Bently Nevada
a Baker Hughes business

ORBIT 60 SERIES

Bridging Concepts

Technical White Paper

Contents

1. Overview

Bently Nevada is introducing the concept of bridging to the new Orbit 60 Series monitoring system architecture. In prior system designs, only modules within a chassis can interact with each other. The addition of bridging allows a system to be extended across multiple chassis. This provides several system improvements:

- Core infrastructure modules can be shared across machines to reduce the overall system cost.
- Very large systems of up to 48 dynamic inputs can be formed in a single system architecture.
- Portions of the system can be placed in different locations, leading to reduced system cost, lower noise susceptibility, and longer signal transmission distances.
- Several small machines can be handled in a single system.
- Reduction of panel space in control room environments by placing I/O's next to the machine in the field.

A bridge module is used to transfer all the data between chassis. Connections between the bridge is over redundant cabling to handle both momentary and permanent faults. Additionally, the bridge modules protect the system from unauthorized traffic through the bridge to bridge connections.

Figure 1: Rear View of Two Chassis Connected by a Bridge.

2. General Information

Cabling

There are three cables between the two bridge modules. These cables are used for redundancy, both for intermittent packet failures and for failure of a cable. All three cables must go between the same two bridges and are required for protection applications. Single connections are allowed only for condition monitoring applications. Multiple bridge modules connecting the same two chassis are not supported.

The loss of a cable causes a fault indication, but the system still functions even if only a single cable is functional. The fault indication is enunciated by the Attention status and Protection Fault - provided the protection path crosses the bridge. The recommended wiring method is to run these three cables separate from each other, so all three cables will not be damaged due to a single fault.

The three cables between the bridges must be close to the same length to avoid differences in propagation timing between the three paths.

The cables used are IX Ethernet cables. Even though the cables are IX Ethernet, the traffic between the two bridge modules is not compatible with Ethernet Switches and Routers and cannot be connected to an Ethernet network. If the bridge detects that there is traffic other than the expected bridge to bridge messages, it shuts down communication and indicates a fault.

Isolation

The links between the bridge modules are isolated. This removes the creation of ground loops between the chassis and when used for Marshalling cabinets, removes the chance for ground loops between the field wiring and the main system.

Fiber and Copper Cables

The initial release of the product will have copper IX Ethernet cables that have a maximum length of 100M. Future releases of the product will have an option for Fiber Optic bridge modules to extend the length of the connection.

The connectors for copper IX Ethernet are different than the typical RJ-45 cable.

Figure 2: iX Industrial Connector vs. RJ-45

Power

Power is not transmitted over the bridge connections. Therefore, each chassis must have its own power supply.

3. Layouts

The ability to bridge between multiple chassis allows a system to increase in size to meet the needs of the installation. The Orbit 60 Series system is very flexible in the topologies that can be created using the bridge modules. A single base can support multiple modules to create a star configuration, or base to base bridging can be used to create a linear topology. These two types of deployment can also be mixed. The one restriction on the layout of the bridges is that there cannot be any loops created in the topology.

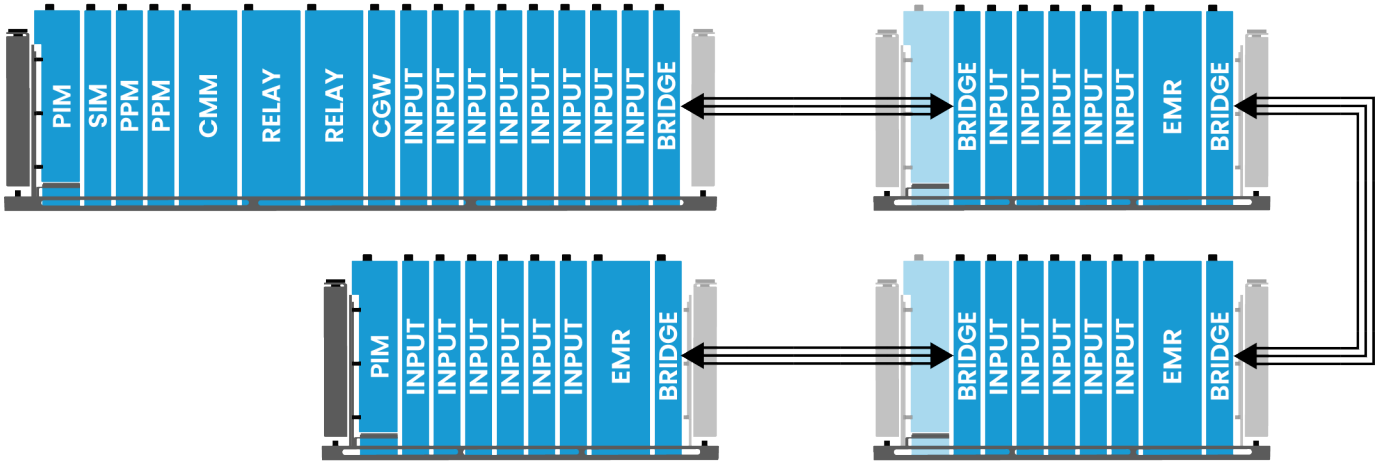

Figure 3: Linear Topology

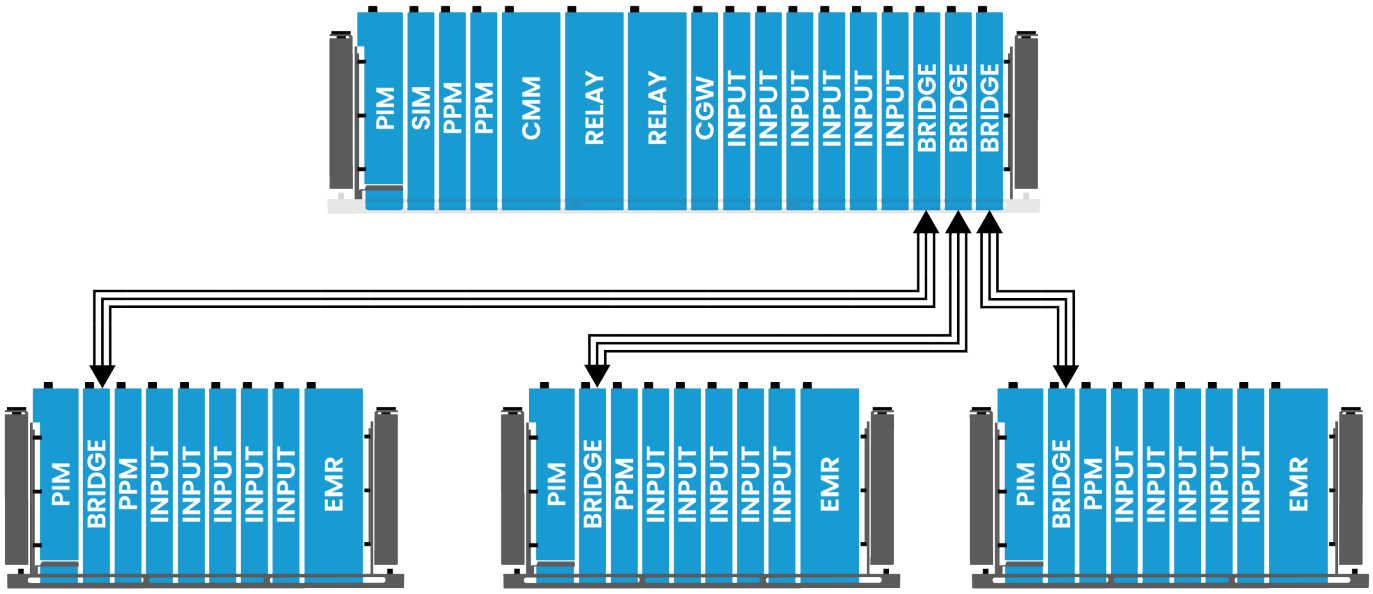

Figure 4: Star Topology

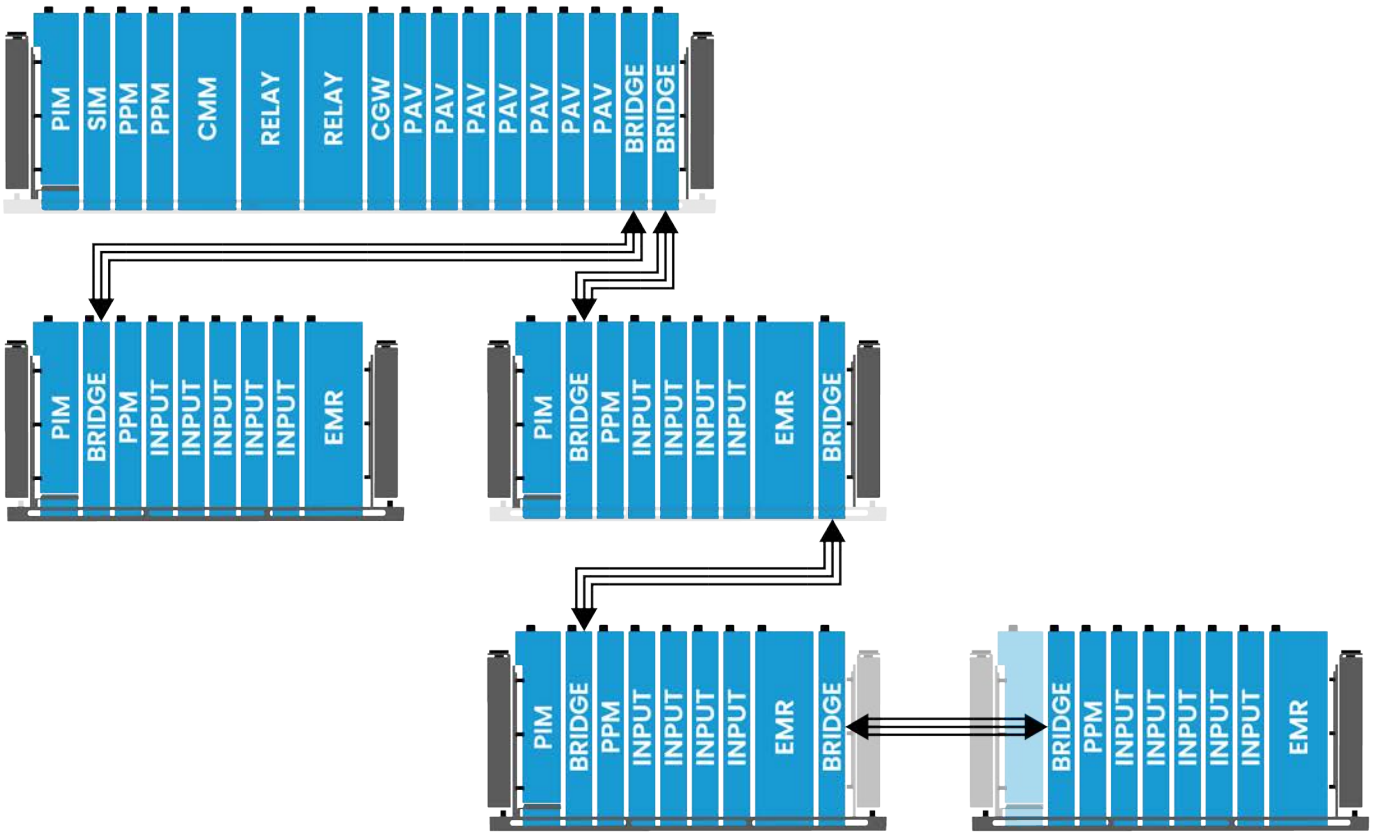

Figure 5: Combined Topology

Chassis connections that create a loop in the topology are not allowed.

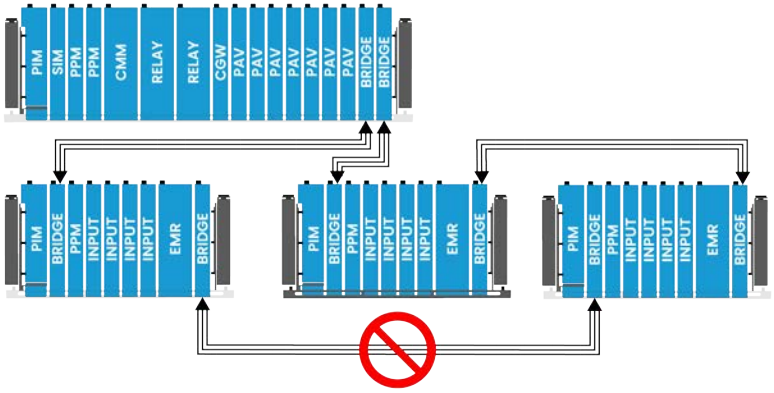

Figure 6: Avoid Loop Backs

4. Typical Configuration

There are several typical layouts that can be created using the bridge modules.

Marshalling Cabinet

The system can be set up with a marshalling cabinet containing all input modules, and then routing the signals to main monitoring system using the bridges. This is an improvement over current methods where individual cables have to run for each transducer from the marshalling cabinet to the main system.

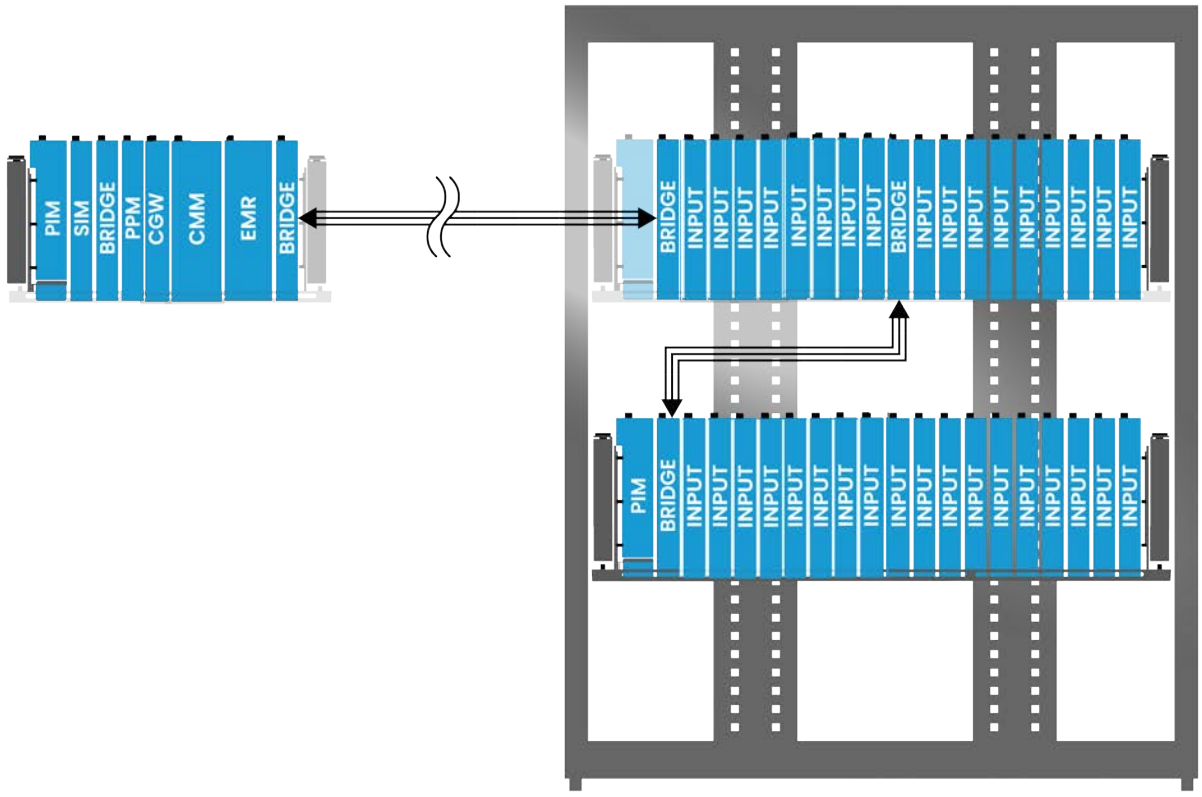

Figure 7: Marshalling Cabinet

Centralized Functions

Another useful deployment method is to centralize several functions in a single chassis in order for sharing amongst several machines. The System Interface Module (SIM), Communications Gateway (CGW), and Condition Monitoring Module (CMM) can be in a single chassis with dedicated chassis with inputs, outputs, and processing for each machine.

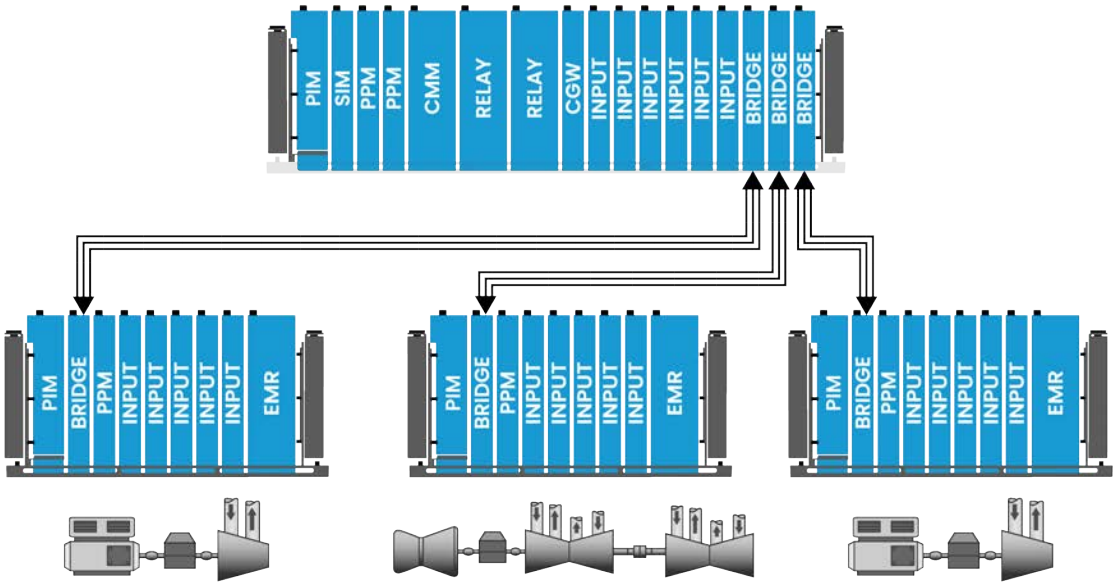

Figure 8: SIM, CGW, and CMM Shared Functions in the System

5. Restrictions

The primary limitation on the number of chassis that can be bridged together is due to the amount of data that can be supported by the system. This is primarily governed by the number of dynamic vibration channels enabled. The limit is approximately 48. This can vary based on the number of other input channels.

The other performance restriction is that for each bridge, there is a 2msec (TBD) delay in transfer of the data between the chassis. This is a small delay versus the minimum Alarm Time Delay of 100msec and the delays in signal processing. For most alarming related use cases, the delay is inconsequential. The data is time stamped at the source, so the delay due to the bridge does not affect data collection and correlation between transducers. The processing modules correlate the data between channels by buffering the first data until the last data is received .

6. Fault Modes

This section discusses the different fault modes that can occur with bridges and what the impact is to the system.

Cable Faults

The system has three cables between the two chassis that are being bridged. As long as a single cable is connected data will flow and the bridge between the two chassis is intact. When the system detects the loss of a cable it will indicate that the Bridge modules have a severity 3 fault. Severity 3 is used to indicate that there is a problem, but the system is still fully functional. If there is a protection path extending across the bridge, the system will also indicate a Protection Compromised status. The protection path is still functional, but its fault tolerance has been reduced.

If all of the cables are faulted, the Bridge module will indicate that there is a severity 4 fault. Severity 4 is used to indicate that there is a fault that affects the operation of the module. If there is a protection path extending across the bridge, the system will also indicate a Protection Fault status. The protection path is no longer operating as configured.

Bridge Module Faults

If one of the two bridge modules has a major fault (severity 4), then the bridge functionality may be lost. The Bridge Module will indicate that it has a severity 4 fault, and it is Not OK. If there is a protection path extending across the bridge, the system will also indicate a Protection Fault status. The protection path is no longer operating as configured.

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