Technical Brief
AN261 Rev A3

Remote Autonomous Zone Nodes (RAZN)
Communications and Meshing RAZNs together

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There are many different versions of the RAZN. This Application note shows a list of all different versions with different ***Input*** and ***Output*** (IO) features.

Overview

RAZNs can ***Mesh Together*** using a long-range wireless modem built into it, or mesh them together using RS-485 serial ports.

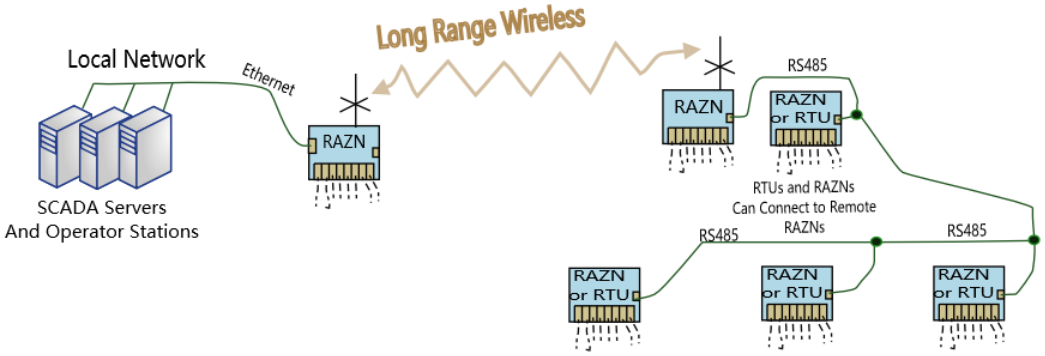
Connecting RAZNs to your network

With this RAZN technology, you can make long-range systems to cover large areas and/or communicate to very remote devices in remote areas.

SCADA systems with RAZNs meshed over to many more low-cost RAZN RTUs up to 20 extra.

SCADA Server is the Master Controller to control the RTUs that are RAZNs.

A. Masters Connects directly to Main RAZN RTU with internal Radio Modem
B. Master RAZN connected to Local Network has built-in long-range Radio Modem to communicate with other Remote Autonomous Zone Nodes.
C. Other RAZNs meshed to a RAZN using RS485 wires are *low-cost* because they have no RF and no Ethernet.

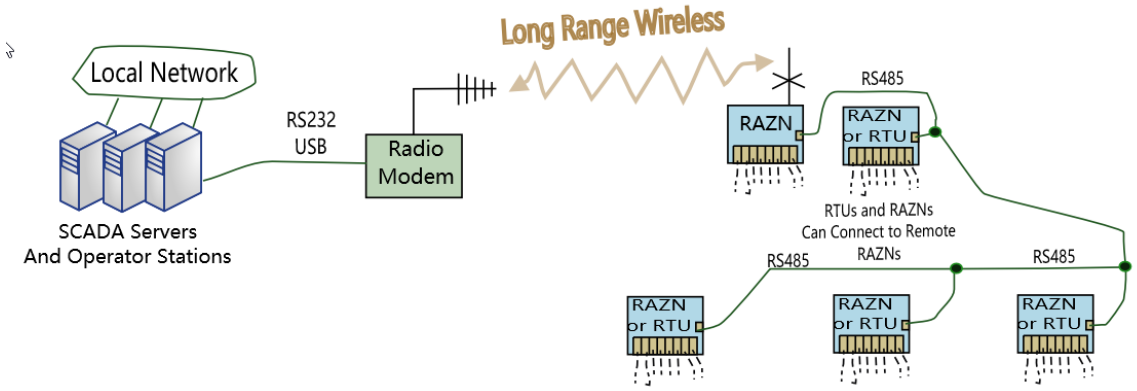


RS485 can communicate up to 32 Driver/Receiver RAZNs. The wired RS485 line length max data rate is typically:
400 Feet = 122m 1 Mbits/sec 4000 Feet = 1219m 100 kbits/sec

Wireless SCADA system communicating with RAZNs wired together.

SCADA Server is the Master Controller

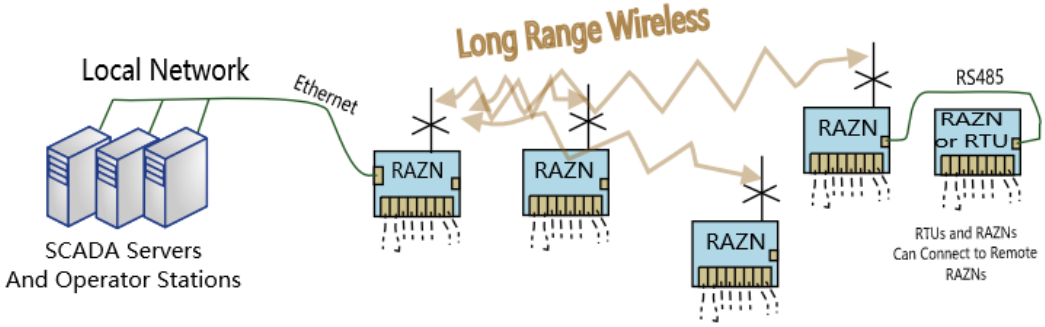
A. Master Controller connects directly to Radio Modem's serial port or the a Radio Modem with an Ethernet or USB port..
B. Main RAZN RTU has built-in long-range Radio Modem to communicate with the Master Controllers.
C. The RS485 RAZNs meshed to the Main wireless RAZN are low cost because they have no RF and no Ethernet.



SCADA systems Ethernet connected to a main RAZN RTU meshed over to many more low-cost RAZN RTUs could include even hundreds of RAZNs.

SCADA Server is the Master Controller

A. Masters Connects directly to Main RAZN. The RV-N55-EA version is TCP/IP Ethernet communication link, with no IO terminals.
B. Main RAZN RTU has built-in long-range Radio Modem to communicate to other RAZNs in a remote area.
C. The many other RAZNs mesh to the Main RAZN vial long-range RF modems inside the RAZNs. Some RF meshed RAZNs can also connect wired RS485 to additional RAZNs in their area.



A system like this could have many Master Controllers or just one Master Controller, and hundreds or thousands or RAZNs to control and monitor thousands of things. And Each RAZN can autonomously control some things also and get SCADA messages from the Master.

Universal Wireless OEM Radio Connector (UWORC)

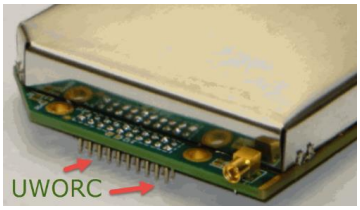
The UWORC radio interface connector, within the RAZN, is setup to utilize Raveon's Data Radio Modems. If you want to have a wireless interface, order the RAZN with a radio or install a radio in your RAZN. This section describes how the RAZN utilizes and configures the radios inside the RAZN if they are installed.

For technical information about UWORC interfaced connector see *Application Note AN224*.

The M6 or M8 radios used with the RAZN should have software version H8 or above in them.

UWORC Interface Features

1. DC Power Input and 3.3V DC output.
2. Asynchronous serial Data with CTC and RTS
3. 3 Digital General Purpose input/output pins
4. Device enable pin to control DC power



5. Analog RSSI output signal
6. The I/O connector is a 20-pin header, 2 mm pin spacing.

Radio Modem Features

Raveon's data radio modems have many features. For use in this RAZN product, they should be set to default setting and some radio modem features must be enabled as listed here. The RAZN utilizes the WMX communication protocol to talk to the radios and the serial interface is typically run at 38400 baud. Reset radios do default with the AT&F command. Contact Raveon if you'd like Raveon to configure the radios and/or include a radio within your RAZN product when you acquire it. These features must be enabled before putting the radio modem in the RAZN:

Enable WMX feature: **WMX 1**
IO mode is digital mode 5: **ATIO 5**
Serial Port baud Rate is 38400: **ATBD 6**

For your system, set the radio Frequency and over-the-air baud rate the way you want it before plugging in the radio module.

Raveon's Data Radio modems have GPS tracking and TDMA features. If a modem with GPS is used, the NMEA output data can be output from this product on a communication port. The ATNM command.

Communicating with the Radio modem inside the RAZN

There are command methods to change radio modem settings in the radio modem model used within the RAZN. Commands to talk to the radio inside the RAZN are the same commands as the radio modem uses as described in the modem's user manual.

To execute commands to the internal radio via the RAZN command interface, the radio modem commands must start with a **$**. See the radio's User Manual to see all commands in the Data Radio Modem.

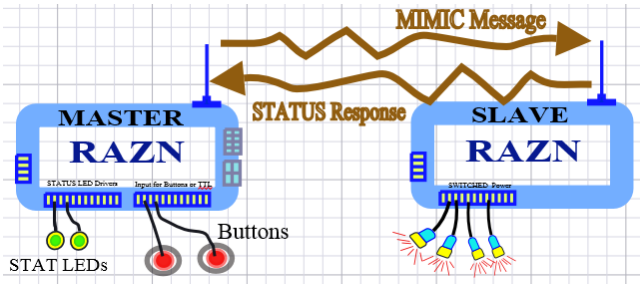
For example: to set the frequency of a radio modem, the **ATFX** command works. If the radio modem is within the RAZN, enter **$ATFX** to have the RAZN pass the **ATFX** command to the internal Radio.

External Radio Modems for Use with the RAZN

The RAZN has an RS-232 serial port option. It is referred to as the C2 COMM interface. SCADA commands can come in or be sent out this C2 serial port. Any conventional data radio modem with an RS232 serial port could be added externally to the RAZN if you wanted an external radio.

MIMIC Mode in the RAZN

MIMIC Mode Feature.



The **MIMIC** feature in a RAZN has the Master RAZN automatically send input status to Slave RAZN, and the Slave RAZN that receives output the received bit status onto its outputs.

The Slave re-transmits the status of its outputs the Master MIMIC RAZN so the Master will the status on its LEDs or on its output terminal

MIMIC another it will

back to display pins. It can also be setup to output the status it receives back from the Slave to one of outs output terminal pins.

The MIMIC message is sent using the SCADA protocol used in the RAZN.

There are three aspects to the MIMIC mode:

1. The Master RAZN sends the status of its digital inputs. This is enabled with the **MIMIC X Y** command.
2. The Slave RAZN or RTU receives the MIMIC message over-the-air or via a communication port, and sets digital outputs to match the input status of the sending Master station.

3. The Slave RAZN will also response back with output status information to the Master so the Master can display the slave's status on status LEDs or synchronize to some Master output terminals.

MIMIC Feature setup commands

The following commands used to setup various features the RAZN has.

		Parameters	Default
MIMIC	**MIMIC X Pc** Setup the MIMIC feature. **X** number of seconds to repetitively transmit status messages. **X**=0 to disable MIMIC mode. **Pc, c** is communication port code to communicate MIMIC messages.	X, Y: 0-64999 The **Pc**: **S**:RS485 port 1 **S1**:RS485 port 1 **S2**:RS232 port 2 **E1**: Ethernet port 1 **E2**: Ethernet port 2 **E3**: Ethernet port 3 **R1**: Wireless link 1	0 disabled
MIMBIT	**MIMBITS XX** Setup the MIMIC bits you want to use. 16 bit hexadecimal number. 0-FFFF (16 bit hex)	XX: 0-FFFF (16 bit hex)	0 (no bits)
MIMRX	**MIMRX XXX** Setup the minimum amount of time a RAZN must receive a MIMIC message in, or it will reset the output bits used in MIMIC mode back to their default reset values. **DEFOUT** sets the default reset bit states used when MIMIC messages fail to come in, and the bits specified in **MIMBITS are the ones that will be reset if a MIMIC message does not come into a MIMIC slave within this xxx time. If set to 0, this default resets will not happen.**	XXX: 0-64900	0 (Doesn't rest)

Meshing RAZNs, RTUs and PLC Outbound Communication Messages

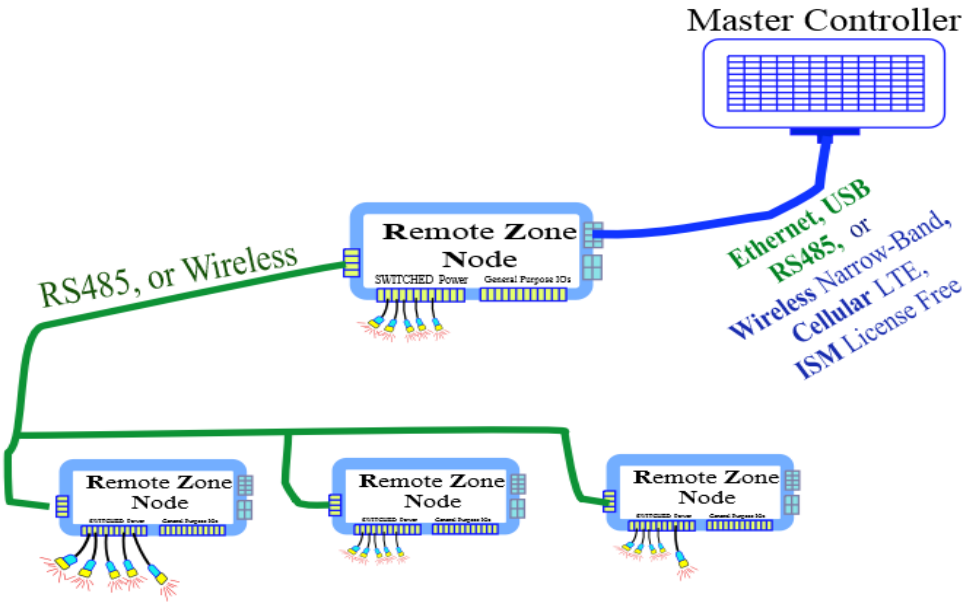
To mesh RAZNs to other RAZNs or conventional RTUs, or PLCs, the following commands are used to configure message forwarding and exchange in the RAZN. This specifies which communication interface should be used to talk to remote devices. The Slave ID code is used to specify the interface to use for the particular slave device or group of devices. The PLCL command is used to Program Local Control messages for remote devices with Slave IDs, and the communication interface used for external PLCL messages is based on the MESID setting. Factory default settings on these are product and version specific. The product's data sheet shows the Factory Default communication settings.

Command	Command Description	Parameters	Factory Default
MESID	**MESID Z MM YY Pc Pc Mesh These SCADA IDs. Z** = A unique Mesh identifier number (1, 2, 3). **MM** is the slave ID to mesh or **mm** and **YY** is the range if IDs to mesh between comm ports **Pc** and **Pc, c** is comm port number, most are 1, if not specified, 1 is the default.. By default SCADA messages to other slaves with IDs 0 – 199 mesh Ethernet with the RS485 serial port. The first **Pc Pc** comm port specified is the primary comm link to the slaved devices with IDs **MM** through **YY**. To disable a particular Mesh: **MESID X N** To mesh all between the Radio Modem and the Ethernet comm port: **MESID 1 R1 E1** See section Meshing RAZNs Together for more information about communication meshing.	**Z** = 1, 2 or 3 **MM** and **YY** can be 0 to 65525 If unused, slaves meshed are ALL. The **c** in **Pc**: **S**:RS485 port 1 **S1**:RS485 port 1 **S2**:RS232 port 2 (HW Option) **E1**: Ethernet port 1 **E2**: Ethernet port 2 **E3**: Ethernet port 3 **R**: The wireless link **R1**: The wireless link 1 **N**: NULL undefined/disabled	1 0 9 E1 S1 2 10 199 R1 E1 3 unused Different versions have different defaults. See their data sheets.

Notes: Changes to these parameters may only be supported via the factory serial port interface.

Meshing RAZNs Together

As mentioned, the RAZNs may be connected with RS-485, Ethernet, Wi-Fi, Narrow-band data radios, LoRa ISM band data radios, and some day soon LTE modems.

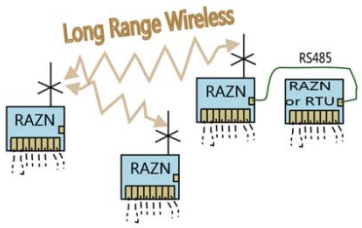


When a command comes into a RAZN, to read a sensor or Control and IO pin, it will do what it is supposed to do, but if the Mesh feature is enabled and the inbound command is not appropriate for the particular RAZN, it will pass the command along to other RAZNs. See the Meshing Commands to setup how your RAZN meshes with other RAZNs or conventional MODBUS RTUs.

So any number of RAZNs can mesh with many others. If wired together, they can cover a almost a full square mile. And they can cover *hundreds* or t*housands* of square miles using Raveon's long-range wireless technology.

The RAZN can run autonomously, and mesh to others in the area. It can to the job without a Master Controller.

One RAZN can measure inputs and send commands to other RAZNs to do what should be done, and as shown on the right, an over-the-air (OTA) message can be passed to another RAZN via RS485.



MESH Nets. For Daisy Chaining or Mesh Networking many RAZNs together, every RAZN monitors messages and can route them appropriately to: wireless, Ethernet, or wired interfaces. Messages can be multiple-meshed over many different RAZNs in the system to Mesh Networks over large areas.

The MESID command is used to setup the slave meshing features.

Each RAZN is assigned a SCADA Slave Address, so when a SCADA message comes into the RAZN, and if the Slave Address in the SCADA message matches the slave address of this RAZN, this RAZN will process it. If you setup meshing features to mesh RTU slave devices, you can have the RAZN pass out the SCADA

message out via one of its many communication interfaces. To specify the Communication interfaces to mesh together, use the Comm Port ID:

S1: Serial Port #1, RS485 serial port. Ok
E1: Ethernet port #1, primary TCP/IP connection. The port number can be configured.
E2: Ethernet port #2, TCP/IP connection. The port number can be configured.
R1: The long range wireless data radio modem inside the RAZN.
That comm number after **S,E,R**, is normally **1**, but where there is a product with multiple comm ports of these same type, 1,2 or others may be used. 1 is the default, so if **E** was specified instead of **E1**, E would be setup as E1.
S2: Serial Port #2, Optional RS232 serial port.

When meshing is setup, which by default SCADA messages with Slave Addresses 0-9 will be meshed from Ethernet to the RS-485 serial port if they come in via a different communication interface. To adjust the meshing via serial ports, use the **MESID** command with the Slave Address ID codes you want to mesh. For example, **MESID 1 22 65 E S** command will configure the RAZN to pass SCAD commands in from Ethernet interface sent to Slaves 22 23, 34, through 65 out over the RS485 Serial port.

To change to wireless RF Meshing: **MESID 1 0 255 E1 R1** command will setup the RAZN to pass out SCADA commands with Slave Addresses that do not match its Slave Address, to the RF Data Radio modem inside the RAZN. The RAZN version used must have the RF data modem option. To configure you RF communication Radio Modem, order it from Raveon the way you want it (Frequency, data rate, power output, ID codes, encryption,…) or you can set it up yourself. See Universal Wireless OEM Radio section describing how to configure your radio. Many RAZN versions use ISM band license-free radios that are factory setup and work well with default settings.

The RAZN can be setup with two different meshing lists. For example, to send out messages from Ethernet connection to slaves 10-19 on the serial port, and 100-225 out the RF data communication interface, enter these commands:

MESID 1 10 19 E1 S1
MESID 2 100 225 E1 R1
MESID 3 …… *There are 1-3 mesh settings available to store in the RAZN. Setup 3 as you want.*

Factory setup defaults are:

MESID 1 0 9 E1 S1 (SCADA Slaves 0-9 are connected to hardware serial port)
MESID 2 10 199 E1 R1 (SCADA Slaves 10-99 are sent out over the air via radio modem)

When a remote RTU or RAZN receives the meshed SCAD command, it may respond, back to the RAZN, and the inbound SCADA data will be passed to the communication interface the sent the SCADA command that was meshed.

When an inbound SCADA message comes into any serial port for some other SCADA device, the SCADA message will be output per the **MESID** settings. And when the SCACA device responds to the message that was sent to it via a RAZN, the RAZN receive the message back, and will pass SCADA message back per the MESID communication interface settings.

If a mesh was defined that you want to disable, the MESID X N command will do this. X is the mesh MESID number, for example, to disable MESHID #1, **MESID 1 N** will disable it.

MSTR command can be used setup communication via a Master Controller communication link and this command can disable or re-enable Auto Comm Meshing to a Remote Terminal Unit (RTU), and RAZNs can be RTUs also. By default settings, Auto meshing is enabled and the Master Communication Interface is Ethernet, it works in default mode as shown below.

SCADA Message Meshing to/from Master Controller and RTUs

Comm. Interface SCADA message into the RAZN	Message Meshed to the RTU SCADA device	Message Meshed to the RTU SCADA device	When the RTU Responds, the SCADA

from master to (Slave ID) or any SCAD message from Slave with (Slave ID)	If Ethernet is Setup as Master Interface	If Auto Comm Meshing	response message is passed back to this Comm. Interface
Ethernet, (5)	*RS-485 out, (05)*	*RS-485 out, (05)*	Ethernet
Ethernet, (7)	*RS-485 out, (07)*	*RS-485 out, (07)*	Ethernet
Ethernet, (13)	*Radio Modem TX, (13)*	*Radio Modem TX, (13)*	Ethernet
Radio Modem RX, (5)	*RS-485 out, (05)*	*RS-485 out, (05)*	Radio Modem TX
Radio Modem RX, (7)	*RS-485 out, (07)*	*RS-485 out, (07)*	Radio Modem TX
Radio Modem RX, (26)	*Ethernet out, (26)*	*Ignored*	Ethernet
RS-485 input, (07)	*Ethernet out, (07)*	*Ignored*	
RS-485 input, (28)	*Ethernet out, (28)*	*Radio Modem TX, (28)*	RS-485 output, (28)

For example, a systems with multiple RAZN RTUs and each RAZN will mesh wired to 3 more RAZNs to control 3X more things, you can setup each main RAZN as shown below:

Example for Multiple RTUS with Multiple Meshed RTUs

Area #1

Set the Main RAZN Slave ID to 10 **SLAVE 10**
Wire 3 RAZNs to the Main RAZN #1
Set the 3 RAZN IDs to 11, 12, and 13
Set the Main RAZN mesh info to RS-485 slaves 11-13 **MESID 11 13 S1**
We'd recommend set it to 11-15 in case some day you want to add more RAZNs.

Area #2

Set the Main RAZN #2 Slave ID to 16 **SLAVE 16**
Wire 3 RAZNs to the Main RAZN #2
Set the 3 RAZN IDs to 17, 18, and 19
Set the Main RAZN mesh info to RS-485 slaves 17-19 **MESID 17 19 S1**

Area #3

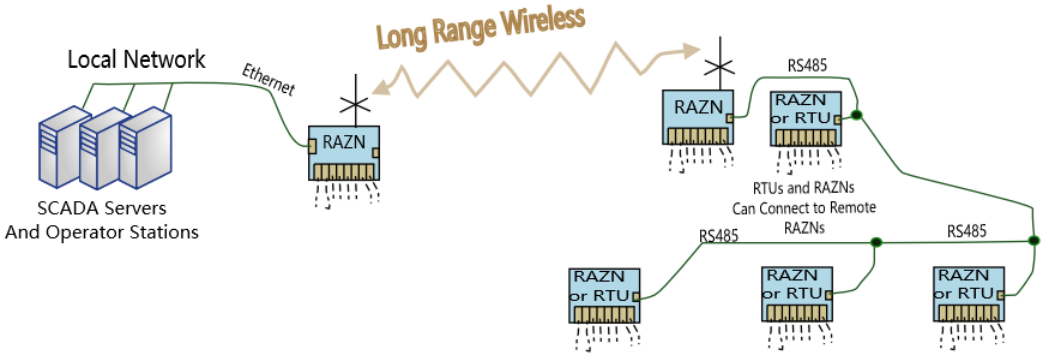
Set the Main RAZN #3 Slave ID to 20 **SLAVE 20**
Wire 3 RAZNs to the Main RAZN #3
Set the 3 RAZN IDs to 21, 22, and 33
Set the Main RAZN mesh info to RS-485 slaves 21-23 **MESID 21 23 S1**

The Programmable Logic Control feature setup with the **PLCL** command can send commands to remote devices. When a logical control event occurs, and the control message is sent to a remote device, the **PLCL** specifies the device to send it to by the Slave ID specified in the **PLCL** command. The communication interface used to talk to that particular Slave ID device, is specified in this MESID feature.

1.1. SCADA systems with RAZN RTU meshed over to many more low-cost RAZN RTUs up to 20 extra.

SCADA Server is the Master Controller

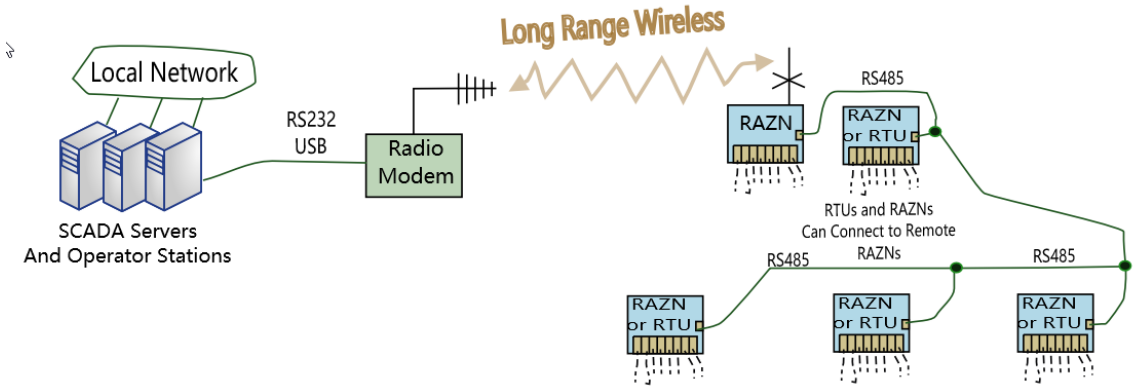
D. Masters Connects directly to Main RAZN RTU with internal Radio Modem
E. RAZN RTU has built-in long-range Radio Modem
F. Other RAZNs meshed to the Main RAZN using RS485 wires are *low-cost* because they have no RF and no Ethernet.



1.2. SCADA systems with RAZN RTU meshed over to many more low-cost RAZN RTUs up to 20 extra.

SCADA Server is the Master Controller

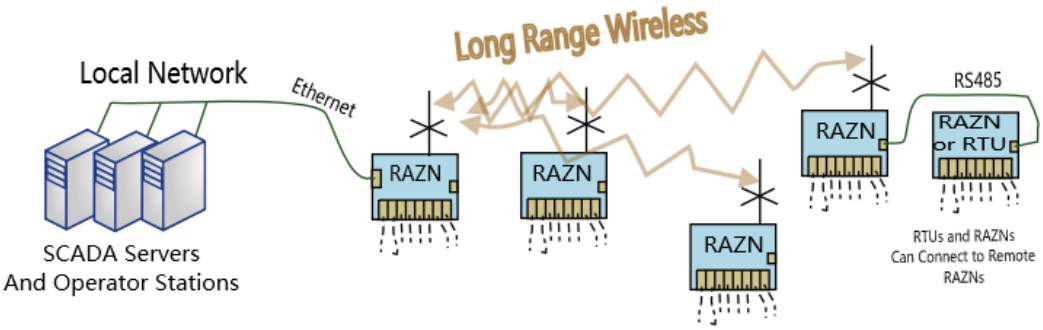
D. Masters Connects directly to Radio Modem serial port.
E. Main RAZN RTU has built-in long-range Radio Modem
F. The RS485 RAZNs meshed to the Main RAZN are low cost because they have no RF and no Ethernet.



1.3. SCADA systems Ethernet connected to a main RAZN RTU meshed over to many more low-cost RAZN RTUs could include even hundreds of RAZNs.

SCADA Server is the Master Controller

D. Masters Connects directly to Main RAZN via Ethernet, IoT, Cellular, WiFi, ….
E. Main RAZN RTU has built-in long-range Radio Modem
F. The many other RAZNs mesh to the Main RAZN vial long-range RF modems inside the RAZNs. Some RF meshed RAZNs can also connect wired RS485 to additional RAZNs in their area.



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