TrackTag
User's Manual

Copyright Notice

Document History

Version	Date	Author	Notes
0.1	1/19/06	Peter Larsson	First Draft
0.2	1/23/06	PCL	Second Draft
1.0	1/24/06	PCL	First Release

Table of Contents

1 TrackTag System Concept

The TrackTag system is designed to accurately pinpoint a vehicle's location within an instrumented perimeter.

Prior to, or shortly after arrival at an impound facility, incoming impounded vehicles will be outfitted with a small active RFID tag (hereafter referred to as "Tag"). Once the vehicle has been "tagged" it can then be placed in the impound lot, whose fence-line perimeter has been pre-equipped with position readers (hereafter referred to as "Reader").

Each Tag will continuously transmit RF signals at a fixed synchronous interval. All Readers within range of these signals will then forward the transmitted data to an on-site Gateway MSR (hereafter referred to as "Gateway"). The Gateway will aggregate data transmitted by the receivers and periodically FTP the information to a central server over the facility's existing WiFi or Ethernet LAN. Once at the server, the RSSI data from the Tags and Readers will be used to calculate the location of the Tag within the impound lot.

In order to determine whether a tagged vehicle has left a given impound facility, each exit shall be equipped with an Exit Reader. When a tagged vehicle passes through the defined exit, the Tag will respond to an exit beacon, resulting in the vehicles position being updated to reflect that it has left the particular facility and is currently "in transit."
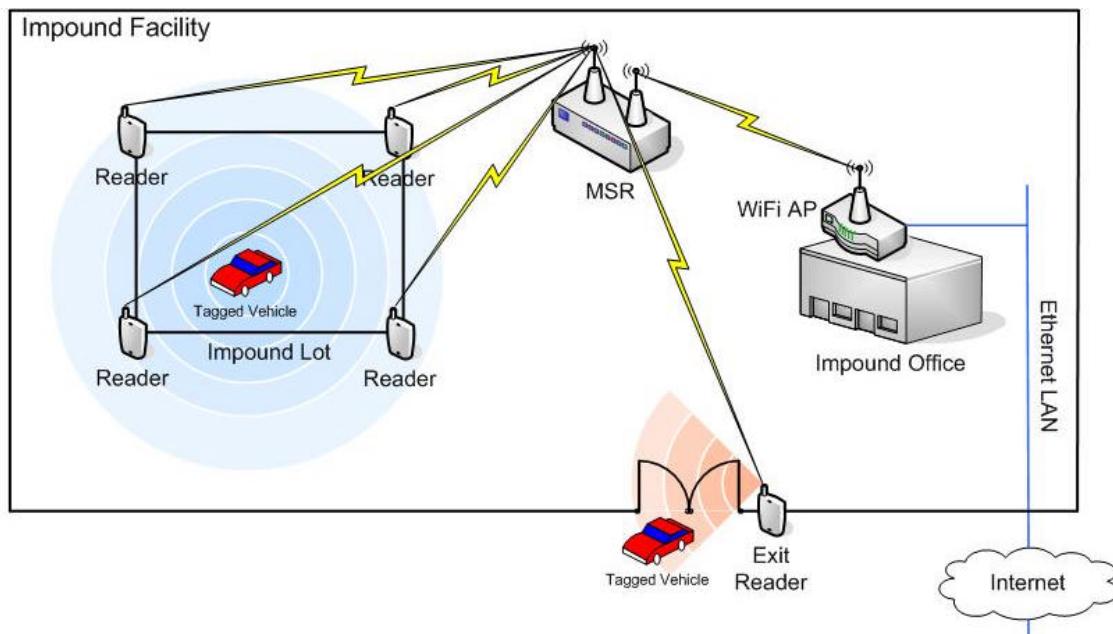
Figure 1 – System Overview

Vehicle location information stored in the off-site server shall be accessible to system users through secure HTTP requests using a standard Web browser (Internet Explorer, Mozilla, Netscape, etc.). Upon request, the location information will be overlaid on a satellite image of the impound lot.

Once a vehicle has been recovered by its owner, sold off, or scrapped, the Tag will be removed from the vehicle and the Tag identification number recycled for use with other impounded vehicles. Tags will be reused across multiple vehicles during their service life.

2 Gateway MSR 5000

2.1 Introduction

The Gateway MSR 5000 serves as an electronic relay between a local area network of 2.4 GHz direct sequence transmitting/receiving devices and the Internet. It requires 110VAC power, a working Internet link, and radio coverage such that it can hear all remote devices. The working Internet link can be either Ethernet running TCP/IP, a WiFi card plugged into the PCMCIA slot, or an analog telephone line capable of supporting a dial-up POTS modem. The Gateway is compatible with the entire suite of SYS wireless products and supports a minimum of 256 transmitters per network.

As depicted in **Figure 1**, the Gateway manages wireless communications of remotely distributed sensor networks, and provides a secure communications bridge to modern computing networks using standard methods and protocols. More specifically, the Gateway's primary functions include:

* Aggregation of wirelessly transmitted data generated by remotely positioned sensor modules. Transmitted information may include sensor data from homogeneous or heterogeneous networks and applications, as well as statistical network and meta (configuration) data.
* Mediation of collected data into a common XML format.
* Routing of data to internal and external systems. In a typical configuration, collected data will ultimately be routed to either the SYS NOC or a customer managed Application Server provided by SYS. However, non-SYS "destinations" are also supported.
* Processing and temporary storage of collected data.

2.2 Specifications

* Enclosure: Nema 4X – Indoor Only
* Dimensions: 11.73" x 6.30" x 15.68"
* Operating Temperature: 32 – 140°F; 0 – 60°C

* Humidity: 0 – 95%; non-condensing
* Power: 1A max. (RMS) @ 115VAC; 40W max.
* Pollution Degree: 2
* Altitude: 6562 ft; 2000m
* LAN: Two 10/100 Mbit Ethernet ports (RJ-45)
* Memory: 128MB Flash

2.3   Gateway Installation: Mechanical

This device is intended to be professionally installed by trained personnel only.

2.3.1 Tools

The following tools are necessary for Gateway installation:
* #1 Phillips screwdriver
* 3/32" precision slotted screwdriver
* Power drill and bits
* Network crimping tool – RJ-45/RJ-11 *(optional)*

2.3.2 Selecting a good mounting location

Selecting a good mounting location is very important for proper operation and ease of installation of the Gateway. A location with proximity to power and radio connectivity to all transmitters (WAP, Readers, and Exit Reader) is required. Verification of radio coverage can be accomplished with the SYS Site Survey Kit. Locations that are easily accessible with the fewest obstructions are best.

The Gateway **must not** be mounted:
* In direct sunlight
* In areas with direct contact to the physical elements
* In areas with direct contact to high pressure water
* On a horizontal surface

The Gateway can be mounted:
* Indoors
* In an open air, but covered space
    ✧ Under awnings, carports, etc.

2.3.3 Mounting the Gateway

Remove all internal shipping material. Be careful not to touch the radio antennas. Please visually inspect the antennas prior to operation.

Mounting hardware can be found inside the Gateway enclosure. Attach the supplied clips to the back of the Gateway in a vertical orientation. Use the supplied hardware to mount the Gateway to a wall or other flat vertical surface. Wood screws, lag bolts, and drywall anchors can all be used to accomplish this, depending on the construction of the mounting surface. The mounting scheme must be able to

accommodate at least 50 pounds of weight. Select the location, mark holes for the fasteners, and attach the Gateway to the wall.

2.3.4 Providing conduit for electrical wiring

The Gateway requires 110VAC for operation. In the case of harsh environments, electrical conduit should be routed from a junction box to the unit. If the installation environment is not exposed to the elements, especially water, then the supplied AC plug will suffice.

2.4 Gateway Installation: Data connectivity

This device is intended to be professionally installed by trained personnel only.

Once the Gateway has been mounted, the Ethernet or Modem connection must be established. Internet access is granted via Ethernet (ETH0), WiFi (PCMCIA expansion slot), or dial-up POTS modem (PCMCIA expansion slot). *It is imperative that the Internet connection be provided before power is applied to the Gateway.*

2.4.1 Provisioning Ethernet/phone connection

If using an Ethernet connection for data export to Xsilogy's data center, one must run shielded CAT-5 cable (terminated at each end with a RJ-45 connector) from Ethernet port #0 (ETH0) on the Gateway to an open port on the facility's LAN (Local Area Network). This LAN must have access to the Internet and the provided port must have permission to transfer files outbound via FTP.

If there is no access to the Internet via the facility's LAN, then a dial-up modem must be used. This method requires a POTS modem connected to the PCMCIA slot, dedicated analog phone line, and local ISP (Internet Service Provider) account.

2.4.1.1 Making an Ethernet cable

The Ethernet cable requires a straight through connection, as opposed to a crossover connection. Standard Ethernet cables can be purchased at most electronics stores or they can be quickly made onsite. CAT-5 cable consists of four twisted pairs, with each pair consisting of one solid color and one striped of the same color. Each end of the cable MUST BE WIRED IDENTICALLY. First, strip away approximately ¾ inch of the outer insulation and shielding- notice the four twisted pairs. Untwist the paired wires and arrange them from left to right according to the following description. When looking down at the cable with the ends of the individual wires facing away from you, the proper sequence of colors from left to right will be:

   White/Green – Green – White/Orange – Blue – White/Blue – Orange – White/Brown – Brown

Note: Feed the Cat-5 cable through the watertight connector of the SkyRamp **before** crimping on the RJ-45 connector!

7

After this configuration has been achieved, the RJ-45 connector needs to be crimped onto the end of the cable. First, trim the colored wires so that they are all the same length when laid flat. Then, holding the cable in the same orientation as above, slide the RJ-45 connector (prong down) over the end of the cable, making sure that the individual wires maintain their original configuration as they slide into their appropriate slots in the connector. Once the connector has been attached, you will see the same wire color sequence if observing as described above- you are now looking down at the top of the RJ-45 connector and the only difference is that the connector is now attached to the end of the cable. Crimp to secure the RJ-45 connector to the CAT-5 cable. Be sure that the metal pins of the RJ-45 connector have pierced all of the individual wires. Repeat for the opposite end of the cable. Plug one end into a port on the LAN and the other into Ethernet port #0 (ETH0) on the Gateway.

ETHERNET CABLE TERMINATION
(Typical Both Ends)

GRN/WHT
GRN
ORG/WHT
BLU
BLU/WHT
ORG
BRN/WHT
BRN

CAT-5 CABLE

RJ - 45
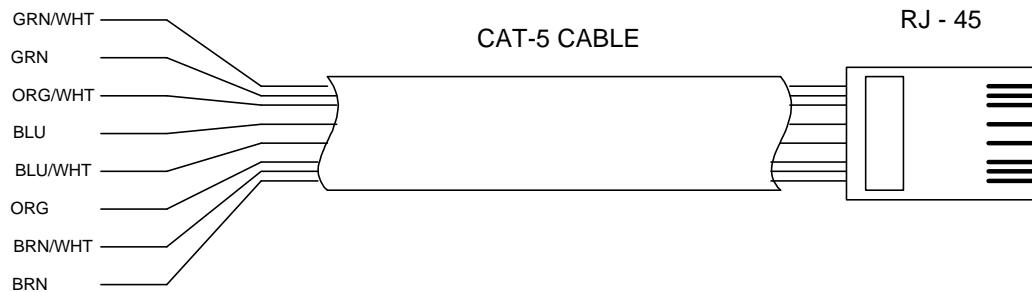
2.4.1.2 Dial-up

If using the dial-up option to access the Internet, then a dedicated analog phone line must be available within 24 inches of the Gateway cable gland. The modem cable can be found exiting the cable gland. Simply plug the modem cable's RJ-11 connector into the facility's analog phone jack.

TELEPHONE CABLE TERMINATION
(Typical Both Ends)

ORG/WHT
GRN
GRN/WHT
ORG

TELE CABLE (Various)

RJ -11

8
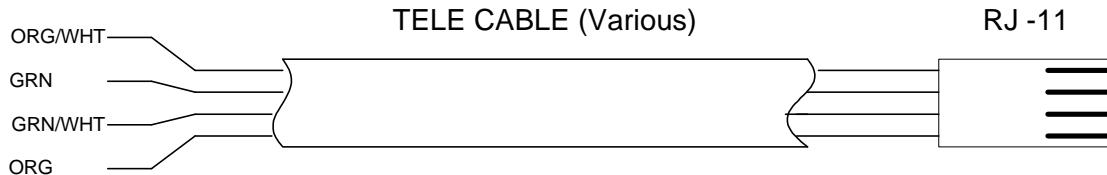
2.5   Gateway Installation: Electrical Power

This device is intended to be professionally installed by trained personnel only.

Once the Gateway has been given data connectivity, a power connection must be established. This device operates on 110VAC only.

2.5.1 Power wiring

The electrical wiring should only be performed by qualified personnel with the source circuit breakers in the "off" position. The Gateway **should not** be powered by a circuit with a local switch. Industrial grade wiring of the proper colors (we recommend black/hot, white/neutral, and green/ground), at least 14 gauge, is required. Insert the wires into the Gateway terminal block marked with the following sticker:
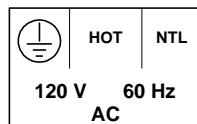
The hot wire is inserted into the block labeled "HOT," the neutral wire is inserted into the block labeled "NTL," and the ground wire is inserted into the block labeled ⏚. Do not forget to tighten down the terminal block screws.

If the installation is indoors and near a three-prong outlet, the supplied power plug can be used. First, with the plug unplugged, route the end of the cord with the wires exposed through the splash-proof strain relief at the bottom of the enclosure. Second, install the hot, neutral, and ground wires in their respective terminal blocks (see figure above) and tighten the terminal block screws. Third, ensure that the splash- proof strain relief connector is tight around the cord.

2.6   Gateway Configuration

This device is intended to be professionally installed by trained personnel only.

The Gateway has a menu system that is used for configuration and maintenance. Each Gateway can be configured to connect to the Internet via either Ethernet or dial-up POTS modem. The specific configuration must be completed on-site after the data wiring has been completed and the Gateway has been powered up. The configuration is accomplished by using a *crossover* Ethernet cable to connect the unit's Ethernet port #1 (ETH1) with a web-browser enabled device (i.e. laptop).

2.6.1 Accessing the Gateway User Interface

1. All devices must be powered OFF.
2. Plug in the MSR using supplied power cord.
   a. Wait 3 minutes for MSR to boot up.
3. Connect *crossover* Ethernet cable to Ethernet port labeled "ETH1" on MSR motherboard.
   a. Connect opposite end of cable to Ethernet port on user's PC or laptop.
4. Turn on user's PC or laptop.
5. Open Internet browser on PC or laptop.
6. Type any IP address into browser address bar.
   a. For example: 10.1.1.1
   b. If SensorWorX login page appears, then skip to Step 15.
   c. If error appears, then continue to Step 6.
7. Click on "Start" in the lower left corner of computer screen.
8. Click on "Control Panel" (WinXP), or "Settings" then "Control Panel" (Win2000)
9. Click on "Network Connections" (WinXP) or "Network and Dial-up Connections" (Win2000).
10. Right-click on "Local Area Connection" and select "Properties."
11. Double-click on "Internet Protocol (TCP/IP)."
12. Select the option "Obtain an IP address automatically."
    a. If this option is already selected, then click on "Start" menu in lower left corner of computer screen.
    b. Click on "All Programs" (WinXP) or "Programs" (Win2000).
    c. Click on "Accessories"
    d. Click on "Command Prompt"
    e. In the Command Prompt window type: ipconfig /release
       i. Wait for confirmation.
    f. In the Command Prompt window type: ipconfig /renew
       i. Wait for confirmation.
    g. Close Command Prompt window.
13. Click "OK."
14. Click "OK" again.
15. Open a new Internet browser window on PC or laptop.
    a. Go to Step 5.
16. Login to MSR.
17. Configure MSR.
18. Disconnect *crossover* Ethernet cable from "ETH1" when finished configuring.
19. Reconfigure user's laptop or PC to original settings (if necessary).

2.6.2 Using the Gateway User Interface

See **Appendix B** for configuration screen shots.

The following are options for Gateway configuration. There are three main sections and ten overall selections:

Network

1) *Select Communication Type*
   a. *Ethernet Config* – configure IP addresses for LAN connection.
   b. *Dialup Config* – configure ISP information for modem connection.
2) *FTP Settings* – use to set FTP configuration (if necessary) when using a LAN connection to the Internet.
3) *Checkin Interval* – set how often the Gateway sends data to data center.
4) *View Interfaces* – view current IP addresses for ETH0 and ETH1.
5) *Test Network* – runs automated test to determine network connectivity.

Actions

6) *Force Checkin* – connects Gateway to data center and sends all data.
7) *Reboot* – forces Gateway to reboot.
8) *Halt* – forces Gateway to shut down (user must unplug Gateway after issuing this command).

Reports

9) *System Overview* – general system information about the Gateway.
10) *Transmitters* – lists all transmitters that the Gateway has received data from.

3 TrackTag Transmitter

3.1 Introduction

The TrackTag transmitter is a battery powered, 2.4 GHz direct sequence transmitting/receiving device. Each Tag has a unique serial number and is shipped preconfigured to transmit every 15 minutes. Tags mounted in stationary vehicles

transmit their data to Readers that are mounted around the perimeter of an impound lot. The Readers then transmit the Tag data to the Gateway (see **Figure 1**). The system calculates the location of the Tag based on the data received from all Readers. Alternatively, when a Tagged vehicle passes through a defined exit, the Tag will respond to a beacon from an Exit Reader, resulting in the vehicles position being updated to reflect that it has left the particular facility and is currently "in transit."

3.2   Tag Installation

This device is intended to be professionally installed by trained personnel only.

The Tag is intended to be attached to a vehicle's rear view mirror or other compatible structure. Each Tag has a unique serial number printed on the back of the enclosure that must be recorded by the user and associated with the vehicle.

Each Tag is shipped with the battery installed and the power turned ON. There is no way to turn the unit OFF. There are no field serviceable components in the Tag, so when the battery dies the unit must either be discarded or returned to SYS for replacement.

3.3   Tag Configuration

Each Tag is shipped pre-configured from the warehouse and is not field-serviceable or configurable.

4   TrackTag Reader

4.1   Introduction

The TrackTag Reader is a battery powered, 2.4 GHz direct sequence transmitting/receiving device. Each Reader has a unique serial number and is shipped preconfigured to transmit all Tag data it receives. Readers are to be mounted at equally spaced intervals around the perimeter of an impound lot; the exact locations determined using the SYS Site Survey Kit. Each Reader must be able to consistently and effectively communicate with the locally mounted Gateway.

4.2   Reader Installation

This device is intended to be professionally installed by trained personnel only.

There is not a power switch on the Reader. It is operational as soon as batteries are installed.

4.2.1 Tools

The following tools are necessary for Reader installation and battery replacement:
* #1 Phillips screwdriver
* Electrical tape
* Wire cutters

4.2.2 Mounting the Reader

Each Reader must be mounted at equally spaced intervals along the perimeter of the impound lot according to the results of the site survey. Using the supplied zip ties (or other mounting hardware where applicable), tightly secure each reader so that the radio antenna is pointing straight up.

4.2.3 Battery Replacement

When the batteries need to be replaced, open up the case by unscrewing all four screws with a Phillips head screwdriver (see **Figure 2**). Make sure to avoid touching the circuit board of the Reader. Replace the two dead batteries with brand new Tadiran 3.6V "D" cell Lithium Inorganic batteries (model TL 5930). When finished, replace the cover and equally tighten all screws. Take care to not over-torque the screws.

Figure 2 – Reader Battery Compartment

4.3   Reader Configuration

Each Reader is shipped pre-configured from the warehouse and is not field-configurable.

5   TrackTag Exit Reader

5.1   Introduction

The Exit Reader is a line-powered 2.4 GHz direct sequence transmitting/receiving device. The Exit Reader's function is to detect when tagged vehicles leave an impound lot and are "in transit" to another location. When a tagged vehicle passes through the defined exit equipped with an Exit Reader, the Tag will respond to an exit beacon, resulting in the vehicles position being updated to reflect that it has left the facility and is currently "in transit."

5.2   Exit Reader Installation

This device is intended to be professionally installed by trained personnel only.

The exact mounting location for the Exit Reader must be determined prior to installation using the SYS Site Survey Kit. The Exit Reader must be able to consistently communicate with both the locally mounted Gateway, as well as any tagged vehicle passing through an approved lot exit.

The Exit Reader is equipped with two antennas. The first is a directional antenna that sends out beacon signals to the Tags passing through the lot exit. The other antenna is an Omni-directional antenna that receives exit beacon responses from the Tags, as well as transmits the Tag information back to the Gateway.

Mount the Exit Reader such that the Omni-directional antenna is pointed straight up and the directional antenna is pointed at the lot's exit gate.

The Exit Reader begins transmitting when 24VDC power is supplied to the unit. Plug in the supplied 24VDC power supply to begin operation.

5.3   Exit Reader Configuration

Each Exit Reader is shipped pre-configured from the warehouse and is not field-serviceable or configurable.

Appendix A – Agency Approvals

FCC

This device contains transmitter module

FCC ID: TXZTT2500

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference.
2. This device must accept any interference received, including interference that may cause undesired operation.

INFORMATION TO USER

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) This device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for Class B Digital Device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures.

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Appendix B – User Interface Configuration Screens

<u>Login Screen</u>
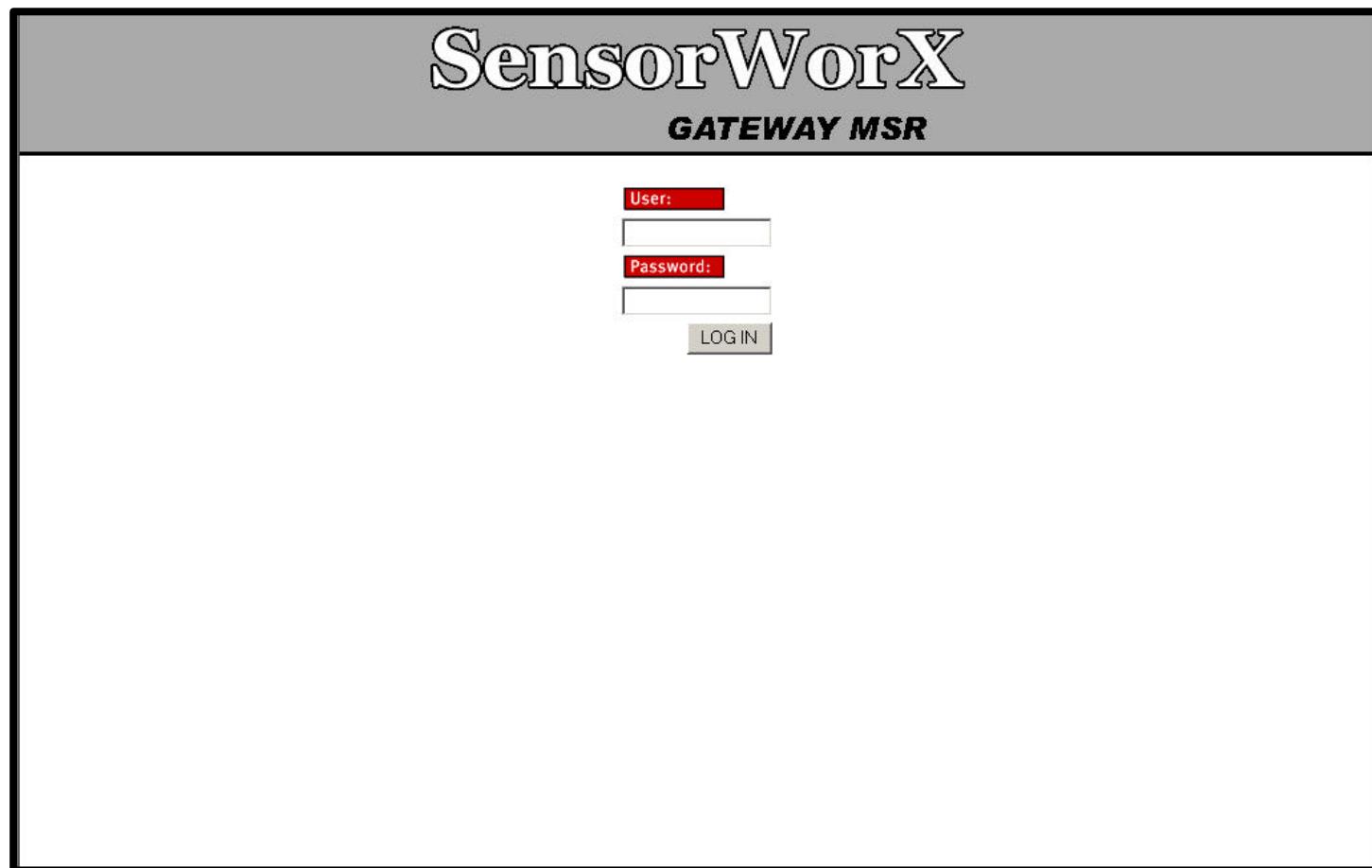
Configuration Home Page

SensorWorX

GATEWAY MSR

Network

- Select communication type
- FTP settings
- Checkin interval
- View interfaces
- Test network

Actions

- Force checkin
- Reboot
- Halt

Reports

- System overview
- Transmitters

Network > Select Communication Type

Network > FTP Settings

SensorWorX
GATEWAY MSR

FTP Settings

FTP Mode: ○ AUTO ● PORT ○ PASV
Proxy Type: [Type 0 ▼]
Proxy IP Address: [   ]
Proxy Username: [   ]
Proxy Password: [   ]
Proxy Port: [   ]

[Cancel] [Submit]

FTP Proxy Types

Type 0:   Do NOT use a firewall (most users will choose this)

Type 1:   Connect to firewall host, but send "USER user@real.host.name"

Network > Check-in Interval

SensorWorX
GATEWAY MSR

Checkin interval: [10 minutes ▾]

| 10 minutes |
| 20 minutes |
| 30 minutes |
| 1 hour |
| 2 hours |
| 4 hours |
| 6 hours |
| 12 hours |
| 24 hours |

[Cancel] [Submit]
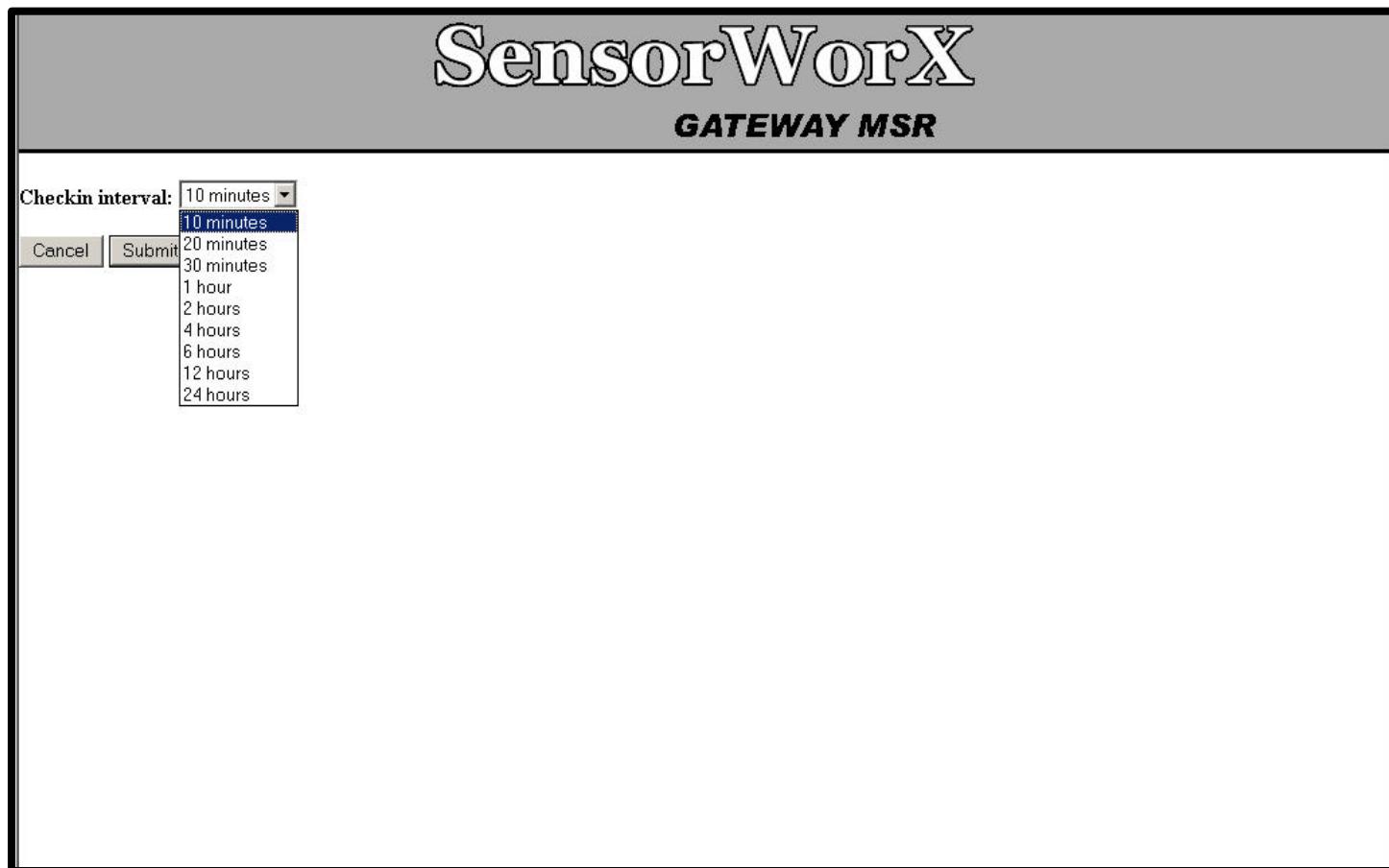
Network > View Interfaces

SensorWorX
GATEWAY MSR

Current Network Interfaces

eth0	
MAC Address: 00:00:24:C3:BB:58	Broadcast: 10.1.255.255
IP Address: 10.1.1.31	Netmask: 255.255.0.0

eth1	
MAC Address: 00:00:24:C3:BB:59	Broadcast: 172.16.31.255
IP Address: 172.16.31.1	Netmask: 255.255.255.0

Home

Network > Test Network

SensorWorX
GATEWAY MSR

Network Test

- Starting the network succeeded.
- Ping of gateway (10.1.0.1) succeeded.
- Ping of nameserver 1 (10.1.0.18) succeeded.
- Ping of nameserver 2 (10.1.0.103) failed.
- Resolved datacenter.xsilogy.com to 10.1.100.11
- Ping of datacenter.xsilogy.com succeeded.
- Getting a file from datacenter.xsilogy.com succeeded.

The SkyRamp is able to communicate with the datacenter.
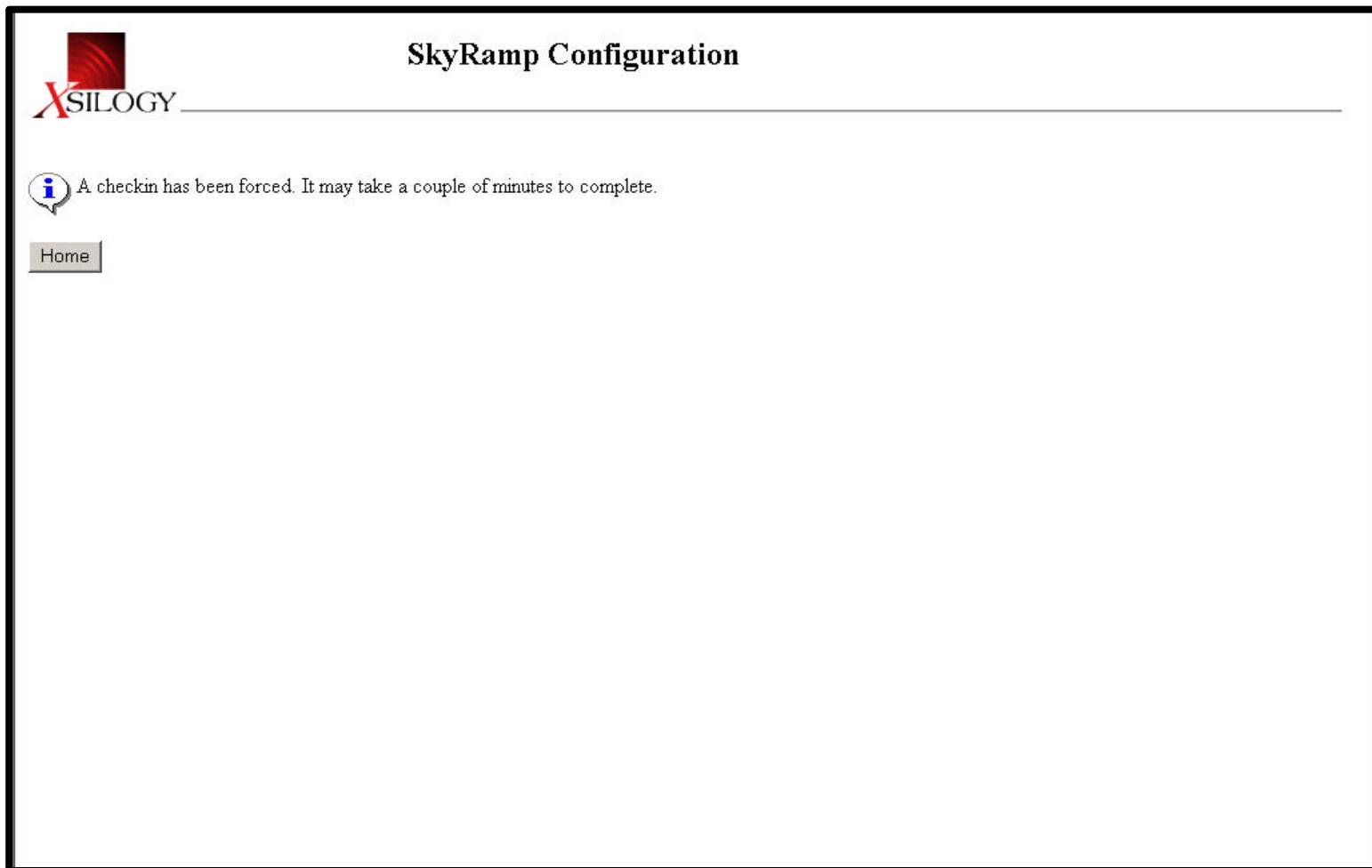
[Home]

Actions > Force Check-in

SkyRamp Configuration

XSILOGY

(i) A checkin has been forced. It may take a couple of minutes to complete.

[Home]

Actions > Reboot

Actions > Halt

Reports > System Overview

SensorWorX

GATEWAY MSR

System Overview

SkyRamp ID: qamsr5k1

Software Version: dev 0.2.3

Free RAM:	2140 kB	**Uptime:**	12 days, 23 hours
Free RAM Disk:	3336 kB	**Load Average:**	0.02

Checkin Interval: 30 minutes

Last checkin: Thu May 19 17:28:03 UTC 2005

Current time: Thu May 19 17:32:43 UTC 2005

[Home]

Reports > Transmitters

SensorWorX

GATEWAY MSR

Transmitters Report

Current time: 2005-05-19 17:31:25

Transmitter ID	Last Transmission
a219c04a	2005-05-19 17:27:11
a219c054	2005-05-19 17:27:04
100101d7	2005-05-19 17:26:23
1001028c	2005-05-19 17:25:11
1001022d	2005-05-19 17:24:04
30303232	2005-05-19 17:22:50
a219c053	2005-05-19 17:20:25
a219c013	2005-05-19 17:17:14
30303235	2005-05-19 17:14:52
01e008e6	2005-05-19 17:06:45
30303432	2005-05-19 16:59:01
100102e7	2005-05-19 16:52:15
a219c01d	2005-05-19 16:42:59
a219c00f	2005-05-19 16:17:52
1001024a	2005-05-19 15:20:10
01900002	2005-05-19 01:05:03