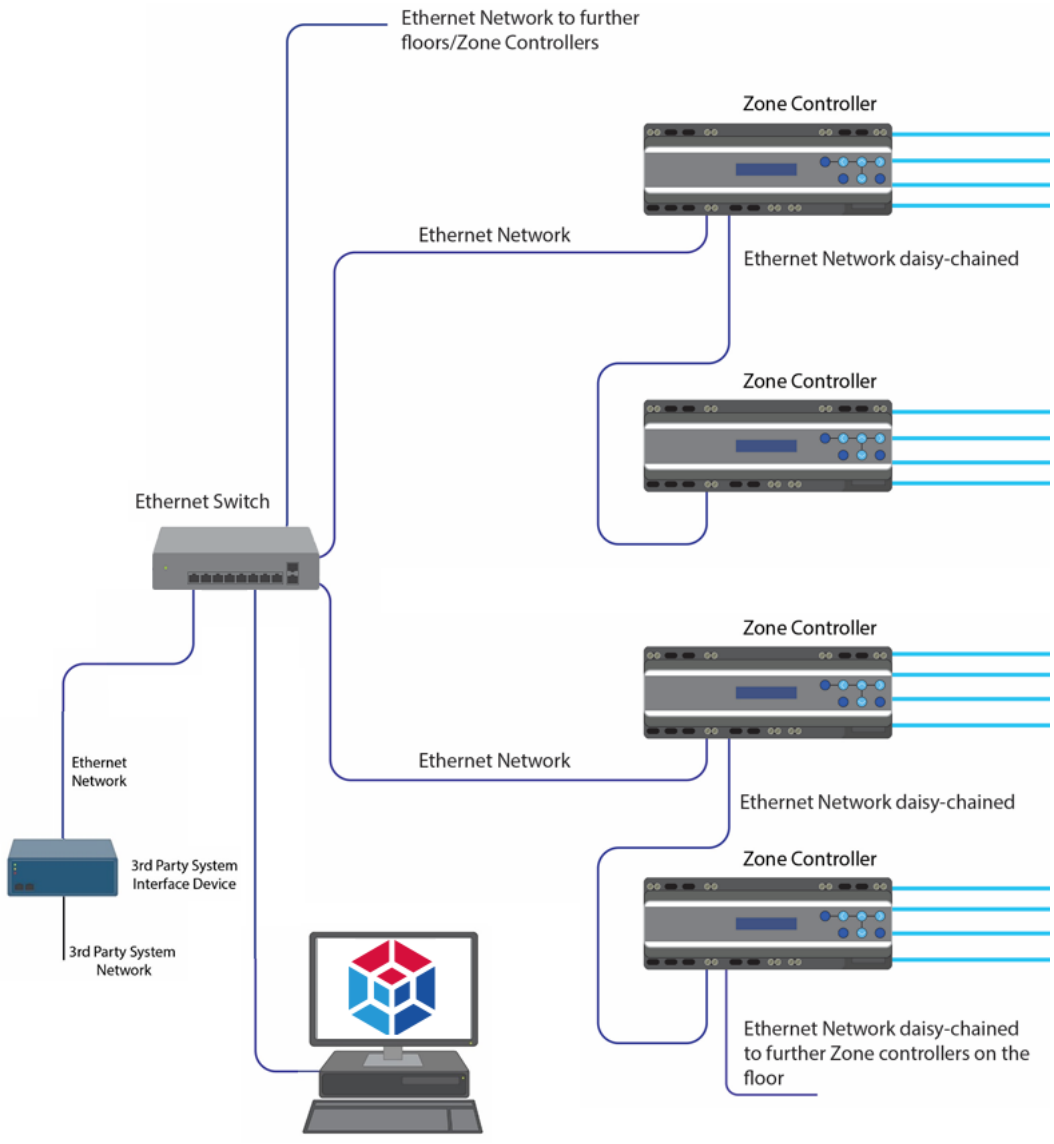
1 Introduction

This Application Note discusses networking concepts relevant to RAPIX systems.

Various high-level components of a RAPIX system use or require an Ethernet network to inter-communicate:

- RAPIX Software
- Zone Controllers
- eHubs (optional)
- Third-party systems (e.g. EisBaer SCADA, Modbus, BACnet gateway)
- External servers (e.g. DNS and NTP)



High-level components of a RAPIX System

2 Concepts

2.1 Ethernet Switch

An Ethernet Switch connects devices together to allow them to communicate with each other. Devices, including other Ethernet Switches, are plugged into the "ports".

2.2 Daisy-Chaining

Zone Controllers contain a two-port switch. This allows small networks of Zone Controllers to communicate without the need for an Ethernet Switch.

Connecting Zone Controllers in series is called "Daisy Chaining". It is recommended that no more than three Zone Controllers are connected together this way.

2.3 IP Address

An Internet Protocol address (IP address) is a numerical label assigned to each device connected to a computer network that uses the Internet Protocol for communication.

Internet Protocol version 4 (IPv4) defines an IP address as a 32-bit number. The newer version of IP (IPv6), uses 128 bits for the IP address. RAPIX system products do not use IPv6 addresses.

IPv4 addresses are usually represented in dot-decimal notation, consisting of four decimal numbers, each ranging from 0 to 255 (called "octets"), separated by dots, e.g., 172.16.254.1.

All devices within a RAPIX system must have static IP Addresses. This ensures the address of each device never changes and is known to all other devices in the system. It is important to make sure there aren't two devices with same IP address.

2.4 Subnets

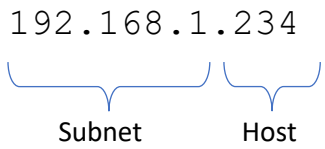
IP networks are divided into subnetworks. For this purpose, an IP address is considered to have two parts: the network prefix in the high-order bits and the remaining bits are called the host identifier. The "subnet mask" determines how the IP address is divided into network and host parts.

A common means of showing this is called CIDR notation, which has the IP address is followed by a slash and the number (in decimal) of bits used for the network part, also called the routing prefix. For example, an IPv4 address and its subnet mask may be 192.0.2.1 and 255.255.255.0, respectively. The CIDR notation for the same IP address and subnet is 192.0.2.1/24, because the first 24 bits of the IP address indicate the network part.

The most common subnet mask values are 255.255.255.0 and 255.255.0.0 and their usage is described below:

Subnet Mask 255.255.255.0

The first 24 bits (the first three octets) of a device's IP Address are its subnet. For example:

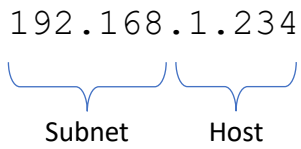


Devices on different subnets will not communicate with each other. For example:

- 192.168.1.234 and 192.168.1.5 will be able to communicate
- 192.168.1.234 and 192.168.66.5 will not communicate

Subnet Mask 255.255.0.0

The first 16 bits (the first two octets) of a device's IP Address are its subnet. For example:



Devices on different subnets will not communicate with each other. For example:

- 192.168.1.234 and 192.168.66.5 will be able to communicate
- 192.168.1.234 and 192.200.66.5 will not communicate

2.5 Private Addresses

Computers and IP devices not connected to the Internet do not need to have globally unique IP addresses. These private networks are widely used and typically connect to the Internet with network address translation (NAT), when needed.

Three ranges of IPv4 addresses are reserved for private networks. These addresses are not routed on the Internet and thus their use need not be coordinated with an IP address registry. Any user may use any of the reserved blocks for non-internet connected (private) networks.

All devices in the RAPIX system normally have a static IP Address in one of these private address ranges.

Name	CIDR block	Address range	Number of addresses
24-bit block	10.0.0.0/8	10.0.0.0 – 10.255.255.255	16777216
20-bit block	172.16.0.0/12	172.16.0.0 – 172.31.255.255	1048576
16-bit block	192.168.0.0/16	192.168.0.0 – 192.168.255.255	65536

2.6 Link-Local IP Addresses

To solve a problem of directly connecting two devices, IPv4 supports Link-Local addresses, using a process called AutoIP. The address block 169.254.0.0/16 is defined for this special use. These addresses are only valid on the link to which a host is connected.

For example, a Zone Controller with a link-local address will only be able to communicate with something that is connected directly to it.

If a device has not been assigned a static IP Address or a dynamic IP Address (from a DHCP server), it will automatically assign itself a random link-local address.

2.7 VLAN

A VLAN is a group of devices on one or more LANs that are configured to communicate as if they were attached to the same wire. VLANs are frequently used in buildings to separate services to prevent them from interfering with each other, even though they are coexisting in the same hardware infrastructure.

2.8 Gateway

In a home or small office environment, the default gateway is a device, such as a DSL router or cable router, that connects the local network to the Internet. It typically serves as the default gateway for all network devices.

Enterprise network systems may require many internal network segments. A device wishing to communicate with a host on the public Internet, for example, forwards the packet to the default gateway for its network segment. These devices may use more complex arrangements, such as routers, to link to devices on an adjacent network, one hop closer to the public network.

2.9 DNS

DNS, or the Domain Name System, translates human readable domain names (for example, www.amazon.com) to machine readable IP addresses (for example, 192.0.2.44). This work is performed by a DNS Server.

2.10 NTP

The Network Time Protocol (NTP) is a networking protocol for clock synchronization between computer systems.

If a RAPIX system is performing time-related tasks (i.e. schedules), it requires an accurate time source. RAPIX devices must be configured to use an NTP server to maintain the time accurately. Two main options are available:

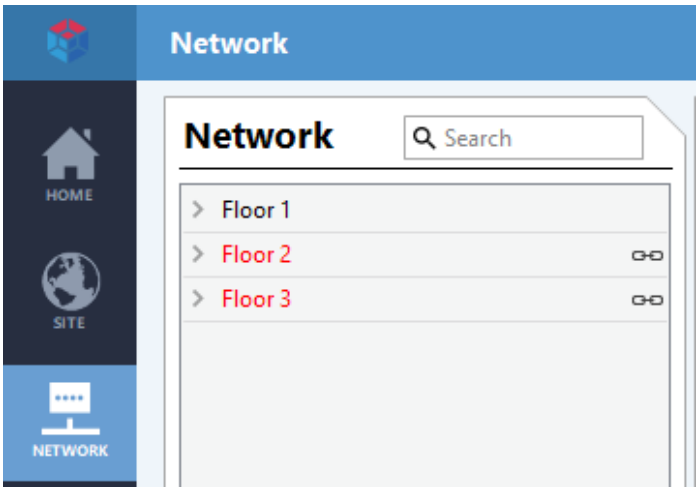
- Public NTP server (requires a connection to the Internet)
- Private NTP server (common in commercial environments)

In both cases, the address of the NTP server must be set in the Zone Controllers and eHubs.

Refer to the RAPIX Schedules App Note for additional details of NTP usage.

3 RAPIX Software communicating with Zone Controllers

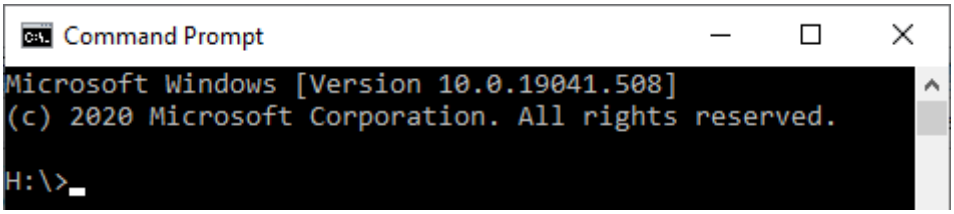
When the RAPIX Integrator software is running, a successful connection to a Zone Controller is shown with a link icon:



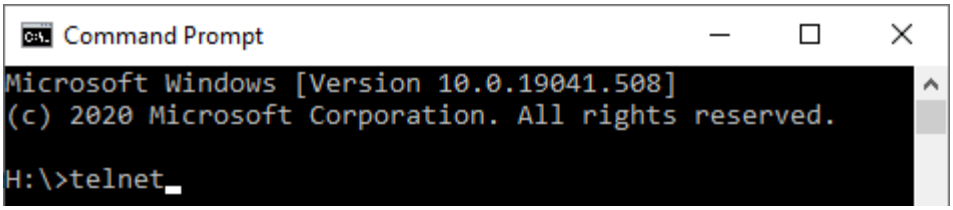
RAPIX Integrator Showing Floor 2 and 3 connected, but not Floor 1

If a Zone Controller is not communicating, the simplest method to manually test the connection between the computer running the RAPIX software and a Zone Controller is to open a TCP/IP connection. This can be done as follows:

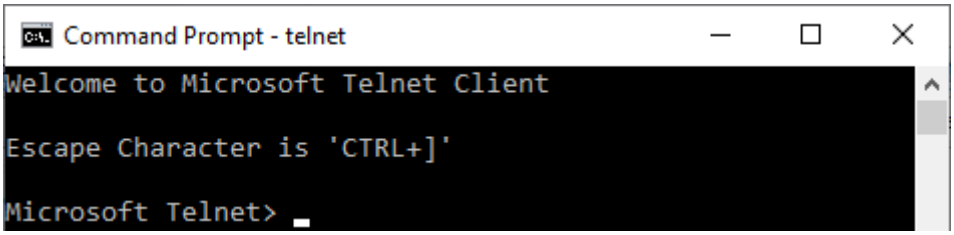
1. Open a command window.



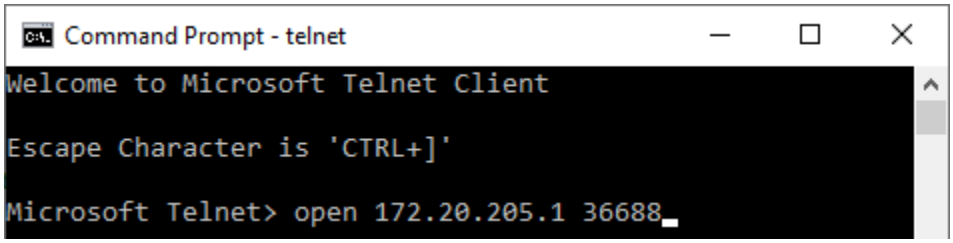
2. Type "telnet" (without quotes) and press the Enter key to start a Telnet session.



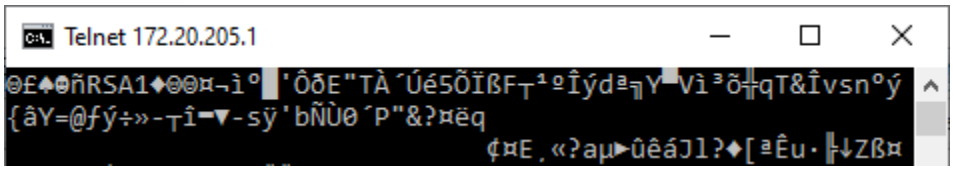
3. The telnet command prompt will be shown:



4. In the telnet session type "open 192.168.1.234 36688" (Without quotes, and use the IP address of the Zone Controller)

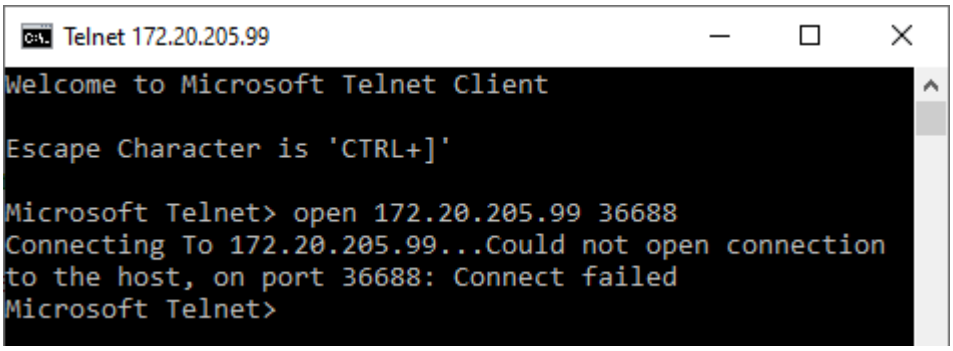


5. If the connection is successful, something like this will appear in the telnet window:



These random characters mean it's an encrypted but successful connection.

A connection failure will look like this in the telnet window:



6. Close the telnet window.

3.1 Firewall

If step 5 above indicated a successful TCP/IP connection, then there is a Zone Controller at the IP Address and it is able to communicate with the PC.

If the RAPIX Integrator software is not able to communicate with the Zone Controller, temporarily disable the firewall on your RAPIX Integrator PC and then try the software again. If you then see it connecting successfully to Zone Controllers, you will then need to look for the firewall rules causing these connection issues and remove or modify them.

4 Zone Controller Mesh

Zone Controllers communicate with each other using an encrypted channel with a TCP mesh network.

Controllers automatically discover and link to other controllers in the project to ensure complete connectivity – any controller can communicate with any other controller irrespective of project size. All controllers must be in the same IPv4 subnet.

Controllers communicate with each other using TCP port 36690. This should normally have connectivity in IP networks. This port may need to be opened if blocked in a managed switch.

The Zone Controller mesh generally uses considerably less than 1 MB/s.

5 Zone Controller Menu

The Zone Controller menu can be used to check various aspects of network connectivity.

Menu Item	Function	Comments
1.12.1	Clients Connected	There will be one client if RAPIX Addressing/Integrator is connected plus one client for each third-party connection.
1.12.6	Message Rate	This is the rate of messages between Zone Controllers. It will be typically less than one message per second for a very small site up to tens of messages per second for a large busy site.
1.12.7	Controllers Observed	This should be the number of Zone Controllers in the site, minus one.
1.12.8	NTP	This can be used to test that the NTP is working correctly.
3.1	Ethernet Connected	This shows whether the Zone Controller is connected to an Ethernet network of some type.
3.2	IP Type	This shows whether the IP Address is assigned by a DHCP server, or it is static. It needs to be static.
3.3	IP Address	This is the IP V4 address
3.4	Subnet Mask	This is the subnet mask. Refer to a previous section for explanation.
3.5	Gateway	This is the IP Gateway
3.6	DNS 1	This is the primary Domain Name Server
3.7	DNS 2	This is the secondary Domain Name Server
3.8	MAC	This is the Zone Controller MAC Address
3.9	Edit IP Settings	Press OK to edit the IP settings

Change History

Rev	Date	Updated By	Comment
1	17 Sep 2020	DS	First Release
2	26 May 2026	AQ	Update details of controller mesh.

Contact Information

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