Rule 1: There must be only 1 message path between any two BACnet devices on an internetwork. No communication loops are allowed.

This means that for any two devices in a BACnet network, there should be a single, clear path for messages to travel from one device to the other.

This is to ensure reliable communication and prevent data packets from looping endlessly within the network, which can lead to network congestion and degradation of system performance.

Why This Rule Is Important:

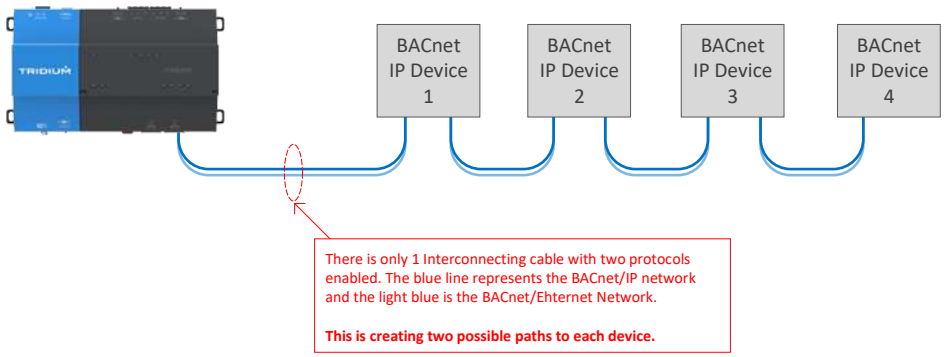
- **Prevents Data Loops:** Without this rule, it's possible for data to circulate endlessly between devices if there are multiple paths and no mechanism to prevent looping. This can overwhelm the network and disrupt communication.
- **Ensures Reliable Communication:** By having a single path, messages are less likely to be lost, and devices can communicate more reliably.
- **Simplifies Network Management:** A network with a clear, loop-free topology is easier to manage and troubleshoot. It reduces the complexity of understanding how data flows between devices.

Example – Misconfiguring Multiple BACnet Device On The Same LAN:

In this example both BACnet/IP and BACnet/Ethernet have been enabled.

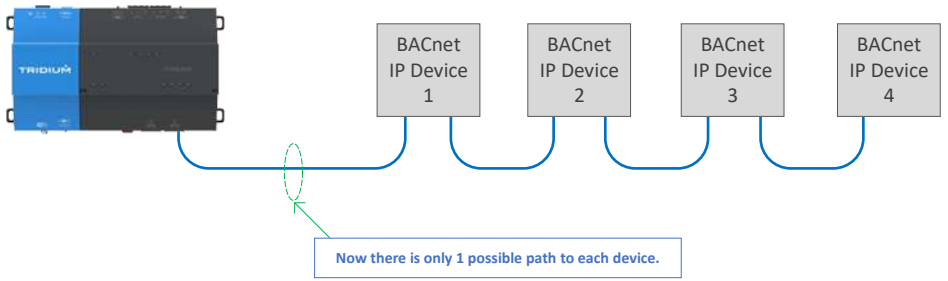
- **BACnet/IP:** Allows BACnet communications over an IP network.
- **BACnet/Ethernet:** Enables BACnet communications over traditional Ethernet.

When both are enabled on devices within the same LAN, there's a risk of creating parallel paths for data to travel between the same two points, which can result in communication loops.



Example – Correct Configuration:

In this example BACnet/IP has been enabled



Rule 2.1: A BACnet router must exist between two BACnet networks (different network numbers) for BACnet messages to pass between the devices on the two networks. This applies to any link-layer types.

This rule is crucial for facilitating communication **between** different BACnet networks. BACnet networks are identified by **unique network numbers**. When devices on different BACnet networks need to communicate, a BACnet router is required to pass messages between these networks, regardless of the underlying physical medium or link-layer protocol (e.g., Ethernet, IP, MS/TP).

Why This Rule Is Important:

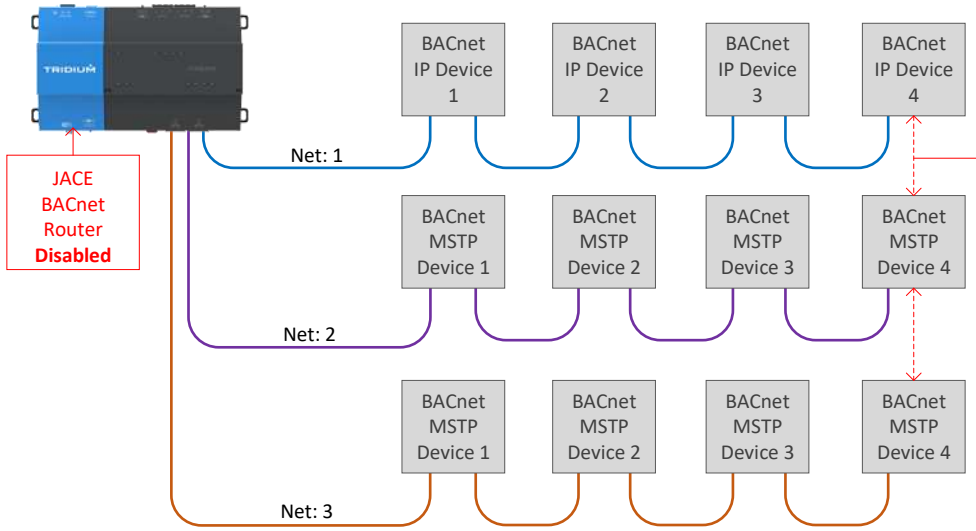
- **Facilitates Inter-network Communication:** The rule ensures that BACnet devices on different networks can communicate with each other, expanding the reach.
- **Network Segmentation:** It allows for network segmentation, which is important for organizing a building's network infrastructure into manageable, secure, and efficient sections.
- **Flexibility and Scalability:** By supporting routers, BACnet can adapt to various network topologies and scales, from small buildings to large complexes with multiple network segments.

Rule 2.2 Shows a more advanced setup BACnet routing between JACE controllers.

Within any given internetwork, each BACnet network must have a unique network number, from 1 to 65534.

Example – BACnet Routing Disabled – Isolation of networks:

If routing was disabled in a BACnet system where multiple networks (with different network numbers) are present and need to communicate with each other. They would not be abled to. In this example the BACnet router is the JACE however this could be a BACnet router device.



No Link between networks:

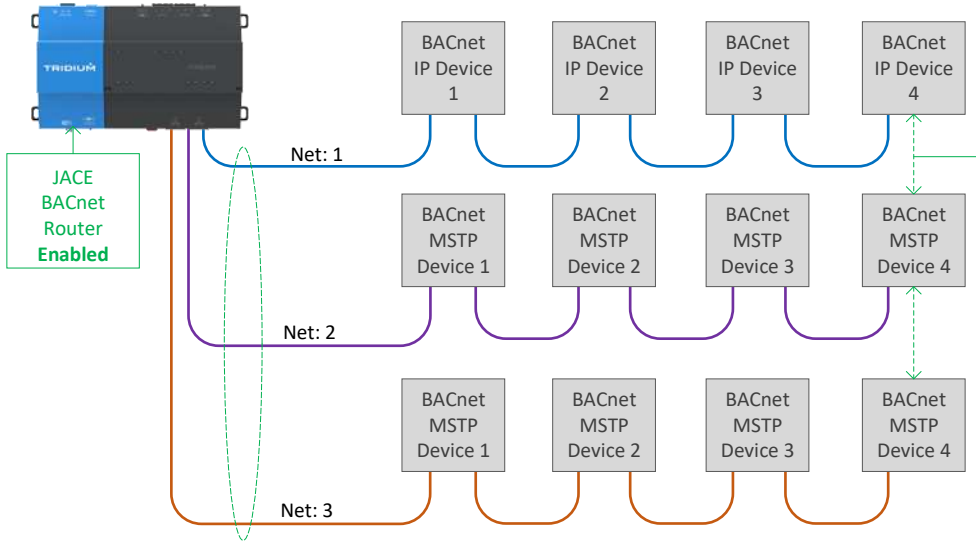
Whilst this set-up will still work for most use cases. Sometimes we need BACnet devices the inter-network.

This is not possible in this example because the JACE which is acting as the BACnet router has its routing disabled.

Devices on different networks cannot talk directly to one and other.

Example – BACnet Routing Enabled:

In this example the JACE operates as a BACnet router, facilitating communication between the connected networks. If a station has Ethernet, IP, and MS/TP ports enabled, it acts as a BACnet-to-BACnet/IP router, bridging between these network types.

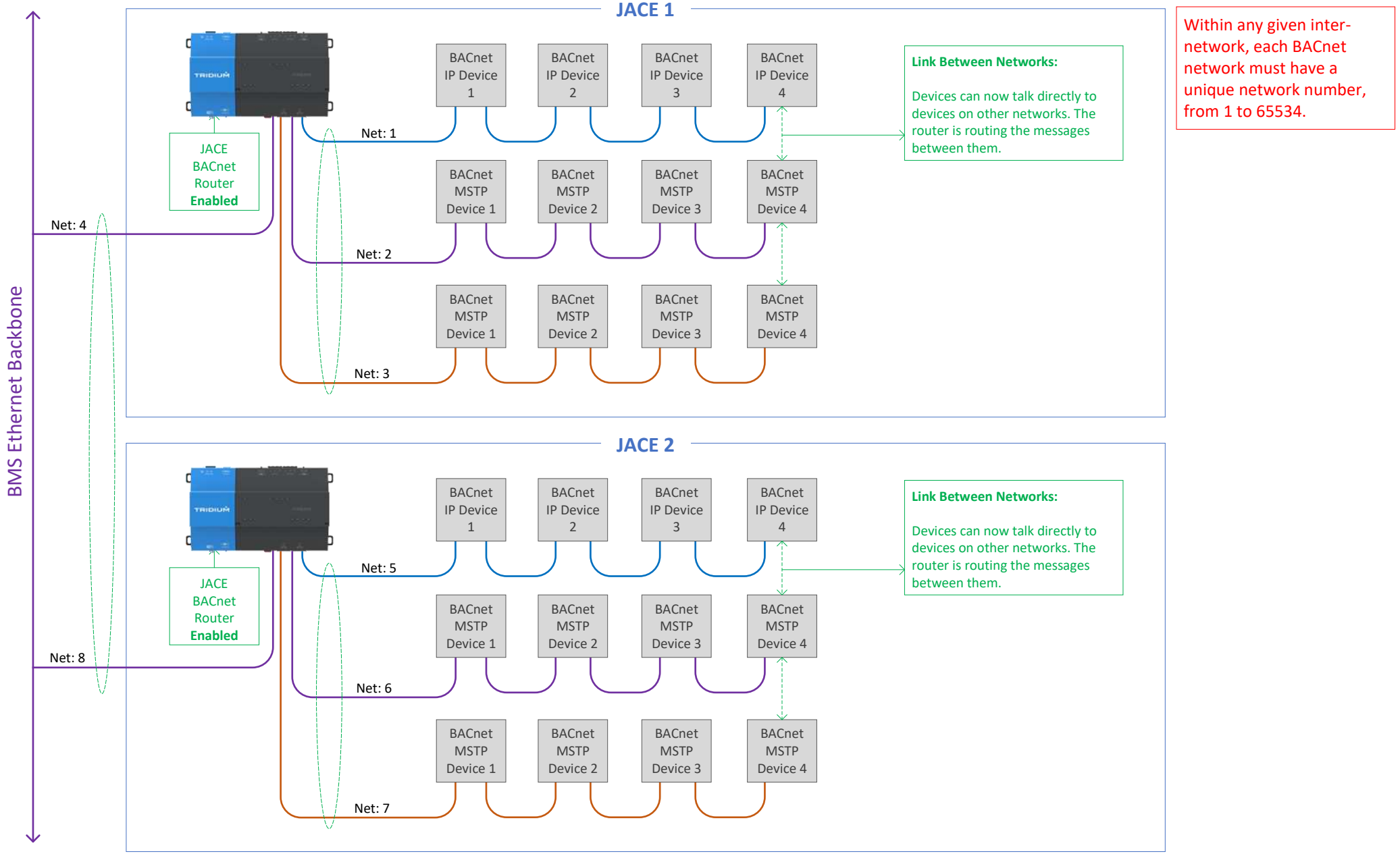


Link Between Networks:

Devices can now talk directly to devices on other networks. The router is routing the messages between them.

Example – BACnet Routing Enabled – Routing Between JACE/s (Inter-network) :

In this example each JACE operates as a BACnet router on the **same subnet.** Each JACE has two ethernet ports, the primary port is used by our BACnet/IP network and the secondary port is connected to our BMS Ethernet backbone. The BACnet router enabled is now routing all our devices BACnet-to-BACnet/IP, bridging the network types and the two JACE/s together.
Now devices from one JACE can be discovered in the other and these devices can talk directly to eachother.



Within any given inter-network, each BACnet network must have a unique network number, from 1 to 65534.

Example – BACnet BBMD Routing Enabled – Routing Between Different Subnets :

BACnet/IP supports the use of BBMDs (BACnet/IP Broadcast Management Devices) to facilitate communication across multiple IP subnets. A BBMD is crucial in environments where BACnet/IP networks span more than one IP subnet. It manages the delivery of BACnet broadcast messages, which are essential for device discovery and communication within the network.

Importance Of BBMD's:

- **Cross-Subnet Communication:** BBMDs enable BACnet/IP devices located on different IP subnets to communicate, overcoming the limitation of standard IP routers that block globally broadcast messages.
- **Broadcast Message Management:** They handle the forwarding of broadcast messages like Who-Is and Who-Has across subnets, ensuring that devices can discover each other and communicate effectively.

Operation Of BBMD's:

- **Broadcast Distribution Table (BDT):** Each BBMD maintains a BDT, listing the IP addresses and distribution masks of all BBMDs within the network. This table ensures that broadcast messages are distributed across all subnets effectively.
- **Foreign Device Table**: This is used by the BBMD to track devices from other subnets that have registered with it, allowing these "foreign" devices to participate in the local subnet's broadcast domain.

Configuration Requirements:

- **One BBMD per Subnet:** Each IP subnet with BACnet/IP devices requires exactly one BBMD to manage broadcast messages efficiently.
- **Network Number Consistency:** In a single BACnet/IP network spanning multiple subnets, all host stations on different subnets should use the same network number for their associated IP Port. Unless being used as an internetwork.