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VM600

Application note 021

VM600 system segregation and cyber security

VM600 rack-based systems have always been secure by design.

Since its beginning, the VM600 system was conceived and designed to separate machinery protection system (MPS) and condition monitoring system (CMS) functionality because of the many advantages that this provides, including versatility, API 670 compliance, cyber security and reduced costs.

VM600 rack-based system

As shown in Figure 1, the VM600 system rack provides a common hardware platform that supports up to 2 power supplies (for power supply redundancy) and up to 12 signal processing card pairs, that is, any combination of MPC4/IOC4T machinery protection card pairs and XMx16/XIO16T condition monitoring card pairs.

The VM600 system rack also includes a rack backplane that supports various communication buses:

- Raw bus – for the sharing of up to 32 dynamic (analogue) signals between cards in the rack.
- Tacho bus – for the sharing of up to 6 tachometer (speed) signals between cards in the rack.
- Open collector (OC bus) – for the sharing of alarm (relay) signals between cards in the rack.
- VME bus – for communication between a CPUx “rack controller” card and MPC4/IOC4T machinery protection card pairs.

Separation of MPS and CMS

To support the “segregation” required by API 670, the VM600 system uses different cards for machinery protection and condition monitoring (see Figure 1).

The MPC4/IOC4T machinery protection card pair provides 4 dynamic channels and 2 tachometer (speed) channels. It is a highly-integrated, highly-configurable card pair that can interface with different front-ends (measurement chains) to provide a wide range of measurements for machinery protection applications. It also provides current outputs and relay outputs that can be used to initiate the shutdown of a machine.

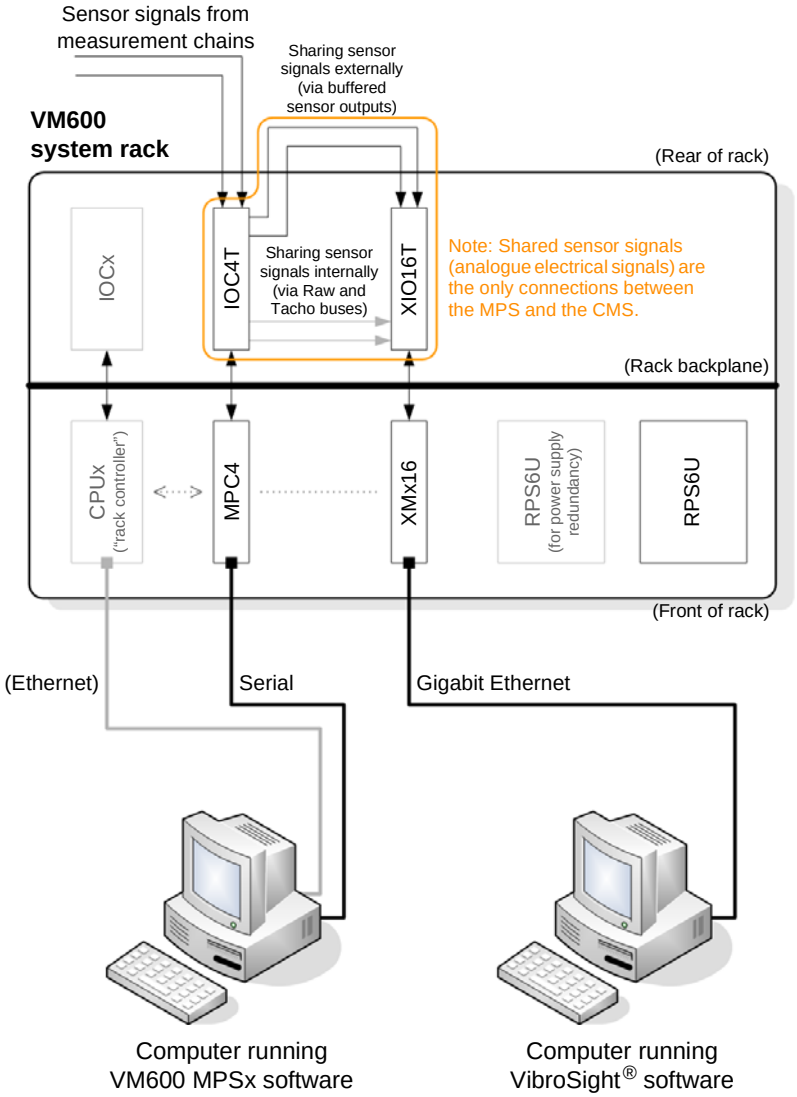

Figure 1: The VM600 system rack separates MPS and CMS functionality

A MPC4/IOC4T card pair is operated using the VM600 MPSx software. The VM600 MPSx software communicates either directly with a single MPC4/IOC4T card pair using a serial (RS-232) link via the connector on the front of the MPC4 card, or indirectly with multiple MPC4/IOC4T card pairs in the VM600 rack using an Ethernet (10/100BASE-TX) link via a CPUx “rack controller” card in the rack. (Note The CPUx card communicates with the MPC4 cards via the VM600 rack’s VME bus.)

The XMx16/XIO16T condition monitoring card pairs provide 16 dynamic channels and 4 tachometer (speed) channels. They are highly-integrated, highly-configurable card pairs that can interface with different front-ends (measurement chains) to provide a wide range of measurements for condition monitoring applications such as vibration monitoring or combustion monitoring.

An XMx16/XIO16T card pair is operated using the VibroSight® software. The VibroSight software communicates with an XMx16/XIO16T card pair using a Gigabit Ethernet (1000BASE-T) link via the connector on the front of the XMx16 or XIO16T card.

Signal sharing

The MPC4/IOC4T card pair provides buffered sensor ("raw") output signals via BNC connectors on the MPC4 (front of rack) card and screw-terminal connectors on the IOC4T card (rear of rack). Required by API 670 and originally intended to allow electronic test equipment to be easily and quickly connected to an MPS for testing and troubleshooting, these buffered sensor outputs also allow a CMS to be quickly and easily added to an MPS with minimal disruption and cost.

In addition, both the MPC4/IOC4T card pair and the XMx16/XIO16T card pair can use the VM600 system rack's backplane buses to share signals between cards in the rack: dynamic (analogue) signals are routed via the Raw bus and tachometer (speed) signals are routed via the Tacho bus.

Adding a CMS to an MPS

The VM600 system rack allows an existing machinery protection system (MPS) to be upgraded to include a condition monitoring system (CMS) in one of two ways:

- For an MPS based on a VM600 system rack – in the existing VM600 rack, XMx16/XIO16T card pairs can be added and the existing sensors signals can be shared between the machinery protection cards (MPC4/IOC4T) and the condition monitoring cards (XMx16/XIO16T) either externally by wiring the buffered sensor outputs or internally by configuring the VM600 rack's backplane and buses.
- For an MPS from a third-party supplier – in a new VM600 rack, XMx16/XIO16T card pairs can be added and the existing sensors signals can be shared between the machinery protection system and the condition monitoring cards (XMx16/XIO16T) by wiring the buffered sensor outputs.

Cyber security

We live in a time when cyber attacks against industrial control systems and critical infrastructure such as power plants are increasing. Accordingly, various organisations are developing guidelines, regulations and standards to help combat the growing cyber security risks. For example, European Union Directive (EU) 2016/1148 on the security of network and information systems (commonly referred to as the NIS directive), ISA/IEC 62443 standards on industrial communication networks – network and system security, the North American Electric Reliability Corporation (NERC) critical infrastructure protection (CIP) standards and the United States Nuclear Regulatory Commission (US NRC) cyber security regulations.

Correspondingly, cyber security is becoming a priority for the operators of power plants, who must now consider cyber security and have an appropriate security plan or strategy in place.

NOTE: Cyber security must be considered at a system level and various factors such as risks and awareness, human factors, training, physical security, remote access and the sharing of information must all be considered in order to ensure a robust and reliable plan/strategy.

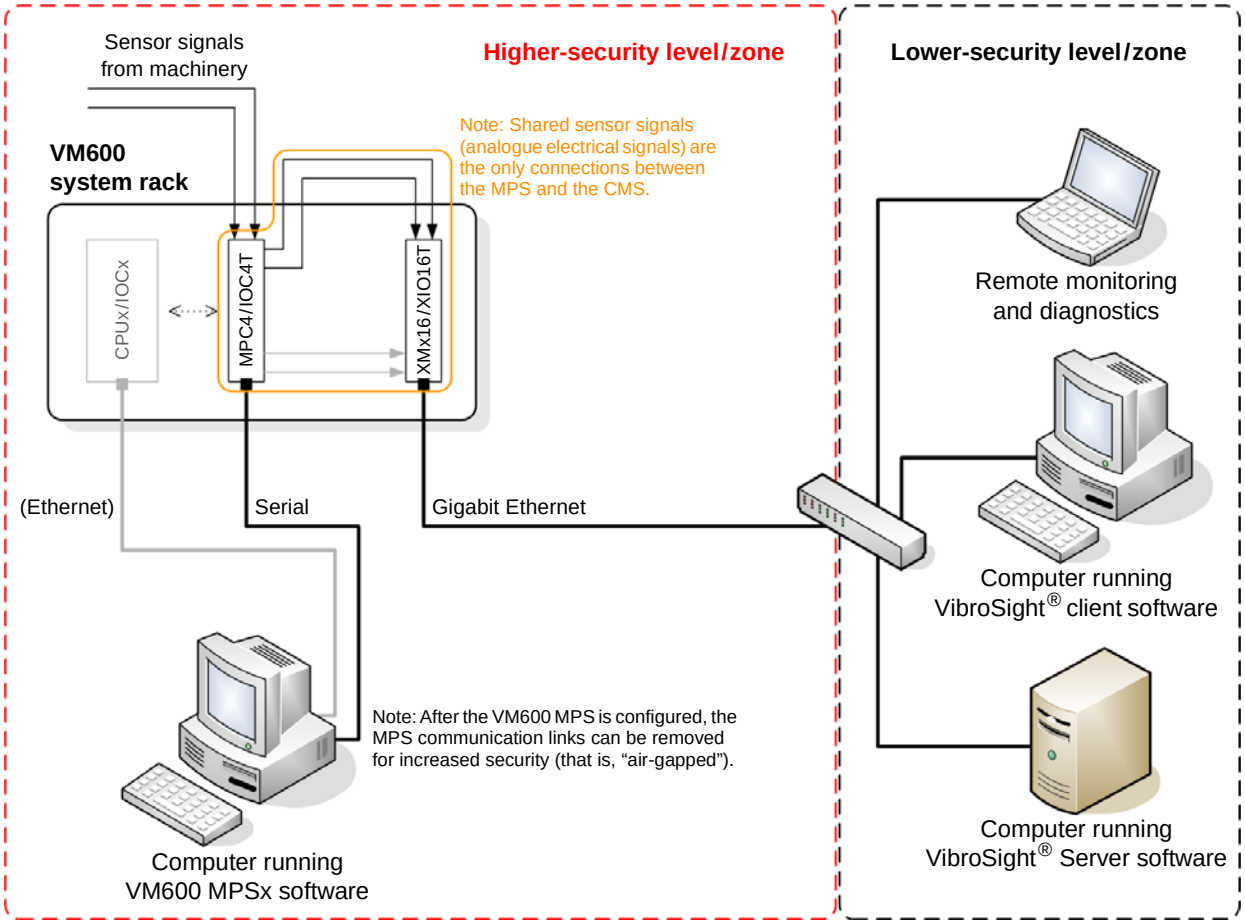

Figure 2: A single VM600 system rack provides both MPS and CMS functionality in a cyber secure environment

As shown in Figure 2, in a typical cyber secure environment using a VM600 system:

- The MPS (MPC4/IOC4T card pairs and VM600 MPSx software) is critical because it provides a machinery protection function and can initiate the shutdown of a machine, so it is installed in a higher-security level/zone with no Ethernet connection to lower-security levels/zones. That is, effectively “air-gapped” to the outside world (Internet or other networks).
- The CMS (XMx16/XIO16T card pairs and VibroSight® software) is not critical because it does not provide a machinery protection function and cannot initiate the shutdown of a machine, so it can be installed in a lower-security level/zone, with an Ethernet connection to other lower-security levels/zones. For example, an Ethernet connection to the outside world could be used to provide remote access for machinery diagnostics.
- The MPS is segregated from the CMS, so in the event of any unauthorised access to the CMS (for example, via Ethernet) it is not possible to use this access to then interfere in the operation of the MPS.
  Note: In a VM600 system, separate cards and software are used, with the result that the MPS and CMS are connected only by shared sensor signals (which are analogue electrical signals).

- The separation of MPS and CMS functionality in a VM600 system supports network and system segmentation requirements such as the physical and logical isolation of critical networks, and their independence from non-control system networks.
- With a VM600 system, costs are reduced, because a common VM600 system rack can be used to house both the MPS and the CMS, while still ensuring API 670 compliance and cyber security.

In summary, VM600 rack-based systems are secure by design because of the inherent separation between machinery protection system (MPS) and condition monitoring system (CMS) functionality. This allows operators of critical infrastructure to – more easily and less expensively – implement an MPS and/or a CMS in cyber secure environments, helping to meet increasing regulatory requirements.

Headquartered in the UK, Meggitt PLC is a global engineering group specializing in extreme environment components and smart sub-systems for aerospace, defence and energy markets.
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The Meggitt Sensing Systems facility in Fribourg, Switzerland was formerly known as Vibro-Meter SA, but is now Meggitt SA. This site produces a wide range of vibration and dynamic pressure sensors capable of operation in extreme environments, leading-edge microwave sensors, electronics monitoring systems and innovative software for aerospace and land-based turbo-machinery.

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