INTEGRATING QC MEASUREMENT DATA INTO MANUFACTURING SYSTEMS

WIRELESS DATA COLLECTION

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The Internet of Things (IoT) and, in a broader sense, the Fourth Industrial Revolution (Industry 4.0) is the omnipresent new paradigm in manufacturing today, profoundly affecting the way manufacturers are operating or are planning to operate. Improving Overall Equipment Effectiveness (OEE) is a key new IoT requirement, and optimizing OEE necessitates accurate, up-to-date data across the entire organization, including measurement and test data collected from both quality labs and directly from the manufacturing floor.

Increasing the speed, volume and accuracy of measurement and inspection data collection is critical, as it provides powerful insights vital to improving efficiency and consistently manufacturing quality parts. In terms of acquiring/ collecting precision measurement data for quality control purposes, the clearest path to these advantages comes from wireless and mobile retrieval technology.

Wireless data collection systems should be mobile as well as robustly encrypted and secured, and be suitable for multiple needs ranging from unrestricted distances and gage compatibility, to ease of use and practical integration into automated manufacturing operations. The best wireless data collection systems can dramatically increase productivity, remove the potential for errors, provide complete documentation and automate the data acquisition process. Systems should include all of these benefits whether used by a single employee or across an entire company with an integrated quality control system.

Why traditional approaches to quality control measurement data leave too much room for error

There are many reasons why manufacturers need to collect accurate, timely and complete measurement and inspection data. OEE, Lean and Six Sigma initiatives require trustworthy data to support the best quality control practices. Manufacturers, especially those in industries such as medical, biomedical, aerospace and defense, must often meet regulatory requirements and provide traceable, reliable documentation for critical part manufacture.

Data collection systems of the past share common limitations, including:

POTENTIAL FOR HUMAN ERROR AND DELAY

Systems that ask workers to manually track key measurements require extremely precise attention to detail, exercised many dozens or even hundreds of times in a single shift – all which is often difficult and unrealistic to consistently do, even if it is being done in the first place. Education is another issue — employees may not have the background needed to fully understand and accurately collect and transcribe data. Transposed digits, misplaced decimal points and similar issues can commonly occur. Additionally, an employee may need to halt production work to capture and record measurements, reducing overall productivity.

DIGITAL SECURITY ISSUES

Unsecured networks that are used to transmit measurement data can provide inroads for hackers to gain more general access to a company's data. When measurement data is transmitted without the proper digital security measures, it presents a potentially serious security risk.

LACK OF SCALABILITY

Business growth and diversification can necessitate more quality control processes which may be spread-out over one facility or multiple locations. At best, if a data collection system is not scalable, setting up separate data collection processes is time consuming, cumbersome and may lead to confusion, inaccuracies and delayed communication. Or even worse, product rejections, failures and legal implications with customers may result.

INCOMPLETE ANALYSIS THROUGH A SAMPLING STRATEGY

A sampling strategy simply cannot provide the complete picture offered by 100% measurement of each component produced. This structure, common with some traditional QC processes, may lead to an inability to predict and identify drifting production tolerances. In addition, this strategy is not even an option for industries such as medical or military that require 100% part inspection and traceable documentation.

## INCREASED POSSIBILITY OF REJECTS

Every rejected part represents money, time and resources lost. Without the full insight provided by 100% measurement, manufacturers risk incurring additional expenses as well as potentially harming relationships with customers. If a would-be rejected part makes its way to a customer, especially one that requires strict standards compliance, the results can have serious implications, if not catastrophic.

How DataSure® 4.0 improves, modernizes and streamlines the collection of quality control measurement data

The underlying principle of DataSure 4.0 is to enable manufacturers to accurately and consistently acquire large amounts of measurement data for meeting Industry 4.0 requirements. DataSure 4.0 is the most complete, scalable, secure and robust measurement data acquisition solution for Industry 4.0.

That means offering foundational benefits thorough automation, ease of operation, streamlined scalability, robust data encryption and protection, and unrestricted distances and unencumbered use for transmission. The result is increased productivity, reduced errors, provision of full documentation and a reliable data acquisition process driven by automation.

W798 Calipers

W733.1 Micrometers

W2900 Indicators

Starrett®
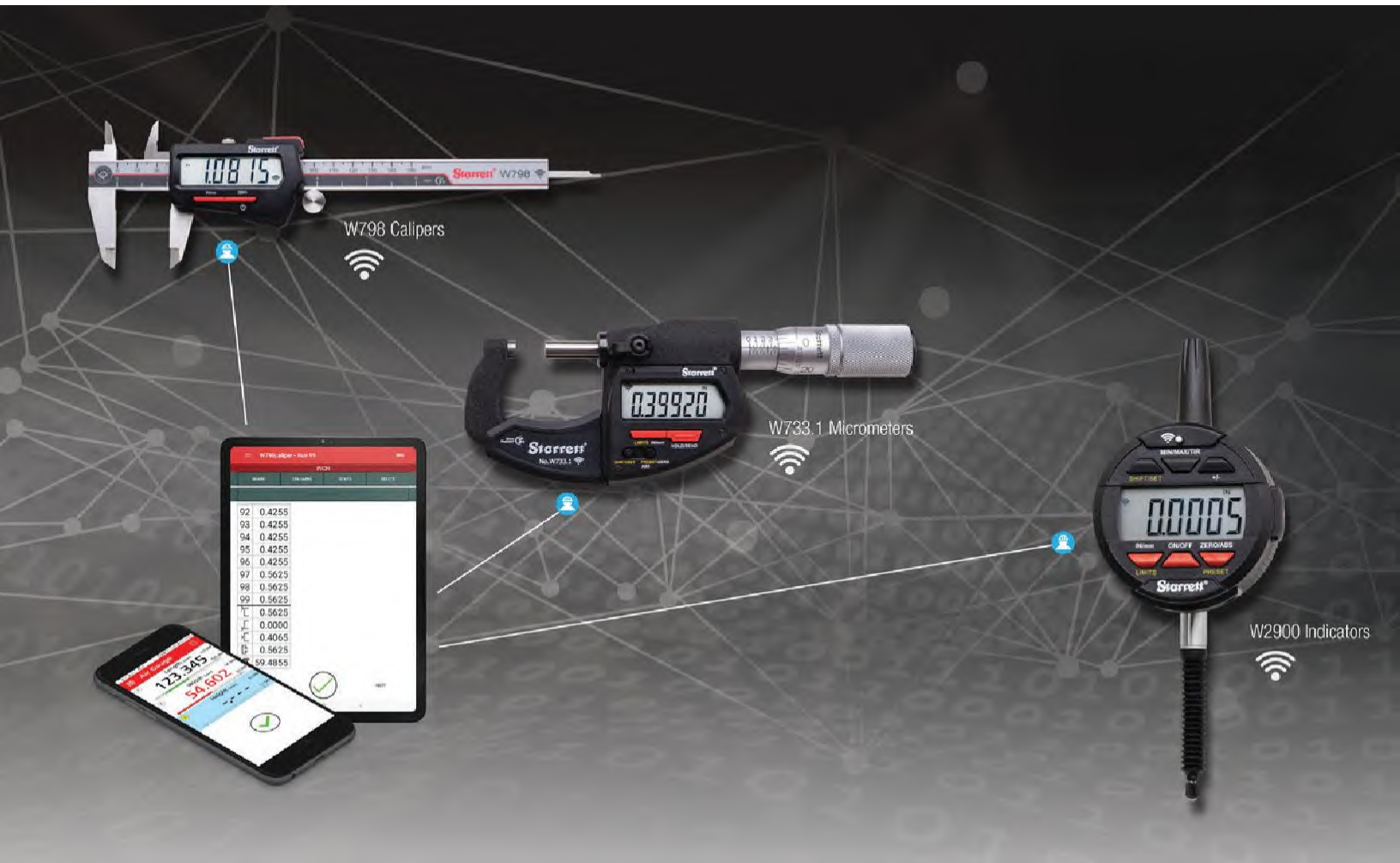
Let's take a closer look at the transformative advantages offered by DataSure 4.0:

DataSure® 4.0 operates on the latest wireless networking technology that uses short-wave radio frequencies to interconnect cell phones, computers and wireless electronic devices, enabling much faster speed, greater bandwidth and longer range for higher data throughput. The system offers a wide range of crucial benefits including:

AUTOMATION

When employees have to repeatedly stop work to record a measurement, productivity is surely negatively impacted. Also, manual data collection processes can introduce errors into the records database, with the potential to severely reduce accuracy and perpetuate flaws going forward. With DataSure 4.0, the press of a button can transmit measurement data, significantly saving time. For example, it is at least four times faster to push a button compared with writing data and then typing it into a computer.

DataSure 4.0 maximizes automation throughout the quality control measurement data collection process, improving process efficiency and the accuracy of measurements captured. Features such as automatic time stamping provide critical context about each data point, required for traceability and compliance to quality control/ production specifications. For assurance, DataSure immediately sends a message back to the measuring tool confirming receipt.

New Starrett Wireless Gages have built-in radio transmitters to transmit measurement data.

SPEED

High data volumes can be processed without delay, even at full capacity, because DataSure 4.0 features higher bit rates and a very high-speed connection of less than 50ms of data travel time, as well as an ultra-low latency network.

EASE OF OPERATION

Establishing a measurement data collection process can be met with resistance on multiple levels. For company management, there may be uncertainty that putting a new method in place will have tangible benefits. For operators, there might be some fear of the unknown and trepidation when learning a new process. To assuage these concerns, Starrett made ease of use a high priority so that operators can quickly feel confident and the data collection process is optimized in a short period of time. For example, ease of operation extends to the DataSure 4.0 mobile app, which eliminates the need to bring larger hardware, such as a laptop, into the field.

A study on data collection throughput and accuracy

In a controlled, 100% inspection test to measure the impact of Starrett DataSure® on throughput and quality assurance, Starrett made three measurements per part and recorded the data on 500 parts.

Methods 1 and 2 involve time-consuming hand movements to pickup and put down the tool in order to record data. Also, results can be uncertain due to the measurement value changing while being inspected. The slowest method (#1) required 29 seconds per part with many errors. Measurement with DataSure wireless data collection software is fast and direct, nearly 5 times faster than Method 1.

METHOD 1

MEASURE, HANDWRITE RESULTS, ENTER DATA REMOTELY

- 37 time/ motion elements, 28.9 seconds per part
- 62 entry errors

Factors affecting accuracy and throughput:

- Measurement must stop so that the machinist or inspector can write down results
- Illegible handwritten numbers, mistakes noted but not corrected, data written in shorthand and inspector's misread by the transcriber
- Value can change when the gage/tool is released
- Data entry errors at the PC

METHOD 2

MEASURE AND ENTER RESULTS TO PC

- 20 time/ motion elements: 15.3 seconds per part
- 4 data entry errors

Factors affecting accuracy and throughput:

- Alternating measuring and data entry caused errors
- Gage not seated correctly when released to key-in data
- Missed data entry, incorrect keystrokes, data entered into wrong cell

METHOD 3

MEASURE AND ENTER RESULTS DIRECTLY WITH A STARRETT DATASURE® WIRELESS DATA COLLECTION SYSTEM

- 17 time/ motion elements: 6.6 seconds per part
- 0 entry errors

Factors affecting accuracy and throughput:

- Measurement technique is maintained
- No interpretation or memory errors
- Immediate, direct data entry eliminates errors

VERSATILITY

A new network topology structure can be configured to many simple or complex situations and distributed remote gateways can also be utilized. The modular structure of DataSure® 4.0 makes it simple to expand or contract a quality control measurement data collection process without having to acquire a new data collection system. Data is transmitted from gages that have either built-in radio transmitters or externally-mounted end nodes to gateways, and is operable on both Android or IOS mobile platforms and Windows® based computers including laptops, desktop PCs, thin client PCs, and servers. DataSure 4.0 repeater and bridge components can also connect directly to PLCs and other high-speed serial automation equipment for real-time data collection or remote machine operation.

For wireless measurement, Starrett DataSure 4.0 wireless measuring tools include embedded radios that make them easier to use for data collection. DataSure is compatible with all Starrett electronic digital gages, as well as electronic gages of other tool manufacturers including Mitutoyo, Sylvac, Fowler, Bowers, and CDI Tools. Backpack radios that expand functionality for Starrett and many competitor-brand tools are unobtrusive and easily attached. Users of DataSure 4.0 can utilize multiple gateways which serve as central or distributed points for data collection, versus conventional systems that have only one gateway. The new, compact gateways and repeaters can easily fit in the palm of a hand.
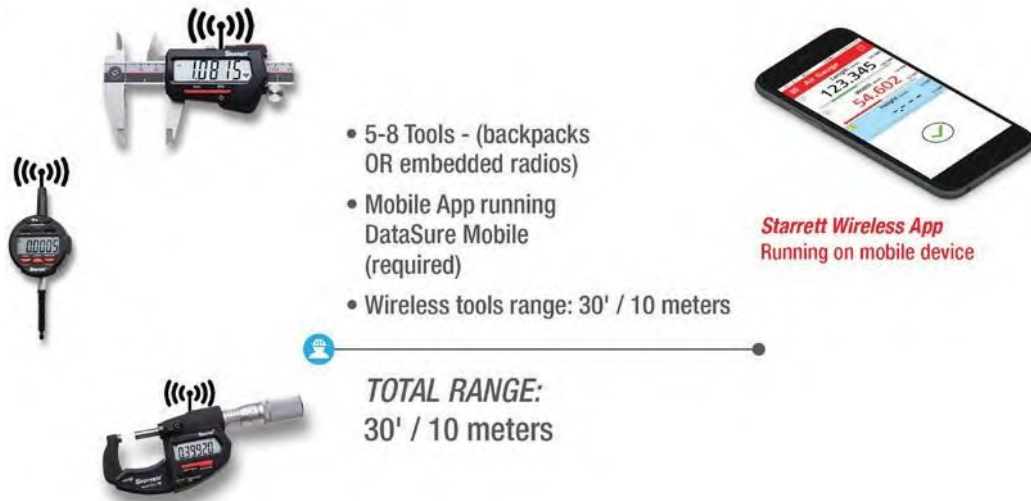
Additionally, applications for data collection are incredibly diverse, and DataSure 4.0 is versatile enough to cover all those applications. DataSure 4.0 is adaptable to nearly every use case, with examples ranging from automotive and agricultural, to 100% measurement of all parts and components in highly regulated industries such as defense, aerospace, medical, energy and more.

SCALABILITY

The Starrett DataSure 4.0 Wireless Data Collection System is designed to dependably and accurately acquire precision measurement data in an extensive range of applications and distances. From just one or a few measuring tools over short distances, to configurations that have many measuring tools located hundreds of yards apart in a large factory or spread out over a mile in multiple facilities, DataSure 4.0 is able to easily accommodate expanded distances and increased application requirements as measurement data collection requirements evolve and grow.
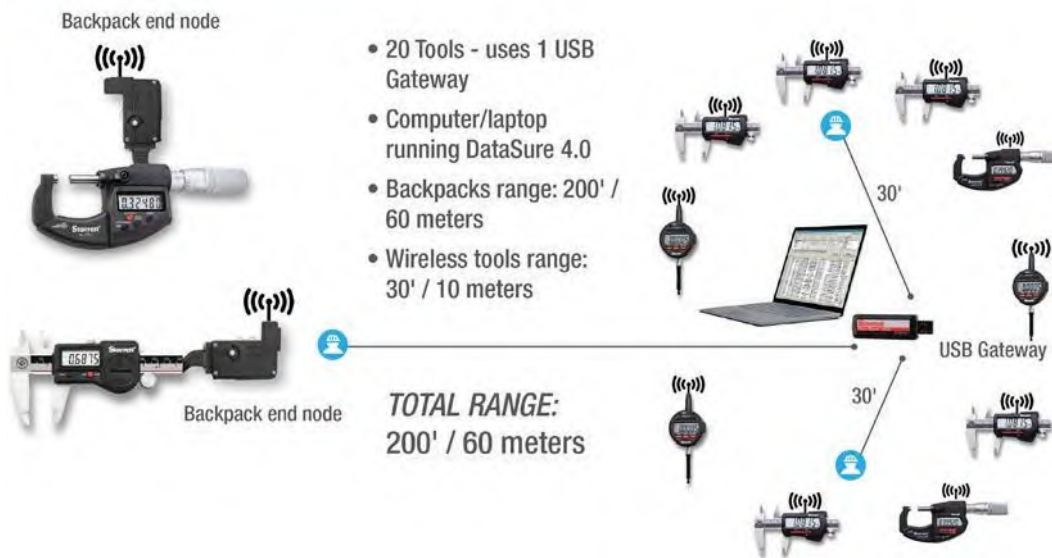
Starrett®

In its simplest application, a "**Portable Scheme**" features the Starrett DataSure 4.0 Wireless app running on a mobile device. This straightforward setup can have one Starrett wireless measuring tool with an embedded radio transmitting   data up to 30 feet (10 meters) to a mobile device. Or, dependent on the mobile device, a Portable Scheme may have 5-8 measuring tools that connect to the mobile app for data transmission up to 30 feet (10 meters). Also, DataSure 4.0 users can easily transmit measurement data up to 30 feet (10 meters) from one (or more) Starrett Wireless Measuring Tool(s) to a laptop or PC that have a USB gateway.

DataSure® "Portable" scheme

- 5-8 Tools - (backpacks OR embedded radios)
- Mobile App running DataSure Mobile (required)
- Wireless tools range: 30' / 10 meters

TOTAL RANGE:
30' / 10 meters
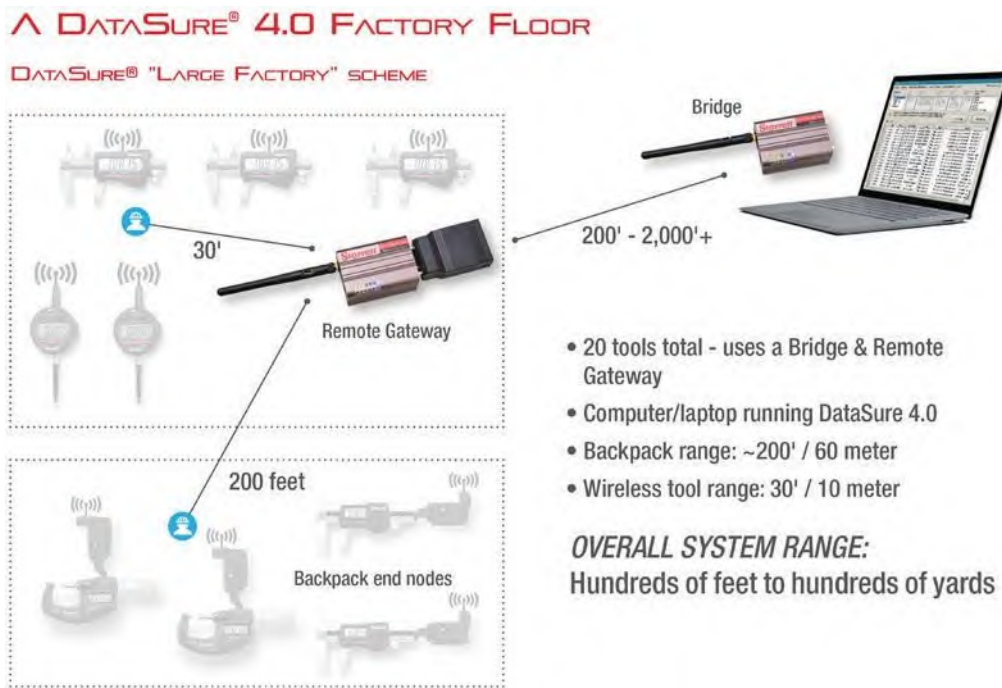
Starrett Wireless App
Running on mobile device

In a "**Typical Scheme**", the manufacturer could have a computer or laptop running DataSure 4.0 to support 20 measuring tools in the data collection process over a distance of up to 200 feet. In this setup, one USB gateway is included and backpack end nodes on the measuring tools increase the transmission range from 30 feet to 200 feet.

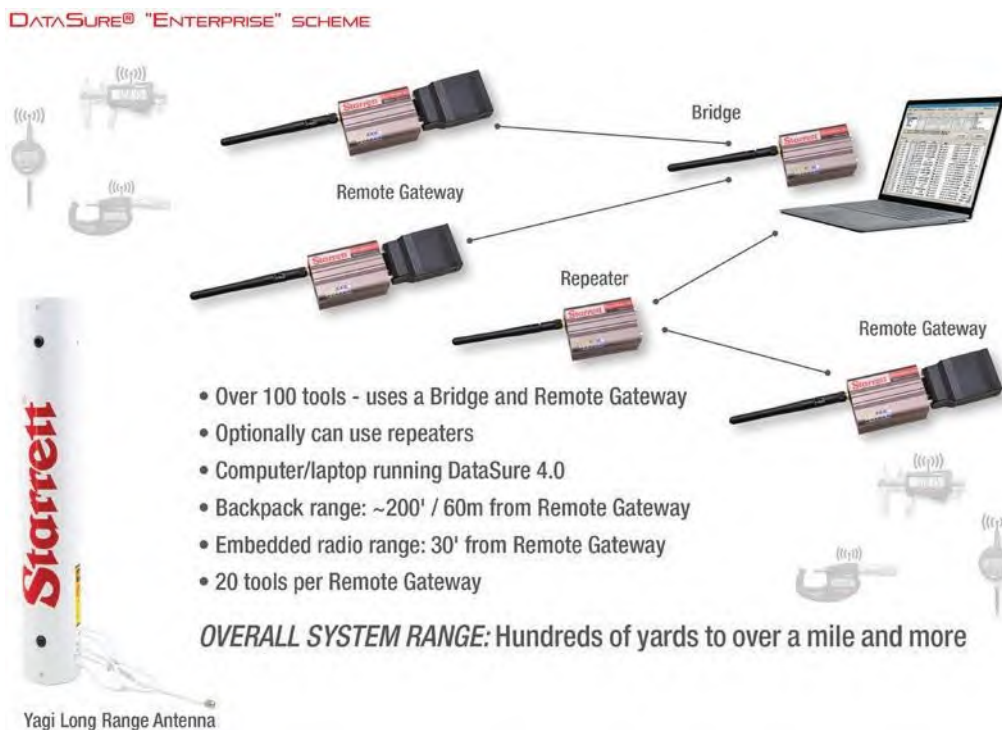DataSure® "Typical" scheme

Backpack end node

- 20 Tools - uses 1 USB Gateway
- Computer/laptop running DataSure 4.0
- Backpacks range: 200' / 60 meters
- Wireless tools range: 30' / 10 meters

Backpack end node

TOTAL RANGE:
200' / 60 meters

USB Gateway

In a "**Large Factory Scheme**" example, 20 measuring tools can use a bridge and remote gateway to expand the total data transmission range to hundreds of feet or yards.

A DataSure® 4.0 Factory Floor

DataSure® "Large Factory" scheme

Bridge

30'

Remote Gateway

200' - 2,000'+

200 feet

Backpack end nodes

- 20 tools total - uses a Bridge & Remote Gateway
- Computer/laptop running DataSure 4.0
- Backpack range: ~200' / 60 meter
- Wireless tool range: 30' / 10 meter

OVERALL SYSTEM RANGE:
Hundreds of feet to hundreds of yards

And in an "**Enterprise Scheme**", measurement data transmission can be increased from hundreds of yards to over a mile. By using remote gateways, bridges and perhaps adding in repeaters, over 100 measuring tools can be incorporated. Each remote gateway can facilitate 20 measuring tools. For even greater distances, Yagi Long Range Antennas can be incorporated in the scheme.

DataSure® "Enterprise" scheme

Bridge

Remote Gateway

Repeater

Remote Gateway

- Over 100 tools - uses a Bridge and Remote Gateway
- Optionally can use repeaters
- Computer/laptop running DataSure 4.0
- Backpack range: ~200' / 60m from Remote Gateway
- Embedded radio range: 30' from Remote Gateway
- 20 tools per Remote Gateway

OVERALL SYSTEM RANGE: Hundreds of yards to over a mile and more

Yagi Long Range Antenna

ROBUST DATA ENCRYPTION AND PROTECTION

Data security is top-of-mind for all manufacturers, including military. And while quality control measurement data by itself might not be particularly valuable to hackers, cybercriminals can still spoof the networks used to transmit quality control data to gain more general access to digital infrastructure.

DataSure® 4.0 addresses this issue through a variety of measures, including proprietary security efforts. DataSure 4.0 is built on a highly secure proprietary wireless platform. Transported data is encrypted using a multi-layered approach that absolutely prevents any outside access to the data, whether passive or active.

In addition, the DataSure 4.0 mobile app doesn't connect to the OS of a smartphone or tablet, restricting unintended access at a critical point. Maintaining good security also includes addressing emerging vulnerabilities in radio transmission on a frequent basis to keep systems secure going forward, which Starrett is dedicated to keeping pace with.

UNRESTRICTED DISTANCES AND UNENCUMBERED USE FOR TRANSMISSION

DataSure 4.0 leverages remote gateways, bridges and repeaters to offer an efficient and reliable data transmission framework. System structures can involve as few components as a backpack or embedded radio along with a mobile device running the DataSure mobile app, or utilize bridges, gateways and repeaters to greatly extend transmission ranges in a large factory configuration.

> The range of DataSure 4.0 is
> # 10-20 TIMES
> that of any other data collection system on the market.

The Starrett DataSure 4.0 software application uses a wireless network to gather information from multiple measuring tools. The wireless network relies on the measuring tools' embedded wireless technology or end nodes to gather and then relay data back to the PC. DataSure 4.0 can also send signals out to the network components to verify transmissions and request data. The hardware components of the system are the: USB Gateway, Remote Gateway, Bridge Extenders, and End Node(s). The End Node is a radio transmitter/ receiver that gets attached to a measuring tool. The USB Gateway is a radio transmitter/ receiver attached to a PC. The Remote Gateway is the same as the USB Gateway but also extends the communication range from the PC, by using a Bridge extender to boost the signals between the Remote Gateway, and the PC. The Remote Gateway has the same range as the USB Gateway but can be setup very far away from the PC.

New Starrett Wireless Calipers are equipped to send measurement data with the push of a button.