

# EDGE COMPUTE PLATFORM FEATURES SPECIFICATION



## INTEGRATOR - AI™

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**TRAFFIC**  
APPLICATIONS



**ITS**  
APPLICATIONS



**PARKING**  
APPLICATIONS



**INTEGRATOR-AI™ EDGE COMPUTE  
PLATFORM FEATURES SPECIFICATION  
[PS-IAI-0003]**

Engineering Reference



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## Revisions

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<b>Date</b>	<b>Who</b>	<b>Changes</b>
06/04/2023	Justin Kravchak	<ul style="list-style-type: none"><li data-bbox="646 451 821 480">• Initial Writing</li></ul>

## Scope

This document describes feature support for each system in the Integrator. It can be used as a technical reference document describing Integrator capabilities

## Interfaces

Interfaces are a means to connect to different devices and services. We have several types of interfaces, each with distinct functionality and purpose:

Sensors	Devices that bring information into the system
Digital Message Sign	Control and monitor digital signs
Traffic Signal	Control and monitor traffic signals
Digital Analog Hardware	Hardwired control and monitoring of electronic circuits, like relay systems or PLC style equipment
Service	Devices that allow for the export of Integrator data and events to external services like HTTP REST API's, TCP endpoints, email, SMS, etc.
V2X RSU (In-Development)	Receive and send messages to the connected vehicle system
Lighting	Control and monitor lighting devices

Our system allows you to create and operate many different interfaces concurrently. You can also mix and match drivers to exploit all available features from a device, for example interface with the same (or different) traffic signal via NTCIP-1202 and SDLC. Our digital wiring and apps enable you the ability to get these different devices to work together.

**Not all features of an interface may be available due to limitations of a specific product or specification. To see what functionality is supported, see the driver's section of that interface. The following sections will describe what features can be supported by each interface type. The driver, and implementation, ultimately decides what can be, and is, supported.**

### Sensors

Sensors are devices generally designed to provide input data to another device. The Integrator will take in this data and pass it around the various internal systems for processing by our apps or allowing it to be acted upon through one of our digital wires in real-time.

There are different kinds of data we can ingest from sensors. The following describes what that data is currently. As the Integrator grows, we will be adding more kinds of data to this list, for example we have near future plans to ingest weather information.

### Object Data

Object data represents moving objects that can be tracked. This includes vehicles, pedestrians, cyclists, and unclassified. There are several data points that can be collected about an object, most are optional due to different capabilities of the array of sensors we work with. A list of some of those data points are (and not limited to just this):

Speed	How fast the object is moving
Width, Height, Length	Dimensions of the object
Classification	Specifics about what the object is: truck, bus, car, person. This is a passthrough from the sensor, so whatever the sensor reports it as will be assigned to this

Type	Vehicle, pedestrian, cyclist, unclassified – A common type the Integrator defines the classification as
Lifespan	How long the object has been tracked
Headway, Gap	Spacing metrics between other objects
Dwell	Time spent in a zone
Heading	Direction the object is facing
Spatial Position	Position and orientation of the object in a spatial system
Spatial Movement	Movement of the object in a spatial system
Spatial History	Position and movement spatial history of the object
Spatial Trajectory	Predictive position and movement spatial data about the object
Zones	Zones the object is occupying and additional details about the object while it is in them

### Special Events

Special events represent any kind of event that may occur or need to be handled (e.g. wrong way, near miss, accidents, predictive events, etc.). Our system can ingest and act on any event that external devices provide us with, but additional data attached to the event is limited to what we normally process, such as objects data.

### Connected Vehicle Messages

In development

### Traffic Signal

This interface provides a means of both monitoring and controlling a traffic signal. Some of the functionality includes

- Monitoring and controlling detector inputs
- Monitoring and controlling signal timing
- Monitoring and controlling phases

### Service

This interface provides a means of sending data or events somewhere else, for example email, SMS, HTTP REST APIs. Some functionality includes

- Sending snapshots of objects and interfaces
- Sending events as they occur
- Notifications and streams

### Digital Analog Hardware

This interface provides a means to interface directly with electronics, at a hardware level. GPIO, PLC IO, Relay systems as some examples. This interface can be used to control all kinds of external hardware. Some functionality includes

- Controlling and monitoring multiple channels
- Digital and analog channel support

### Digital Message Signs

This interface provides a means to control and monitor digital signage. Some functionality includes

- Monitor and control sign messages

## V2X RSU

This interface lets us communicate to the connected vehicle system. Some functionality includes

- Send and receive messages from the V2X system
- Store and repeat, immediate forward messages

## Drivers

Our driver system allows us to interface with just about any device. The largest advantage is that it allows us to work with both standardized and proprietary systems. If a product is not supported, and fits within the scope of our software, we can develop a driver to support it. Drivers can be developed to expose a common interface to manufacturer specific hardware or be custom tailored to operate in a proprietary manner; or both if needed. This system allows us to remove vendor lock, where you are forced to use one product due to compatibility constraints. Barring limitations of the product, and our ability to inject that missing functionality, we can essentially develop a driver to provide support for just about any device.

## Sensors

AMAG Panorama

Video analytic input

Data provided

Object data	Position, classification, speed, zones, heading
Special events	Near miss, wrong way, and more
Device status	Up/down state

## Health Monitor

A sensor used to monitor the health state of an external device (Operational, fault, inoperative). Can be used in our wiring system to react to state changes of that device. User selectable monitors for different ways of detecting the device's state:

ICMP	Basic ping to determine if a device is responding, no support for detecting a fault state
HTTP REST (In-Development)	Query an HTTP REST API endpoint and read the response to determine what state the device is in. Users can select how to read the response and direct what state the device should be in based on that response
SNMP (In-Development)	Query an SNMP agent and read the response to determine what state the device is in. Users can select OIDs and map out the response values to determine what state the device is in

The health monitor driver is typically not needed if we have a driver dedicated to the device already. If we have a driver, it will include operational state information by default. This driver is intended for monitoring of devices we don't have a driver for but you'd like to monitor anyways.

Data provided

Device status	Up/down/fault state – dependent on the monitor used
---------------	---



### ISS SX300 IP

#### Transportation Radar

MVDS sensor that provides trip wire style vehicle detection. Supports the X3 protocol over Ethernet. Our driver enhances this detector by adding missing functionality and allows it to work with other traffic devices.

#### Data provided

Object data	Classification, speed, zones, length, NTCIP-1209 interval data
Device status	Up/down state

### Ouster Gemini

#### LiDAR perception input

#### Data provided

Object data	Classification, speed, zones, heading, length, height, width
Device status	Up/down state

### Outsight ALB

#### LiDAR perception input

#### Data provided

Object data	Classification, speed, zones, heading, length, height, width
Device status	Up/down state

### Seoul Robotics

#### LiDAR perception input

#### Data provided

Object data	Classification, speed, zones, heading, length, height, width
Device status	Up/down state

### Blue-Band

#### D-Tx Detection Suite Driver

#### Data provided

Object data	Classification, speed, zones, heading, length, height, width
Device status	Up/down state

## Traffic Signal

### Blue-Band SDLC

An SDLC implementation for controlling and monitoring a traffic signal

- Monitor load switch output state (red, yellow, green)
- Act as a detector rack BIU and provide 16 channels to put in calls to the signal
- Assign as DR BIU 1-4 providing support to operate all 64 channels
- Interface with multiple controllers concurrently

Sunday, June 4, 2023

NOTE: This interface requires an external hardware interface due to the specialized communication interface that SDLC uses

NTCIP 1202

Ethernet interface to control and monitor a traffic signal using the NTCIP protocol.

- Put in calls on phases for pedestrians or vehicles (16 phases)

- Put in calls on detectors for pedestrians or vehicles (NTCIP1202v3 supported controllers only, 128 channels)
- Monitor intersection flash state
- Monitor signal mode
- Monitor phase output states for pedestrian (walk, ped clear, don't walk) and vehicle (red, green, yellow) heads
- Monitor ring status (phase intervals, timing information, and termination reasons)
- Monitor and control signal timing configurations
- Monitor and control controller stop time
- Issue force-offs

## Digital Message Sign

### NTCIP 1203

Ethernet interface to control and monitor a DMS sign using the NTCIP protocol.

- Post messages
- Blank the display
- Monitor what is on the display

## Digital Analog Hardware

### TCP MODBUS (In-Development)

Ethernet interface to a MODBUS controller

- Digital and analog channels, varies by the hardware selected
- Control outputs
- Monitor and collect data on inputs

### Blue-Band Contact Closure Card

A wireless contact closure system

- Designed to plug into a traffic signal detector rack and act like a loop detector input
- Can be installed standalone and just used as a basic relay control for circuits
- One master card and the ability to chain additional cards to support 8 channels with one main interface

## Service

### DB

The DB service provides the ability to log an event or data locally to the Integrator. Using the DB app to browse/download the events and data aggregated about them

- Log any event or wire activation
- Create your own datasets with criteria defined by you using our digital wiring system
- Age and count based record pruning to reduce the need of maintenance due to persistent storage capacity

### SMTP (Email)

Send emails with event information

- Send emails when a specific wire is activated, or an event occurs
- Provide detailed information directly in the email about the selected data
- Supports TLS or plain text email services

- User configurable recipient lists and subjects
- Supports authenticated services
- Output throttling

## TCP

Provides data through a TCP tunnel using the Integrators proprietary protocol

- Send any event or data through the tunnel
- Supports plain text or TLS encryption
- User selected output data formats like JSON
- Uses Integrator communication protocol to transmit (see “Integrator Communication Protocols” document for information on how to ingest data from this connection)

## V2X RSU

NTCIP-1218 (In-Development)

Using the standard protocol to communicate with RSU's

- Ingest and react to J2735 messages such as preemption, signal priority data, and safety messages
- Send SPAT data to the RSU
- Send object data to the RSU for broadcasting, such as pedestrian or maintenance/construction personnel positioning
- Send warning messages to the RSU such as road side alert messages for things like wrong way drivers
- Setup the integrator as a broadcasting beacon using local RSU's to convey road conditions, construction information, or other localized hazards supported by J2735

## Lighting

Allows for the control of lighting interfaces such as setting intensity, color, and state (on/off). NOTE: We have a few

drivers awaiting final approval before we list them here

## Apps

Apps are individual programs that run within the Integrators platform. They have access to all functionality and data the Integrator supports. Each app is developed to provide specific functionality to enhance the Integrator's feature support. They can be quickly developed to provide any complex functionality that the Integrator may not support.

### Blackbox

This app provides a means to save a snapshot of object

### Object Analytics

This app aggregates object data points and turns them into a flattened set of data points. Data points include:

Counts	Volume
Speed	Min, max, mean, median, 85 <sup>th</sup> percentile, 15 <sup>th</sup> percentile
Length, Width, Height	Min, max, mean, median
Classification, Type	Each data point grouped by classification and type
Headway, Gap	Min, max, mean, median (zones only)
Lifespan, Dwell	Min, max, mean, median

Heading	Mean, median
Sensor, Zone, All	Group data by sensor, zone, or overall

- Data is saved locally and can be downloaded as a report
- User configurable resolution
- User configurable database pruning to keep storage capacity available
- User configurable reports:
  - Format: Excel, CSV, JSON
  - Date ranges, down to seconds resolution
  - Selectable units of measurement

### SPM+

This app....

### NTCIP 1209

Provides implementation of several OID's to act as an NTCIP-1209 compliant detector supplying interval-based data.

Speed	Average speed of vehicles in a lane during the interval. Km/h
Occupancy	Occupancy % of time for the lane within the interval time
Volume	Count of vehicles during the interval

- User configurable zones to lanes mapping
- For supported sensors only
- User configurable interval times

### Interface Health

This app provides up/down/fault counts and time for connected interfaces.

- Up/down/fault times as % or counts
- Browse historic health of devices or download as report
- View as aggregated or individual events
- User configurable reports:
  - Format: Excel, CSV, JSON
  - User selectable date ranges

### Digital Analog Hardware

This app is in development, but will provide analytics on digital and analog channels of supported interface.

### DB

This app provides a means of browsing, and downloading, events saved locally to the Integrator from the digital wiring system.

- Browse events locally
- Select events by topic or device
- View event details and data attached to them from the GUI
- User configurable reports:
  - Format: Excel, CSV, JSON

- User selectable date ranges

## Signal Optimization and Coordination

This app is in development, but its purpose is to analyze traffic signal operations and service demands and modify signal timing to increase efficiency and safety for vehicles and people.

## Brokers

Brokers provide a means for others to connect to the Integrator. Depending on the broker connected to, it can provide a means to receive real-time data and even give the option of controlling any device connected to the Integrator.

### SNMP

Apps and other components in the Integrator can setup OIDs so that external services can query our SNMP v2c agent for data. For example, NTCIP-1209 exposes OIDs relevant to the NTCIP-1209 specification. The supported OIDs are dependent on what apps and components are configured and running.

### HTTP REST API

Using a REST API, external services can control and query any device or system connected to the Integrator. The Integrator implements 4 HTTP request methods to indicate the action to perform on the endpoint:

GET	Used to retrieve information
PUT	Used to update an existing resource
POST	Used to create a new resource
DELETE	Used to delete a resource

Here is a list of common API endpoints (see “Integrator Communication Protocols” document for details on how to use each):

/api/zones	Manage zones
/api/wires	Manage digital wires
/api/users	Manager users
/api/groups	Manager user groups
/api/tokens	Manager tokens
/api/system	System wide management of the Integrator
/api/status	Get status information about the Integrator
/api/settings	Manage system configurations
/api/network	Get status information on network interfaces
/api/drivers	Manage loaded drivers
/api/driver	Access driver specific endpoints
/api/auth	Authentication service
/api/system/factory-reset	Factory reset the Integrator
/api/broker/snmp	Manage the SNMP broker
/api/app/db	Manage and get data from the DB app
/api/app/interface-health	Manage and get data from the health interface app
/api/app/ntcip-1209	Manage and get data from the NTCIP-1209 app
/api/app/object-analytics	Manage and get data from the object analytics app
/api/app/spm+	Manage and get data from the SPM+ app
/api/interfaces	Manage and get the status of connected devices (interfaces)

/api/interface/service/test	Send a test message to a specific service to make sure it is working
/api/interface/digital-message-sign/messages	Set what is on the display of a digital message sign
/api/interface/digital-analog-hardware/channels	Control channels on an interface
/api/interface/traffic-signal/detectors	Control detectors on a traffic signal interface
/api/interface/traffic-signal/forceoff	Issue force off on rings
/api/interface/traffic-signal/stoptime	Enable/disable stop time
/api/interface/traffic-signal/timing	Modify signal timing

## WebSocket

Implementing the WebSocket specification, connect and subscribe to real-time data and control connected devices. (see “Integrator Communication Protocols” document for details on how to use this broker)

## TCP

Implementing the TCP protocol, connect and subscribe to real-time data and control connected devices. (see “Integrator Communication Protocols” document for details on how to use this broker)

## Digital Wiring (Transportation Lab™)

This is our Transportation Lab™ which allows you to get creative with controlling your connected devices and even automate them to work together. There are different kinds of wires, each providing a distinct kind of behavior.

Logic	This wire lets users configure conditionals to match and actions to execute when all conditions are met
Interval	This wire executes a set of actions at a user defined rate
NEMA TS-2 Presence	This wire emulates presence-based detection systems that typically operate traffic signals meeting at a minimum NEMA operational standards
Script (In Development)	A scripting based wire that lets users write their own scripts. Users familiar with programming can write their own behavior for a wire using this wire type. The scripting language to be used is not determined yet, but highly likely to be <b>Lua</b> .

See our “Digital Wiring Guide” to learn how to use each of these wires to their full potential.

## Logic

This wire lets users define a set of conditions, and if those conditions match, execute a set of actions.

- Special activation limits and constraints
- User configured actions and conditions
- Chain multiple actions and conditions together to carve out the behavior you want There are several

conditions the user can set; more can be added as the functionality is needed:

Zone	Match against one or more zones
Zone Occupants	Count the occupants of a zone; includes filtering of object types
Event	Match a specific event
Event Confidence	Match an event confidence level
Event Level	Match an event level
Event State	Match an event state

Interface	Match one or more interfaces
Interface Operstate	Match one or more operational states for an interface
Digital Analog Hardware Channel	Match one or more channel states
Digital Message Sign Message	Match a message on a display
Traffic Signal Detector	Match one or more detector states
Traffic Signal Flash	Match against the signal's flash state
Traffic Signal Phase	Match against one or more phase states
Traffic Signal Ring	Match against one or more ring states
Traffic Signal Mode	Match against a traffic signal mode
Traffic Signal Stop Time	Match against a traffic signals stop time state
Traffic Signal Ring Termination	Match against one or more ring termination reasons
Traffic Signal Ring Phase	Match against one or more servicing ring phases
Traffic Signal Ring Next	Match against one or more next ring phases
Model	Match against one or more data model types
Object Classification	Match against an object classification
Object Dwell	Match against an objects dwell time within one or more zones
Object Event	Match against object tracking state (ingress, egress, update)
Object Gap	Match against an objects gap time within one or more zones
Object Headway	Match against an objects headway time within one or more zones
Object Heading	Match against an objects facing direction
Object Height	Match against an objects height
Object Width	Match against an objects width
Object Length	Match against an objects length
Object Lifespan	Match against an objects total time being tracked
Object Speed	Match against an objects speed

There are several actions the user can set; more can be added as the functionality is needed:

Event	Generate an event
Delay	Wait for a specified duration
Wire Abort	Abort the actions of a wire
Wire Disable	Disable a wire
Wire Enable	Enable a wire
Wire Reset	Reset a logic wire
Service Message	Generate and send a message to a service interface
Digital Message Sign Message	Set (or clear) the message of a digital message sign
Digital Analog Hardware Channel	Set the state of one or more channels
Traffic Signal Detector	Set the state of one or more detectors
Traffic Signal Force off	Issue a force off on one or more rings
Traffic Signal Stop Time	Enable/disable stop time
Traffic Signal Timing	Modify signal timing

## Interval

This wire runs a set of actions at a user defined rate.

- Frequency with millisecond precision
- Set limits on how many times it can execute



- User configured actions
- Chain multiple actions in a single wire to carve out the behavior you want

There are several actions the user can set; more can be added as the functionality is needed:

Event	Generate an event
Delay	Wait for a specified duration
Wire Abort	Abort the actions of a wire
Wire Disable	Disable a wire
Wire Enable	Enable a wire
Service Message	Generate and send a message to a service interface
Digital Message Sign Message	Set (or clear) the message of a digital message sign
Digital Analog Hardware Channel	Set the state of one or more channels
Traffic Signal Detector	Set the state of one or more detectors
Traffic Signal Force off	Issue a force off on one or more rings
Traffic Signal Stop Time	Enable/disable stop time
Traffic Signal Timing	Modify signal timing

## NEMA TS-2 Presence

This wire emulates presence-based detection systems that typically operate traffic signals meeting at a minimum NEMA operational standards.

- Multiple actuators
- Zone algorithm counters
- Specialized fault handling
- Map multiple zones and detectors together
- Not limited to just controlling traffic signals, but any circuit that may require this behavior There are

currently two (2) actuators

Traffic Signal	Interface with a traditional traffic signal detector interface to put in, and clear, calls
Digital Analog Hardware	Interface directly with the hardware in the signal cabinet (or control cabinet)

There are currently two (2) zone counters

Occupants	Counts objects in a zone. User configurable filter to target specific types of objects (people, cars, bicycles etc.)
Waiting	An algorithm that determines if the object is waiting for service. User configurable behavior metrics to determine a waiting state. Also includes a filter to target specific object types

## Script

This wire lets you write your own scripts to operate as a wire. This will expose internal APIs for you to use just like most apps and other wires have available to them. The language and details of how this operates are still being decided.



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