Process Weighing

Integrating Process Weighing Data
Industrial Weighing – White Paper

Efficient transfer of weighing process data to higher level MES or ERP systems can help make manufacturing processes more transparent. Increased transparency can improve asset use, reduce operating costs, and make complying with certification standards or industrial regulations easier.

Identifying and implementing the most effective system for data collection and integration can be challenging, however, especially in a legacy manufacturing operation.

This paper explores weighing process integration challenges and provides points to consider when defining operating boundaries and data objectives. Weighing and communication solutions are more likely to meet objectives and produce measurable ROI when these points are taken into account.

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METTLER TOLEDO

1. Defining data Integration challenges

Challenges manufacturers face when effectively integrating weighing data into an automated ERP/MES system include:

speed - ability to deliver reliable, "filtered" weighing data to a higher-level automation system during time-sensitive applications (such as high precision filling) so production adjustments can be made.

flexibility - ability to communicate information that affects weighing accuracy, materials use and production rates such as product ID, target weight, tare weight, scale status, operator messages, and error information.

cost - ability to use solutions that integrate data from multiple scales into a single automated system.

equipment limitations - allowing for or replacing equipment with new controllers that enable automation.

adverse conditions - high pressure wash-down; explosive/corrosive environments; high vibrations; electromagnetic interference and/or extreme temperatures.

An expert assessment of conditions that a weighing system is expected to perform under without loss of accuracy or communications to the higher level system can help define operating boundaries. Then, together with the data integration objectives, the selection of the most suitable weighing equipment and data communication solution can be made.

2. Determining data integration objectives

Before selecting a weighing terminal/communication system, an assessment of data integration objectives must be made. Typical questions to answer include:

- What type of information will be communicated between the weighing terminal and automation system?
- Who or what needs the data and why?
- What triggers a data send and how frequently will communication be made?
- What are present data format requirements? Are they negotiable?
- What is the communication medium? Is it negotiable?

Several of these questions are strategic in nature: what type of information is required, by whom, and to what end? Once these questions have been answered, the remaining solutions can be explored with a goal of enhancing performance. This increases the likelihood that the final process integration will provide measurable, and even rapid, ROI.

3. Assessing data integration solutions

If PLC control is being considered, bus interface type can influence weighing equipment specifications. PLC bus network selection is based on factors such as the automation supplier bus type, the number of required nodes, device types/amount of networked data, desired data transfer rate, and project budget.

An automation equipment vendor will compare pros and cons of different network types. Capabilities such as:

- upload of target weight data to the weighing terminal
- calibration information collection and/or calibration via a PLC program, and
- scale tracking statistics

are all possible with the right weighing terminal. Weighing goals such as overall process precision and filling speed, together with the chosen PLC bus network, will define what type of terminal and interface is required.

If PLC data integration is not required, PC-based serial or Ethernet TCP/IP data communication becomes an option. Ethernet TPC/IP systems use wireless data communication more easily than PLC systems. OPC interfaces can integrate weighing data via an OPC server to other OPC-enabled applications. OPC provides a standardized data format that can lower integration and support costs, reduce system complexity, and speed up industrial automation project development.

In the METTLER TOLEDO product universe, a high-level generalized comparison of PLC and TCP/IP systems follows.

Communication Method	Requirements/Limitations
Basic weighing data via serial or Ethernet TCP/IP	• Standard terminal data format with pre-defined, limited data sets • "Print template" stored in weighing terminal and communicated to external hardware • OPC server communicates weighing data format
Basic weighing data via 4-20ma or 0-10VDC signal	• Limited communication of weight and/or rate • Requires separate communication between control system and weighing terminal for functions such as zero or print commands
Weighing data via PLC fieldbus, e.g. EtherNet/IP™, Profibus® DP	• Requires PLC hardware/program to integrate data • PLC interface capabilities limit data packet/message size • Production certificate

4. Suggesting best practices

Best practices for integrating weighing terminals with higher level systems will follow automation equipment supplier recommendations. While best practices for every type of automation network is beyond the scope of this paper, several best practices examples for implementing ethernet-based networks such as EtherNet/IP™, Modbus TCP™ or ProfiNet® follow.

Industrial network vs. office network

Industrial network design requires different considerations from office network design. Traffic generated during programming, configuration, and diagnostics of EtherNet/IP™ devices, as well as during exchange of non time-critical data, is typically low-rate traffic generated on a sporadic basis.

However, in a manufacturing process, traffic generated during time-critical data exchange consists, predominately, of UDP/IP Unicast and Multicast packets. IP Multicast traffic generated in an EtherNet/IP network is high-rate, short-packet traffic generated on a continuous basis.

If an EtherNet/IP sub-net is connected to a plant network, the continuous propagation of Multicast packets must be blocked. While the continuous information flow from the sub-net may be desirable for optimized weighing, it can cause a multicast message storm that degrades the plant's overall network performance if it is not managed.

Shipments of Industrial Ethernet-Based Devices (Thousands of Units) ©2008 ARC Advisory Group
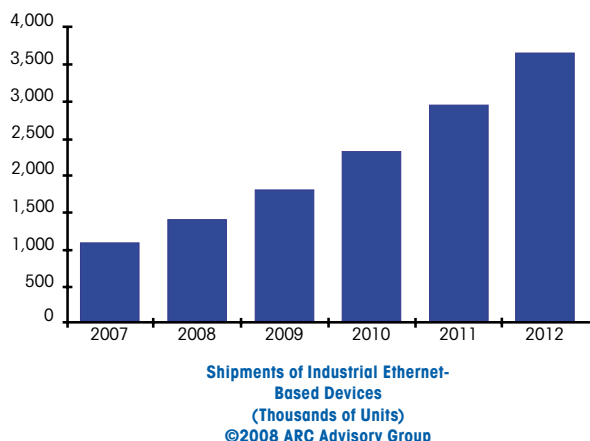
Ethernet-based device popularity is increasing due to enhanced speed, increased bandwidth, common components, and installation ease.

Optimizing Industrial EtherNet/IP

Rockwell Automation has provided the following recommendations to optimize network performance when using EtherNet/IP.

Select Unicast EtherNet/IP communication whenever possible.

Unicast I/O for EtherNet/IP allows for direct point-to-point communication between two devices on a network. This communication is more efficient when I/O data does not need to be shared among multiple devices. Further information on Unicast vs. Multicast communication can be found in ODVA publication 70, "Recommended Functionality for EtherNet/IP Devices," which can be accessed using this paper's concluding links.

Minimize device load due to unwanted IP multicast traffic.

Depending on sub-net configuration and device connectivity, this objective can be achieved using managed Ethernet switches supporting virtual LANs (VLANs) and IP multicast routing.

Minimize switch load due to unwanted IP multicast traffic.

Use full duplex, managed industrial network switches capable of IGMP (Internet Group Multicast Protocol) snooping, port mirroring, VLAN setup, SNMP statistical information, IP address blocking, auto-restore of configurations, per port broadcast/multicast storm control, spanning tree protocol, and frame prioritization.

Minimize network load due to unwanted incoming IP multicast traffic / Block IP multicast traffic generated within the EtherNet/IP sub-net from propagation into the larger plant network.

Network cable connectors with IP67 environmental ratings and extended temperature ratings to 80C are preferred when establishing industrial networks. CAT6 or CAT6a industrial shielded cabling must be used in high noise environments. In some cases grounded metal conduit can minimize electrical interference. Proper grounding is important to avoid loops that can cause communication drops or signal interference.

Use of vendor supplied PLC sample code or other integration tools such as Rockwell Automation Add-on-Profiles (AOPs) and Add-on-Instructions (AOIs) can simplify integrating devices into an automation network and minimize programming errors.

5. Troubleshooting communications

Data communication troubleshooting for a weighing terminal and automation system depends on the communication method being used. For serial or EtherNet TCP/IP to PC, simple connection using a PC application such as HyperTerminal can verify basic weight data transfer via the terminal's communication port.

Ethernet network troubleshooting is typically divided into major areas including:
• network media (cabling, connectors, network interface cards),
• software settings/network configuration, and
• network signal performance.

A variety of technician tools such as TDR (time domain reflectometer) devices, handheld network analyzers, and cable performance analyzers are employed when troubleshooting network media problems.

For PLC based applications, some vendors supply PC based simulation software for viewing and verifying data communicated from a weighing terminal's PLC port. LEDs mounted to the communication PCB provide basic information regarding operating status. Bypassing the PLC application program and directly writing to output command and data words can provide powerful troubleshooting as well.

Weighing terminal troubleshooting can also occur via remote access to a terminal's configuration file, error logs, and web pages showing diagnostics or operational status.

6. Summary
Efficient transfer of process data to higher level MES or ERP systems, along with intelligent weighing platform/system upgrades, can:
- enhance manufacturing process controls,
- improve asset use
- lower operating costs, and
- generate measurable ROI.

Clear goal identification–either performed internally, or with the help of weighing process specialists–can ensure that hardware and software investments reap intended process improvement dividends.

Considerations for proposed system upgrades include:
- Speed of process (for example, high-speed filling), which influences data exchange rates;
- Existing equipment and potential connectivity;
- Available budget;
- Adverse operating conditions, such as high-pressure wash-down, corrosive chemicals, hazardous environments, and extreme temperature;
- The data itself-who/what needs it, why and in what format?
- Is PLC connectivity is required, or will serial or Ethernet TCP/IP-to-PC work?

Finally, Ethernet network troubleshooting requires knowledge of network media, configuration, and signal performance. Some vendors supply PC-based simulation software for verifying data communicated from a weighing terminal's PLC port. Vendors themselves can help with comparisons of various weighing platform and system communication solutions.

7. Additional Resources
More information on communication capabilities, data format, and fieldbus network-specific requirements for METTLER TOLEDO weighing terminals are available via www.mt.com. The following links provide general and vendor-specific information that can help optimize automated processes that involve weighing.

- METTLER TOLEDO:
  www.mt.com/terminals
- Rockwell Automation Integrated Architecture Tools:
  www.rockwellautomation.com/solutions/integratedarchitecture/resources4.html#Termination
- Rockwell Integrated Architecture Builder software:
  www.rockwellautomation.com/en/e-tools/configuration.html
- ODVA DeviceNet™ Library:
  www.odva.org/default.aspx?tabid=73
- ODVA EtherNet/IP™ Library:
  www.odva.org/default.aspx?tabid=76
- Profibus/ProfiNet®:
  www.profibus.com
- Network Analyzer: Wire Shark,
  www.wireshark.org;
  Fluke Networks:
  www.flukenetworks.com
- Kepware OPC:
  www.kepware.com

www.mt.com

For more information