 2x Gbit Ethernet, 2x USB 2.0, as well as an optional CAN bus and/or Profibus interface, whereas legacy installations benefit from two serial interfaces (RS232/485). For wireless connection to the cloud or the local network, the Kontron K-Box A-201 mini can be equipped with LTE (4G) and GSM (2G/3G) or Wi-Fi. Three external antenna connectors enable high signal quality. The integrated solid-state drive (SSD) with up to 64 gigabytes capacity delivers rugged as well as fast storage capacity for the operating system and data, and a trusted platform module (TPM) is integrated for increased data security, all in a compact footprint (Figure 6) of only 56.8 mm x 150 mm x 95 mm (H x W x D).

Figure 6. Kontron KBox A-201*

Application Programming

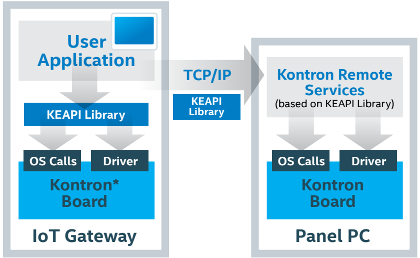


Figure 7. Kontron Embedded API* (KEAPI*) Architecture

Interface (API)

The IoT gateway makes use of the Kontron Embedded API* (KEAPI*) to access and control the Panel PC over Ethernet. Standardized across all Kontron platforms, KEAPI considerably simplifies remote access of hardware resources. KEAPI functions use hardware drivers and operating system calls to perform requested operations on the local board. Figure 7 shows KEAPI supports connections via

TCP/IP to Kontron Remote Services (KRS), which can be installed on top of KEAPI. KRS listens on a predefined port and waits for incoming requests, thus KEAPI calls are available remotely and incoming requests are sent to the KEAPI interface. KRS has an integrated security layer.

Cloud Platform

Kontron and Salesforce developed a working cloud platform with software and hardware components that allow seamless integration into existing applications that handle customer and support management functions.

- The Salesforce1 Platform is an enterprise-ready cloud platform for developing enterprise apps. It supports a rapid development and runtime environment for writing and running code, in addition to providing drag-and-drop tools for business users to create apps for the Web and mobile devices.

  The platform delivers powerful services, including point-and-click development, business logic, mobile SDK, analytics, multi-language development, social collaboration, and cloud identity solutions. It also supports services such as user interface (UI) components, flexible page layouts for mobile, a 1:1 customer engagement engine, and custom actions – all geared for going fast. And since it is API-first, developers can build an app without any experience or UI – helping them connect with the next generation of devices, apps, and customers in a whole new way.

  The Salesforce1 Platform brings together Force.com, Heroku, and ExactTarget's Fuel into one family of cloud services, as shown in Figure 8.

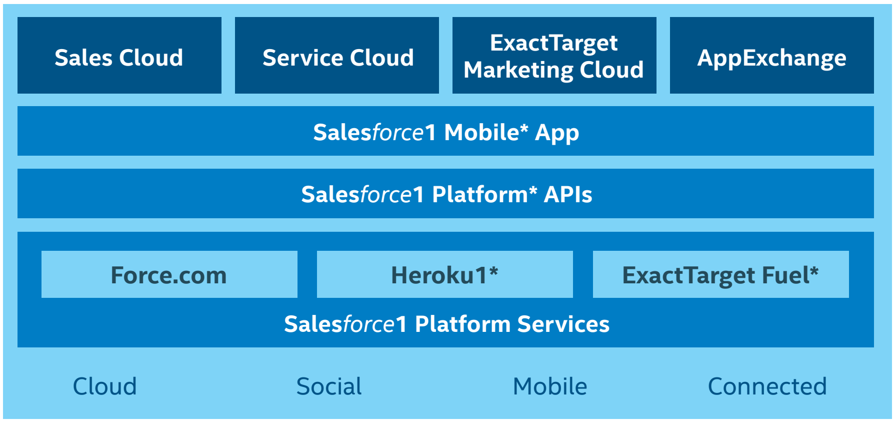


Figure 8. Salesforce1 Platform*

Security

The Kontron IoT gateway incorporates three levels of security mechanism: secure boot, malware protection, and virtual private network (VPN) tunnels:

- **Secure boot** establishes a root-of-trust (RoT) that ensures only cryptographically-verified, authenticated software is allowed to run during the boot process. It detects tampering with boot loaders, key operating system files, and unauthorized option ROMs by validating their digital signatures. Detections are blocked from running before they can attack or infect the gateway.
- **Malware protection** using McAfee Embedded Control security software maintains system integrity by only allowing authorized code to run and only authorized changes to be made. It automatically creates a whitelist of the authorized code on the system. Once the whitelist is created and enabled, the system is locked down to the known good baseline, no program or code outside the authorized set can run, and no unauthorized changes can be made.
- **Secure Socket Layer (SSL) transport** is used to protect data transmitted between the IoT gateway and the Salesforce1 Platform.

IoT Tenets

The field service automation demo developed by Intel, Kontron, and Salesforce was designed to provide security and interoperability from edge to cloud in keeping with five key tenets defined by Intel:

- **World-class security** as the foundation
  - The solution implements robust hardware and software-level protection that secures data between IoT-based factory devices and the cloud.
- **Automated discovery and provisioning of edge devices** to ease deployment
  - The Kontron Embedded API helps developers communicate with Kontron devices on the factory floor.
- **Data normalization** through protocol abstraction to improve interoperability
  - The Kontron IoT gateway provides a developer-friendly runtime environment for interfacing to different device and network protocols natively and optionally, including Ethernet, USB, CAN, Profibus, RS232/485, LTE (4G), GSM (2G/3G), and Wi-Fi.

- **Broad analytics infrastructure** to realize customer value
  - The Salesforce1 cloud platform makes it easy for developers to deploy data analytics, such as analyzing fault conditions to predict component failure.
- **Infrastructure** to monetize hardware, software, and data management from edge to cloud
  - The Salesforce1 cloud platform with extensive ecosystem support and customer relationship management (CRM) capabilities provides a strong foundation for monetizing IoT applications.

Summary

This paper covers a field service automation demo that uses an Intel-based IoT gateway to send machine failure data to the Salesforce1 Platform, which sends notifications to field service engineers via their mobile phones. In fact, this usage model, which connects manufacturing equipment to humans outside the factory, can be applied in a wide variety of ways to solve all sorts of problems or support new business models. The power of the Internet of Things is making machine data available to key stakeholders, of which this demo is a clear example.

Resources

Intel® Internet of Things Solutions Alliance
Members of the Intel Internet of Things Solutions Alliance provide the hardware, software, firmware, tools, and systems integration that developers need to take a leading role in IoT.

Intel® IoT Gateway Development Kits
Intel IoT Gateway development kits enable solution providers to quickly develop, prototype, and deploy intelligent gateways. Available for purchase from several vendors, the kits also maintain interoperability between new intelligent infrastructure and legacy systems, including sensors and data center servers.

For more information about Kontron solutions for building automation, visit **www.kontron.com.**

To learn more about the Salesforce1 cloud platform, go to **http://www.salesforce.com/platform/overview.**

For more information about Intel® solutions for the IoT, visit **www.intel.com/iot.**

Kontron is a member of the Intel® Internet of Things Solutions Alliance. From modular components to market-ready systems, Intel and the 250+ global member companies of the Alliance provide scalable, interoperable solutions that accelerate deployment of intelligent devices and end-to-end analytics. Close collaboration with Intel and each other enables Alliance members to innovate with the latest technologies, helping developers deliver first-in-market solutions.

[1] "A Cost-Effective Disaster Recovery Solution for Intel Factories," November 2010, pg. 1, www.intel.com/content/dam/doc/white-paper/mission-critical-computing-intel-it-disaster-recovery-paper.pdf.

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