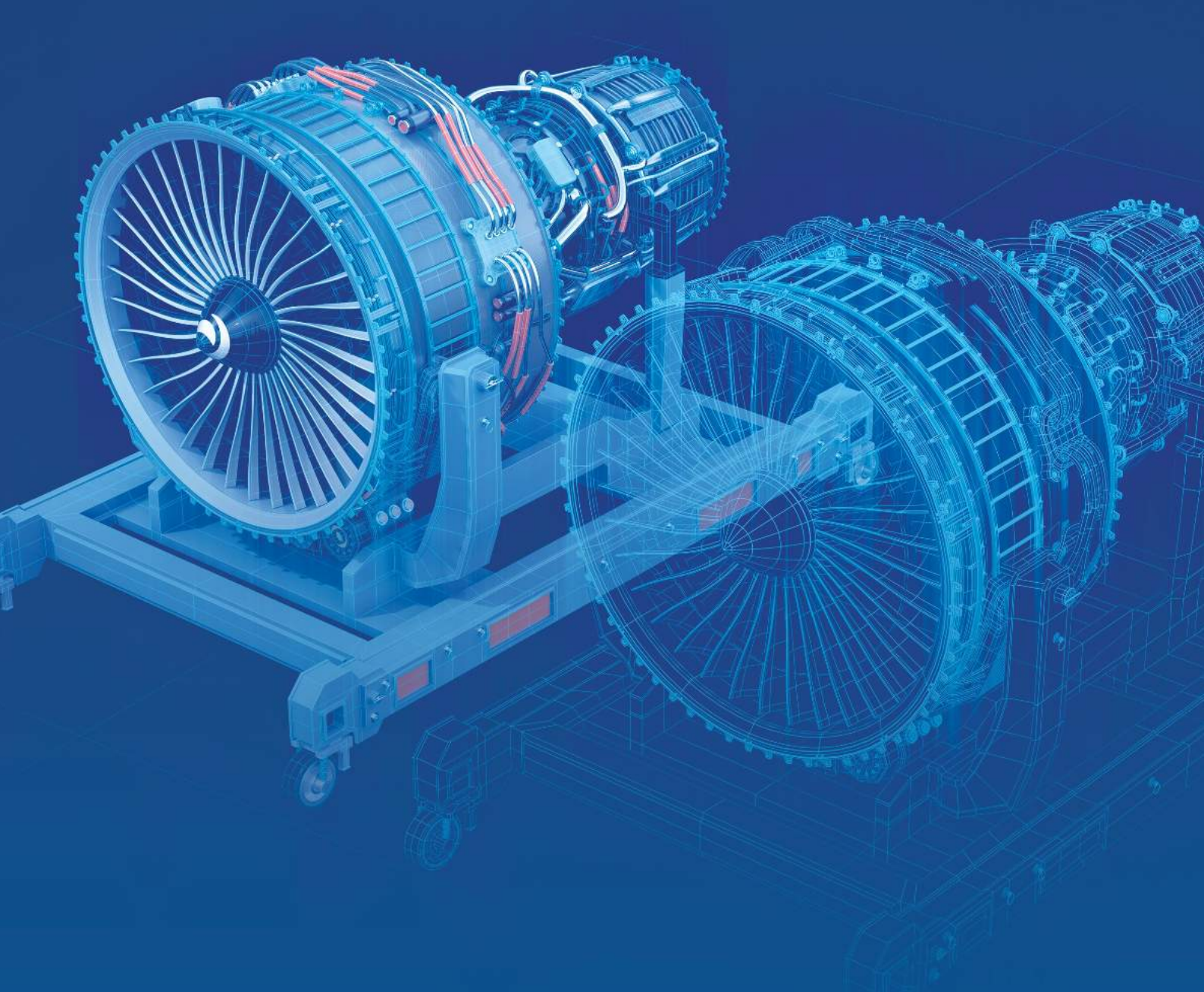

TeamViewer IoT Digital Twin

The TeamViewer Digital Twin enables users to visualize machine states in real time and make critical machine modifications directly on the visualization. These modifications are applied immediately to the physical machine itself.

TeamViewer
Internet of Things

SOLUTION BRIEF

What Is a Digital Twin?

Forrester defines a digital twin as a "Simulation of product performance in-field, based on operations data."[2] Taking a closer look at the components of that definition, we can see the basics of what a digital twin is, and what it does.

- The "operations data" is data collected by sensors in key areas of one or more machines engaged in a single process
- The "in-field" data-collection sensors are connected to the internet so the collected data can be disseminated online
- The digital twin presents a "simulation of product performance" with visualizations of the data in the form of charts, graphs, levers, switches, and other images that represent the machine whose operation and state is measured by the sensors
- Changes to the physical machine can be made by adjusting the control devices (levers, switches, etc.) visualized in the digital twin Preventive maintenance: a schedule-based maintenance, by physical inspection, diagnosis, and procedures to avoid unexpected failures and the associated downtime.

Digital twins visually integrate Internet of Things (IoT), machine learning (ML), and software analytics to make it easier to track machine states, correct problems, predict maintenance needs, and perform most repairs and maintenance either automatically or remotely, with no physical intervention.

Digital Twin Categories

Some companies and institutions categorize their digital twins based on the business function in which they are deployed, such as:

Service Twin

Process Twin

Design Twin

Other companies distinguish between a representation of a physical product, an operational process, or a person's task.[1]

Why Using Digital Twins Is on the Rise

Digital twins are becoming more prevalent in IoT for two reasons:

1. Digital twin visualizations are a significant improvement over a typical IoT dashboard.
2. They boost process speed.

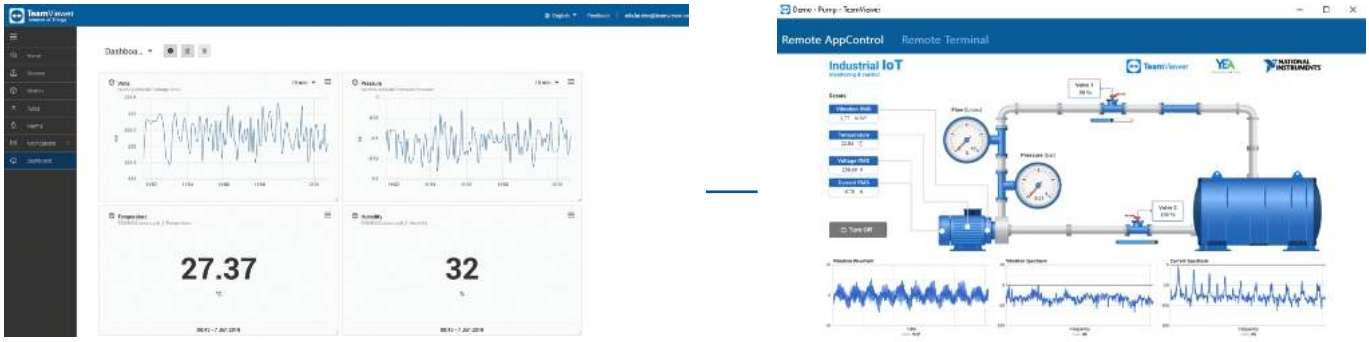

Figure 1: *Sensor data summarized in the TeamViewer IoT dashboard (L) and the remote terminal for controlling a water pump with a TeamViewer digital twin (R).*

[1] *Thompson, Stacy: What Is Digital Twin Technology?, 2019, https://www.ptc.com/en/product-lifecycle-report/what-is-digital-twin-technology, 2020/05/26*

[2] *Miller, Paul/Voce, Christopher/Matzke, Pascal, Taylor, Renee/Lynch, Diane: From Grease To Code: Industrial Giants Must Bet Their Futures On Software. To Survive, Manufacturing Firms Must Become As Proficient In The Digital World As In The Physical One. 2019.*

Typical IoT Dashboard vs. Digital Twin

	Typical IoT Dashboard	Digital Twin
Data visualization	All numbers, which the user must interpret to understand the state of the machine	Images, graphs, and charts that show the user the state of each monitored area of the machine in relation to acceptable and preferred parameters
Speed	Latency as the data is translated into numbers for the dashboard, plus the time it takes for the user to interpret the data	Near real-time data visualization that provides immediate recognition of the state of the machine
Remote machine controls	Requires finding the right set of numbers and then typing in the preferred values to change the physical machine	Enables manipulating the virtual levers, handles, and other control devices to make actual changes immediately in the physical machine

While the improvement in data visualization in the digital twin makes it easier and faster to use than a standard IoT dashboard, process speed increases that provide significant improvements in efficiency are at least equally important. IDC forecasts that the use of digital twins may improve process speed by 30 percent.[3] Gartner brings similar estimates, e.g, industrial companies could look at a 10 percent improvement in efficiency through this technology.

Gartner expects 1 million IoT devices to go into operation every hour in 2021. A representative survey by IDC in 2019 showed that 80 percent of the large companies surveyed, and 68 percent of the medium-sized companies surveyed intended to start an IoT project within a 12-months period (IDC 2019, p. 20).[4]

The rise in use of IoT — and the improved efficiency that digital twins brings to IoT — explains why Gartner named digital twins to its top ten strategic technology trends for 2018.

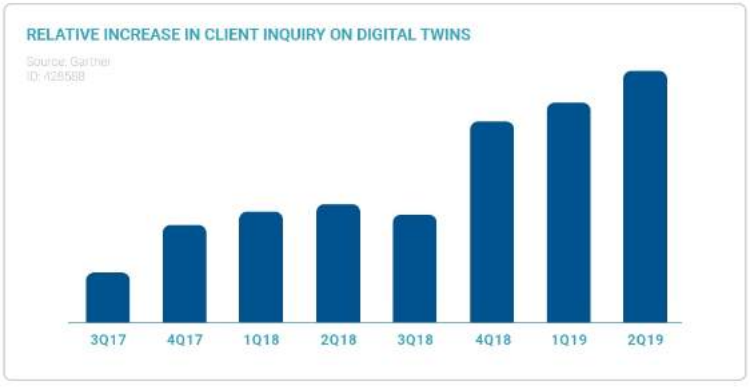

Figure 2: *Over the last several years, interest in digital twins has increased substantially (Gartner 2019, p. 10)[5]*

[3] *IDC FutureScape: Worldwide Operations Technology 2017 Predictions, November 2016*

[4] *Georg, Elena/Becker, Marco: Industrial Internet of Things in Deutschland 2019/2020 Edge Computing, Data Impact, Analytics, Connectivity, Security, Plattform, 2019, www.idc.de.*

[5] *Lheureux, Benoit/Velosa, Alfonso: Survey Analysis: IoT Digital Twin Adoption Proliferates Across Many Sourcing Options, 2019, ID: G00428588.*

Anatomy of the TeamViewer Digital Twin

TeamViewer IoT is ideally suited to companies with machine parts that use a combination of contemporary digitally controlled machines and legacy machines built since 2002 that use operating systems other than Windows or Linux. By supporting legacy machines, the TeamViewer digital twin puts to rest the concerns of decision makers who believe they can integrate their machinery into the IoT world only at great expense, if at all, and therefore cannot be made available to digital twins.

With TeamViewer IoT, companies use their own machinery much more efficiently. Plus, they can develop and implement remote maintenance and control options in the products they sell in order to:

- ✓ Reduce time to resolution for the benefit of purchasers and end users
- ✓ Offer brand-new services or additional service features to their customers
- ✓ Enhance the efficiency of their TeamViewer IoT solution by integrating a TeamViewer digital twin

A single digital twin can be set up to monitor and adjust key endpoints in a process, regardless of the number of machines involved. Each key endpoint must be outfitted with a sensor that is connected to the internet, so the digital twin can provide a comprehensive visualization of the entire process. TeamViewer digital twins are not just visualizations of information, but also ways to modify machines at the endpoints being monitored and more.

The easiest way to appreciate the full functionality of the TeamViewer digital twin is to examine its base layer and four interconnected layers as shown in Figure 3 below.

Figure 3: *TeamViewers 4-layer digital twin model*

Key Benefits of a Digital Twin

- Visually simplifies the data generated by multiple processes in complex structures so deviations from the target state can be seen and recognized immediately
- Allows users to respond to real-time data and control machines directly through the digital twin by using virtual scales, switches, and other controllers
- Improves service quality by more accurately analyzing real-time data
- Enhances service speed by enabling remote service and significantly reduces the need for on-site technician visits
- Presents computer-aided simulations that depict the behavior of objects to support product development

TeamViewer Digital Twin helps customers:

- ✓ Generate a visual representation of a physical asset
- ✓ Enable data and workflow analysis to automate tasks and processes
- ✓ Predict when machines will require maintenance
- ✓ Allow customers to instantly manage and control a physical asset from anywhere at any time
- ✓ Alert the appropriate operators and technicians when a detected issue requires human intervention

Base Layer: Endpoints

Many IoT-connected endpoints used for monitoring and adjusting machine performance rely on frequent physical interactions. They need to be manually started or stopped and require occasional restarts. Sometimes the software that controls the endpoints needs to be updated. Digital twins enable these interactions to happen remotely through internet in real time.

Key Features & Benefits

A digital twin provides direct remote access to endpoints, making it much easier to maintain all the machines involved in one process, even when they are in multiple locations. These access options optimize operating processes by reducing the number of necessary physical machine interactions. Maintenance or technical support which previously required direct on-site machine interaction can be performed remotely using a digital twin.

Layer 1: Visualization

The visualization layer is a fully customizable graphical representation of the physical asset. Its purpose is to portray the machine's workflow based on real-time information from connected devices. Virtual dynamic scales help the user identify machine state changes immediately. The user sees an overview of the full machine state from a single view. This layer works as the connecting platform for all other layers.

Key Features & Benefits

You can import your own design of the physical device to be depicted as a visual background in the digital twin. Images in common formats such as .jpg, .bmp, and .cvg graphically visualize the physical functions of the asset to record the entire machine status as easily as possible. The ability to import your own design means that visualizations can be made to look like the machines they represent, so operators are instantly oriented when they look at the screen.

Control elements such as switches, levers, and more can also be positioned as widgets, making it possible to change values of the physical device on the digital twin. These changes are immediately executed on the physical device.

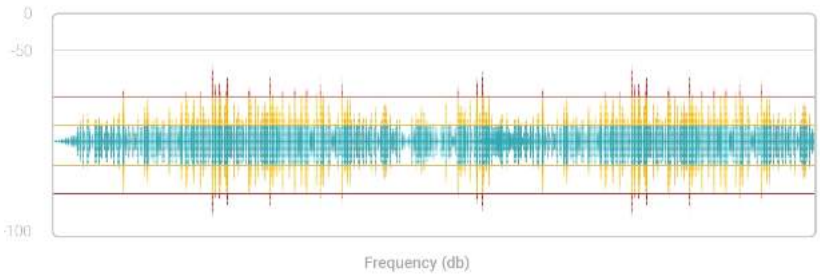

Figure 4: *Visualization of an endpoint with parameters of green (good), yellow (warning), and red (requires attention).*

Technical Highlights

To read data from a device, it first must be linked to the TeamViewer network. The TeamViewer IoT software agent is installed on Linux and Windows-based devices. Guided by a decision tree and detailed instructions, an assistant connects the data streams to the TeamViewer platform.

With legacy devices dating to 2002 that do not operate on Windows or Linux, a fully functional connection can still be established quickly by connecting a gateway upstream. The gateway communicates with the devices via various interfaces using the MQTT and OPC UA protocols or the REST API.

Retrofitting older devices in this way makes it possible to include them in the digital twin, increasing efficiency, prolonging service life, and extending the product life cycle.

Technical Highlights

Various predefined widgets can be dragged and dropped to positions in the digital twin that correspond to those in the physical object. These widgets offer distinct ways to visualize data, such as on a scale, in a graph, or with a meter like the tachometer in a car.

Colors can represent predetermined operational parameters. For example, the data could be shown in the green range if the monitored operation is proceeding ideally, yellow if it is acceptable but less than ideal, and red if it is unacceptable (see Figure 4). The user can see instantly what state the machine is in without having to remember numeric parameters or perform any calculations.

Layer 2: Monitoring

The monitoring layer collects and delivers real-time mechanical, electrical, and digital data on various device metrics such as speed, vibration, load, acceleration, pressure, temperature, and more, depending on the plant or machine.

A machine's productive life span can be optimized by continuously monitoring the machine's condition and using machine learning to accurately predict when problems will occur.

Key Features & Benefits

Based on the constant analysis of incoming data in real time, engineers can forecast when maintenance will become necessary.

For example, instead of performing vibration-related maintenance on an assembly line at routine time intervals, maintenance is not performed until an alert is triggered when those vibrations approach a predetermined reference value. Waiting as long as possible to perform the maintenance — but making sure it is done before vibrations exceed a critical value — extends the life of the machine without risking consequential damage.

Moving from fixed to wear-oriented maintenance intervals reduces maintenance and repair costs. With ongoing collection and analysis, data can be extrapolated to generate future-oriented forecasts. It leads to less wear and tear, ensuring a prolonged product life cycle.

Technical Highlights

A digital twin makes remote root cause analysis possible at the first sign of irregularities. An engineer, machine owner, or technician can check the status of an endpoint in real time, remotely, and at their convenience, but only with a stable data connection and low latency.

Once the root cause of the problem is determined, dynamic visualization of the process flow shows when parameters are exceeded or undercut and allows users to take corrective measures by adjusting the virtual controls in the digital twin. Thus, a problem can be limited to an endpoint or a machine, requiring no physical measures to be taken.

Layer 3: Control

Being able to control machines remotely is a key benefit of IoT. The digital twin simplifies how machines are controlled remotely by providing a graphical visualization of the machine on which the user can make changes that are mirrored immediately in the physical machine.

Key Features & Benefits

Correcting configurations, triggering a restart, and much more can be done remotely with ease.

Visualized switches, controllers, and other control options allow the user to directly access and take control of an endpoint. The actions triggered in the digital twin are transmitted in real time to the physical endpoint as a corresponding action. And any physical changes made on the actual endpoints are visualized in the digital twin.

The user can check the current machine status from any location and take immediate control over the machine as needed.

Technical Highlights

With remote connectivity, the ability to control the machine through a digital twin is available from anywhere. Real-time machine data must be provided 24/7 through an encrypted connection to ensure a secure and private flow of up-to-date information.

Layer 4: Automation & Machine Learning

The application of rules and machine learning in process monitoring triggers automated responses to issues and leads to shorter reaction times. This reduces the risk of machine failures and the costs associated with them.

Key Features & Benefits

An intelligent rule engine defines ideal, acceptable, and unacceptable levels of performance. The rule engine detects abnormal data values and automatically executes predetermined prescriptive measures. With an insignificant event, such as a slight increase in temperature that doesn't exceed a predefined tolerance level, the rule engine can trigger a cooling action. In the event of a more serious anomaly that requires human intervention, it sends a notification describing the issue to a predefined group of technicians and other stakeholders. With automated alerts, remedial action can be taken sooner, so the mean-time-to-repair (MTTR) is reduced and the mean-time-to-failure (MTTF) is increased.

Machine learning refines the rules as it collects more data. The longer the digital twin monitors the machine, the more precisely machine learning dictates when exactly to issue the alert. Also, machine learning with predictive analytics makes maintenance predictions far more exact.

Studies show, on average, predictive maintenance increases productivity by 25 percent, reduces breakdowns by 70 percent and lowers maintenance costs by 25 percent. Efficient condition monitoring leads to reduced machine downtime.

Technical Highlights

The rule engine helps optimize production processes by acting on unexpected events before a person might otherwise notice the event, offering advantages in production process optimization.

Unexpected events, for example, the sudden stopping of a conveyor belt, can affect the entire process. In this example, the rule engine slows down or stops the process steps and sends an automatic notification with detailed information to a designated responsible party.

Unique Features & Benefits of the TeamViewer Digital Twin

Remote Access Connectivity

TeamViewer operates 1,110 routers worldwide to offer a fully cloud-based, massively scalable infrastructure deploying advanced algorithms determining best possible, lowest-latency connection (direct peer-to-peer or via router). This ensures a 99.99 percent service availability. Remote access makes it possible for controllers to work from anywhere.

Security

All connections and sessions are protected by secure data channels set up with an RSA public/private key exchange and encrypted with 256-bit AES. This technology, considered a state-of-the-art encryption method, is used in a comparable form for https/SSL. Since the private key never leaves the client computer, this procedure technically ensures that intermediate computers on the Internet cannot decipher the data stream. This also applies to the TeamViewer routing servers.

The combination of TeamViewer remote access connectivity and industry-grade security means you do not need to use a virtual private network (VPN) to keep TeamViewer IoT and Digital Twins secure.

New Service Offerings for Original Equipment Manufacturers (OEM)

OEMs can add remote access capabilities to their products. For example, they can offer their own customers faster and more targeted support. When problems occur, customers can provide the manufacturer with access to the endpoint and insight into its status.

By analyzing both historical and real-time data, support teams can efficiently resolve the issue without having to send a technician directly to the customer. The OEM can use this service to retain customers or offer it as a paid service. Many scenarios are possible, including outsourcing the entire maintenance function to a service provider.

Using a service twin (simulation of product performance on site, based on operating data) is beneficial for original equipment manufacturers. They can provide new services to the customer, such as faster and more efficient support through device access. Or printer manufacturers can bill according to the number of copies.

Simulation twins can shorten the time-to-market by simulating a wide range of conditions. They also save time, costs, and reduce the investment risk by reducing the need to build expensive prototypes.

Use Cases

Photovoltaic Inverter Manufacturer

A leading manufacturer of photovoltaic inverters has teamed up with TeamViewer IoT to address critical challenges related to their business.

Photovoltaic inverters convert the energy from solar panels to usable electricity. Solar plants are typically in remote locations far from cities, which makes efficient monitoring of them nearly impossible. Normally, operators would detect a malfunction when the damage would already be done.

With TeamViewer IoT, the manufacturer greatly improved their plant monitoring by setting up parameters and appropriate alerts that are triggered when these parameters are breached.

For example, heat sensors now record exceeded heat levels in real time, trigger a system shutdown, and alert the right expert to immediately look into the issue at hand — without having to travel to the inverters themselves. With this solution, inverters can be automatically shut down before any damage has occurred, thus saving repair costs while the right operator investigates the issue remotely.

Tractor Manufacturer

A world market leader in the tractor manufacturing sector uses TeamViewer IoT to access the electronics in the tractor with the customer's consent. The manufacturer uses this function to improve its own customer support.

For example, they can support the customer remotely in the event of technical problems or can activate software-enabled features. Customers interrupt their work for a brief time, but they do not have to visit a service center. It saves working time and thus reduces opportunity costs. The manufacturer offers some functions for a fee and thus generates additional sales.

Next Steps

Questions? Connect with us at
iot-sales@teamviewer.com or call +1 (877) 258-3157.

TeamViewer
Internet of Things

About TeamViewer

As a leading global remote connectivity platform, TeamViewer empowers users to connect anyone, anything, anywhere, anytime. The company offers secure remote access, support, control, and collaboration capabilities for online endpoints of any kind and supports businesses of all sizes to tap into their full digital potential. TeamViewer has been activated on approximately 2 billion devices; and about 45 million devices are connected to the network at any given time.

Founded in 2005 in Göppingen, Germany, TeamViewer is a publicly held company listed on the Frankfurt Stock Exchange, employing about 800 people in offices across Europe, the US, and Asia Pacific.

Stay connected.