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SmarTek Acoustic Sensor - Version 1 (SAS-1)

Installation and Setup Guide

Part-C Operating Modes and Architecture

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Note: In all cases, do not work or position equipment over an active traffic lane. Working over active lanes presents a hazard to the installer and to travelers using the highway. Follow local authorized procedures when installing the SAS-1 unit and any associated components or subsystems.

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SAS-1 Operating Modes

The SAS-1 can be set up for a specified fall back or default operating mode. This mode defines what the SAS does and how it communicates after reset, power up, or a prolonged period of communication inactivity. The SAS-1 can be set to operate in either a text message mode (**Flow Mode**) or a "Loop Equivalent" relay mode (**Relay Mode**).

In the **Flow Mode**, the SAS-1 performs vehicle detection and speed estimation processing for all 5 lanes and forms a Traffic Flow Message. The Traffic Flow Message includes vehicle count, lane occupancy, and average speed for each of the 5 lanes. This message is prepared and made available every observation period. The observation period is a selectable parameter ranging from 2 seconds to 220 seconds. If the SAS-1 is set for periodic communication, the Traffic Flow Message will be output on the SAS-1 data cable every observation period whether anything is present to receive it or not. If the SAS-1 is set for polled communication, the most recent Traffic Flow Message will only be output on the SAS-1 data cable if the SAS-1 received a polling request. This allows multiple SAS-1 units to share a common home run cable or wireless link without interference or message collision.

In the **Relay Mode**, the SAS-1 performs vehicle detection and speed estimation processing for all 5 lanes and forms a bit serial Relay Message. Each bit serial Relay Message includes "loop equivalent" presence relay state information for 10 time points for each of the 5 lanes. This message is prepared and made available every 80 milli-seconds. Hence, the bit values (1 or 0) in this message represent relay state for an upstream and downstream "loop equivalent" for each lane. If the SAS-1 is set for periodic communication, the bit serial Relay Message will be output on the SAS-1 data cable every 80 milli-seconds whether anything is present to receive it or not. If the SAS-1 is set for polled communication, the most recent bit serial Relay Message will only be output on the SAS-1 data cable if the SAS-1 received a polling request. This allows multiple SAS-1 units to share a common home run cable or wireless link without interference or message collision.

SAS-1 Architecture

The SAS-1 architecture is inherently simple and modular since all signal processing, spatial processing, and detection processing is performed in the SAS-1 unit. This results in a short simple measurement text message that requires very little communication bandwidth. The SAS-1 electronics and messaging protocols facilitate a number of connection options for getting the processed information from the SAS-1 unit (mounted on a highway structure) to a roadside cabinet or to a central control center. Many different configurations are possible involving single and multiple SAS-1 units, hard wired and wireless communication, with and without local controller cabinets. The following sections show four common ways to connect SAS-1 units to local cabinet controllers and to central control centers.

SAS-1 Hard Wire Home Run to Roadside Cabinet

The SAS-1 may be connected to equipment in a roadside cabinet that may be only several feet from the SAS-1 or may be hundreds or thousands of feet from the SAS-1. The basic SAS-1 configuration uses a hard-wired home run cable to get power and control signals from the cabinet to the SAS-1 and signals/messages from the SAS-1 to the cabinet controller (Figure 1). Multiple SAS-1 units may also share a single home run cable if each SAS-1 unit is set up with a different SAS ID and each is setup to be polled.

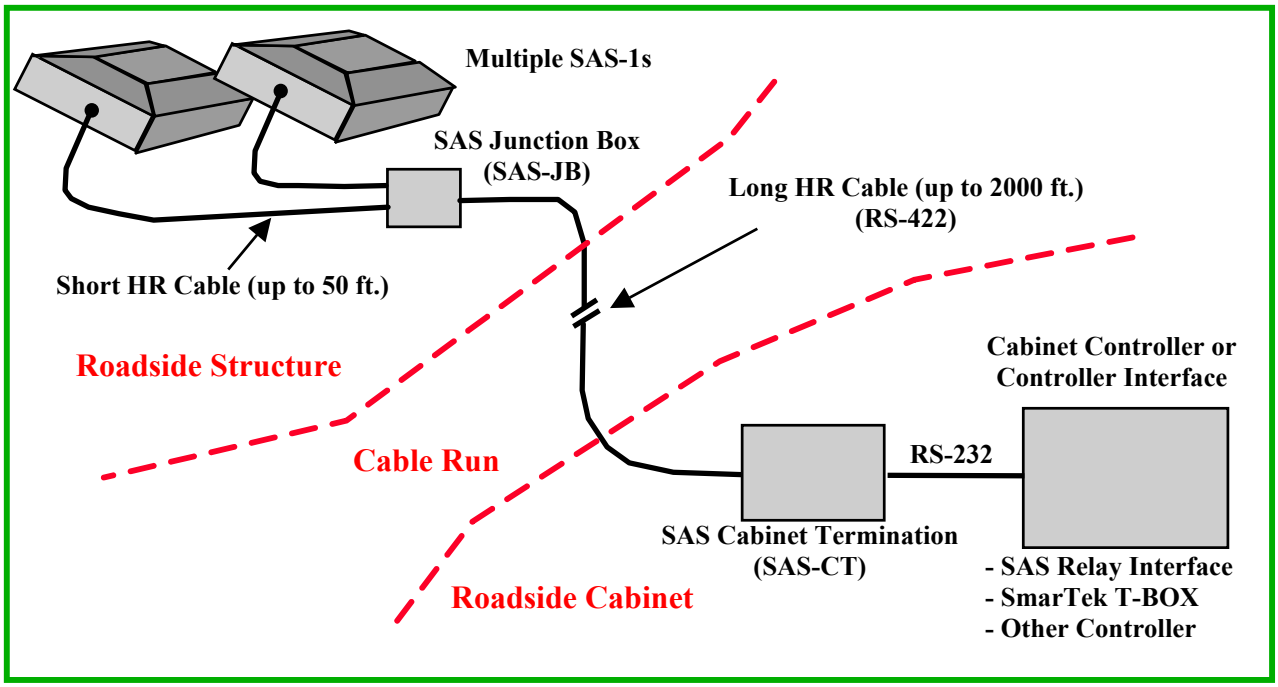

Figure-1 SAS-1 Architecture Using Hard Wire Home Run Cable

The SAS-1 has a small footprint and does all processing necessary for monitoring up to five highway lanes. The SAS-1 unit is configured at the factory with the specified communication protocol (RS-422 is standard) and provides solid state surge protection between all data lines and ground and between the +VDC line and ground. Each SAS-1 can be set up with a selectable SAS ID and can be set to wait for polling so that multiple SAS-1 units can share a common communication channel without interference. That channel may be hard wired or wireless.

The SAS-Junction Box (SAS-JB) is a small, strap-on, weather-tight enclosure that is mounted conveniently on the roadside structure. It is used to connect the short home run cable from one or more SAS-1 units to a much longer home run cable if long runs to a roadside cabinet are required or if a single home run cable is to be shared. The SAS-JB also provides the means to configure the SAS-1 system with an additional stage of gas tube surge protection.

The Short Home Run Cable ships with each SAS-1 unit and is specified at the time of ordering to be between 20 and 50 feet. The short home run cable has four pairs of stranded 24 gauge

conductors and a continuous shield with a stranded shield conductor. For long runs, the long home run cable used should be 22 gauge or larger.

The SAS-Cabinet Termination (SAS-CT) is a small circuit card (mounted inside the controller cabinet or in a Type 170 card file) that provides the termination point for the home run cable from the SAS-1. The home run cable is terminated with a high quality terminal block connector that is plugged onto the SAS-CT. The SAS-CT provides electrical protocol conversion (RS-422 to RS-232) to facilitate connection to an RS-232 port of the cabinet controller or the RS-232 port of the SAS-Relay Interface (SAS-RI). The SAS-CT provides a single stage of solid state surge protection and additionally a stage of gas tube surge protection for all data and power lines.

The SAS-CT to Controller Serial Cable is used to connect the SAS-CT to the cabinet controller via a modular (RJ-45) connector at the SAS-CT. The other end of the cable is a modular (RJ-45), a DB-9, or a DB-25 connector depending on the controller or communication device it is connected to.

SAS-1 Wireless Link to Roadside Cabinet

A single SAS-1 unit or multiple SAS-1 units may be connected to a local controller/data concentrator cabinet using wireless spread spectrum radio modems as shown in Figure 2. The

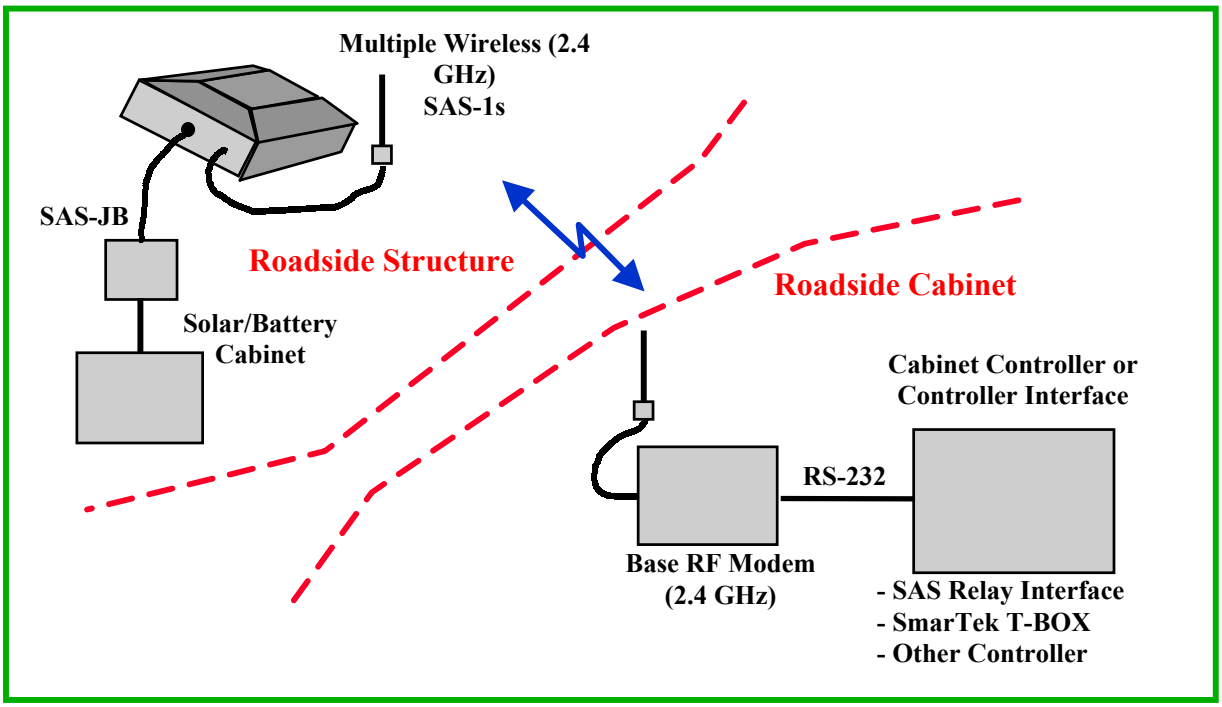

Figure 2 SAS-1 Wireless Link to Roadside Cabinet

SAS-1 wireless option is implemented by putting the radio modem inside the SAS-1 cover or using an external radio modem shared by multiple SAS-1 units. Hence, only power and antenna cables are connected to the SAS-1 mounted on the roadside structure. To support the use of

multiple SAS-1 units communicating to the same base radio at the cabinet controller/data concentrator, each SAS-1 is set up with a different SAS ID and set to wait to be polled. Multiple radio networks may also operate in the vicinity of one another without interference since the radio modems can be set to different network numbers or spectrum hopping patterns.

SAS-1 Wireless Link to Control Center via Internet/CDPD Modems

For SAS-1 stations with no means of hard wired communications back to a local controller cabinet or to a central control center, CDPD modems and digital wireless service may be employed as shown in Figure 3. The connection between the control center and the SAS-1 monitoring station is uniquely made using TCP/IP protocol and IP addresses. This architecture also supports multiple SAS-1 units (each with a different SAS ID) connected to a single CDPD modem so long as they are set up to be polled.

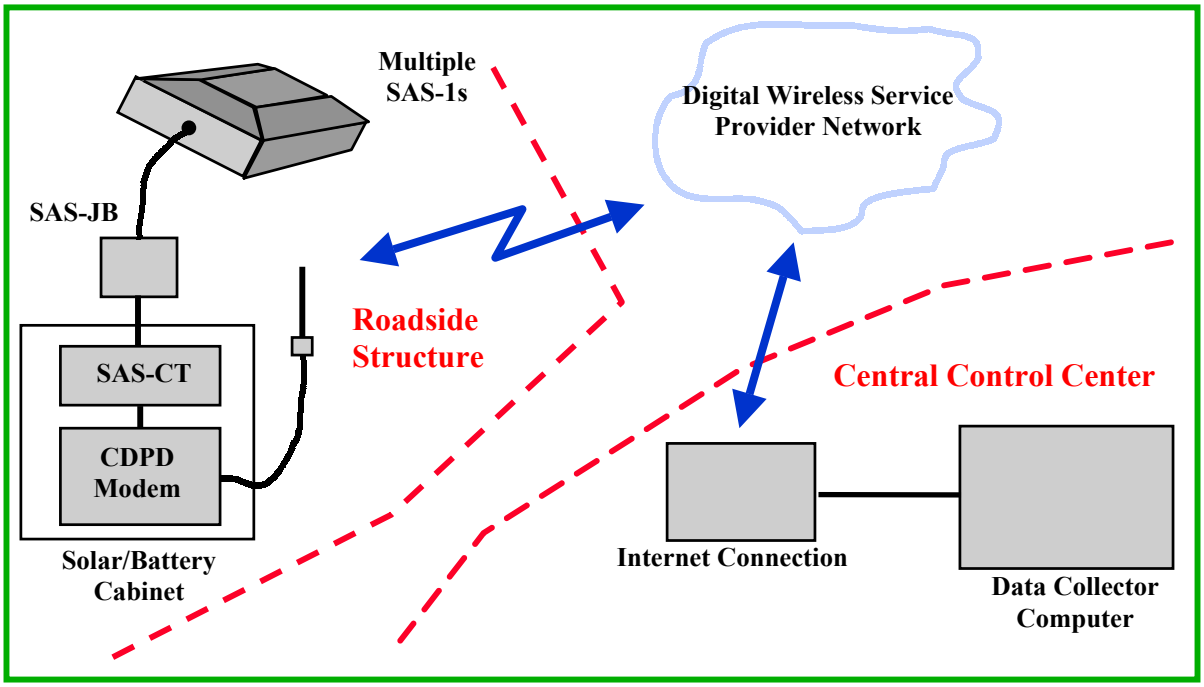

Figure 3 SAS-1 Wireless Link to Central Control Center

SAS-1 Link to Control Center via Traffic Management System Network

For Traffic Management Systems with a dedicated hard wired, fiber communications, or wireless network connecting the SAS-1 station and the central control center, network device servers may be employed as shown in Figure 4. The connection between the control center and the SAS-1 monitoring station is uniquely made using TCP/IP protocol and IP addresses. This architecture also supports multiple SAS-1 units (each with a different SAS ID) connected to a single network device server so long as they are set up to be polled.

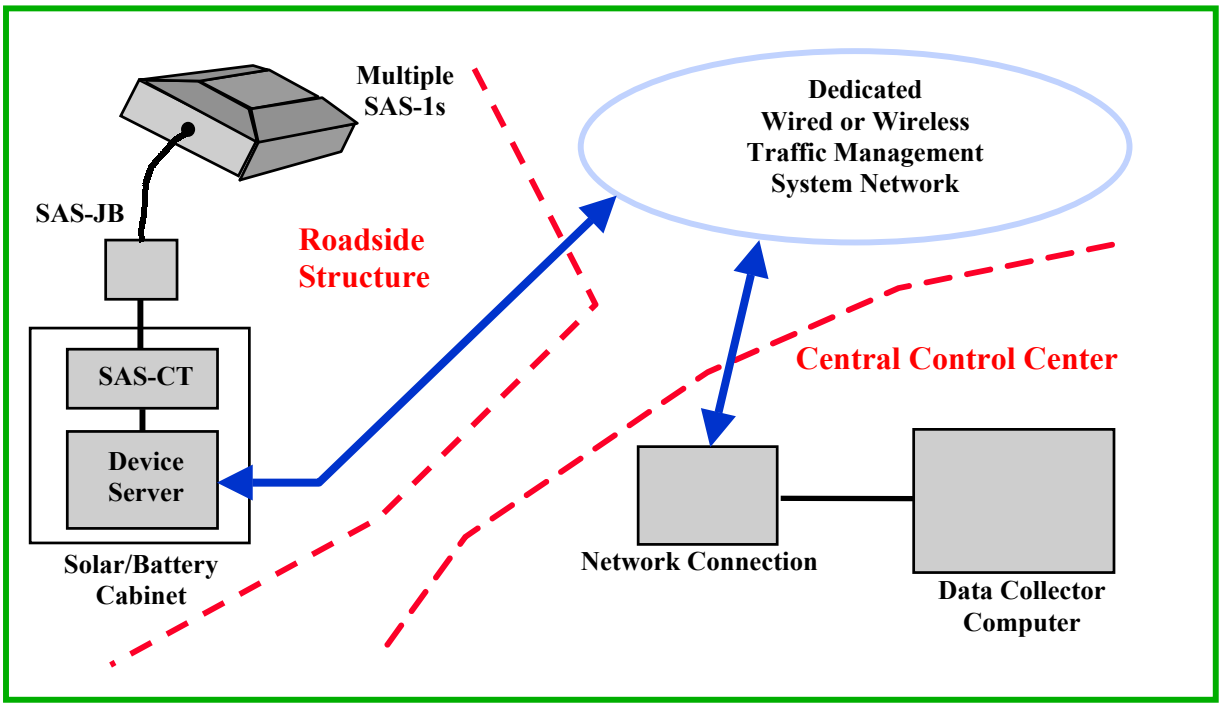

Figure 4 SAS-1 Dedicated Network Link to Central Control Center