S5
Communications

Rev. 1

S5 Communications

For a complete understanding of the S5 Battery Validation System (BVS) communication options, it is necessary to understand the measurements performed by the S5 controller and the alarms it generates. This explanation will be followed by a thorough description of the communication options available to the S5.

S5 Measurements and Alarms

The S5 measures unit and system battery voltage, ambient temperature, and pilot-cell temperatures in real time. These measurements and unit impedance measurements are also performed at a programmable interval and the resultant measurement values are stored in memory. Since impedance changes gradually, the default measurement interval is weekly. Five sets of measurements can be stored in the memory of the S5's computer. Once the memory is full, new measurements will overwrite the oldest data. A PC running the BVM software should be used to retrieve the measurements for permanent storage and analysis.

The S5 has programmable limits for all the measurements it takes and will alarm if a measurement exceeds its allowable limits. For unit voltage and impedance measurements, there are two sets of limits for voltage and impedance: critical and maintenance. Maintenance alerts are less serious than critical alarms and are generated only when maintenance alarm limits are exceeded after an impedance measurement is taken.

If the S5 finds any measurements outside of the programmed limits, it will re-check the measurement before going into alarm. The S5 can hold up to 32 alarms and alerts in memory. Six dry contact alarm outputs are available for relaying alarms to external devices. One or more alarm conditions can be defined for each alarm relay output. There are also four digital inputs which can be used to relay alarms from external equipment to the S5.

When the S5 detects a battery discharge, it records the start and stop time of the discharge. These discharge intervals are stored in the memory of the S5's micro-controller. At the beginning of the discharge, the S5 starts recording the battery voltage and battery current at one-second intervals. After 15 seconds (user programmable) it will generate a discharge alarm. Also after 15 seconds (user programmable), it begins recording the unit voltage at one-minute intervals (also user programmable) and the battery voltage and battery current four times during this interval (default is 15 seconds). This data is stored in memory for later retrieval and archiving by a PC running the BVM software.

Battery system diagnostic measurements and functions may be performed on-site or remotely using the BVM software. The software can also retrieve the alarm status, the last measurements, and discharge measurements. Alarms can also be reset remotely. The configuration of the S5 as well as limit settings can be modified through the BVM software.

Measurement data and alarms can also be retrieved from the S5 controller via TCP Modbus. See the BTECH document titled "S5 TCP/IP Modbus Registers" for a further description. Alarms are also available via SNMP. More information is available in the document titled "S5 SNMP". Both of these documents are available on BTECH's website (www.btechinc.com).

The remainder of this document will focus mainly on communications between the S5 controller and BVM software package. Various pieces of software make up the BVM software package. The main component of the software package, the Battery Validation Manager 4.1, provides graphing and reporting of data from each S5 BVS as well as handling the various settings. The BVM program also allows the user to communicate manually with the S5 to perform diagnostics, change the configuration, change alarm limits, and view voltage, current, and temperature in real-time. Another component, the BVS Observer, automatically polls the S5 for data and receives and communicates alarms according to the method chosen by the user. Any alarms generated by the BVS will be automatically sent to the BVS Observer (user configurable). The BVS Status Monitor software allows the user to organize a number of S5 controllers into logical groups and quickly see the status of the batteries they are monitoring.

The S5 BVS is factory equipped with four different communications options:

1) Serial – A 9-pin female serial port is located on the front panel of the controller and configured as a DTE. Attaching a computer to this port may override the dial modem and will be indicated by a blinking orange power LED.

2) USB – A type B USB port is available on the front panel of the controller. The use of this port will require the installation of a Windows driver. The driver is available as part of the BVM software installation or can be installed separately from Windows Update. Attaching a computer to this port will override the use of the front panel serial port (it uses the serial port internally) and may override the dial modem port. The override will be indicated on the front panel by a blinking orange power LED.

3) Dial Modem – An internal dial modem is available to be attached to a phone line. The RJ-22 jack is located on the rear of the controller.

4) Network Interface – A RJ-45 jack is located on the rear of the controller for an Ethernet connection.

Only communications with the BVM and BVS Observer software is supported through the serial port, USB port, and the dial modem. The network interface supports communications with BVM and BVS Observer as well as SNMP and Modbus.

The S5 controller can communicate via two of its communication interfaces simultaneously since the dial modem and network interface have separate communication paths internally. The preferred options should be set via the BVM software from within the Controller Configuration Page. Communication via one of the front ports is always possible since it will override one of the other communication paths.

Managing Multiple S5 BVS's

As the number of S5 battery monitors within an organization grows, a structured deployment plan is recommended. Some considerations are whether the BVS is managed locally or from a central monitoring station. Some organizations require each location to manage their own batteries, while others are managed from one central location. Another option is to allow BTECH to monitor the batteries for the organization. **These decisions will determine the methods used for communication with the S5 BVS's.** Choosing the appropriate communication option is largely a matter of corporate policy and the customer's decision on a monitoring strategy. Due to the flexibility of the multiple communication interfaces built into the S5, each situation can be handled with only minimal changes to the controller's configuration. After proper configuration, it will provide the user with a full complement of measurement and alarm features.

The BVM software also allows organization to manage users; their identification and level of access. This will help to designate responsibility for the role of administrator and users. The primary responsibility of a BVS User is to address battery issues with data from the BVS. An Administrator should be capable of providing a trouble-free working environment for the user. Some primary administrative tasks include: deciding who receives and responds to BVS alarms, which methods to employ to receive alarms, i.e. SNMP, MODBUS, dry contact relays, and the back-up of BVS data and configuration files as well as the BVS configuration files.

S5 Serial and Dial-up Communication

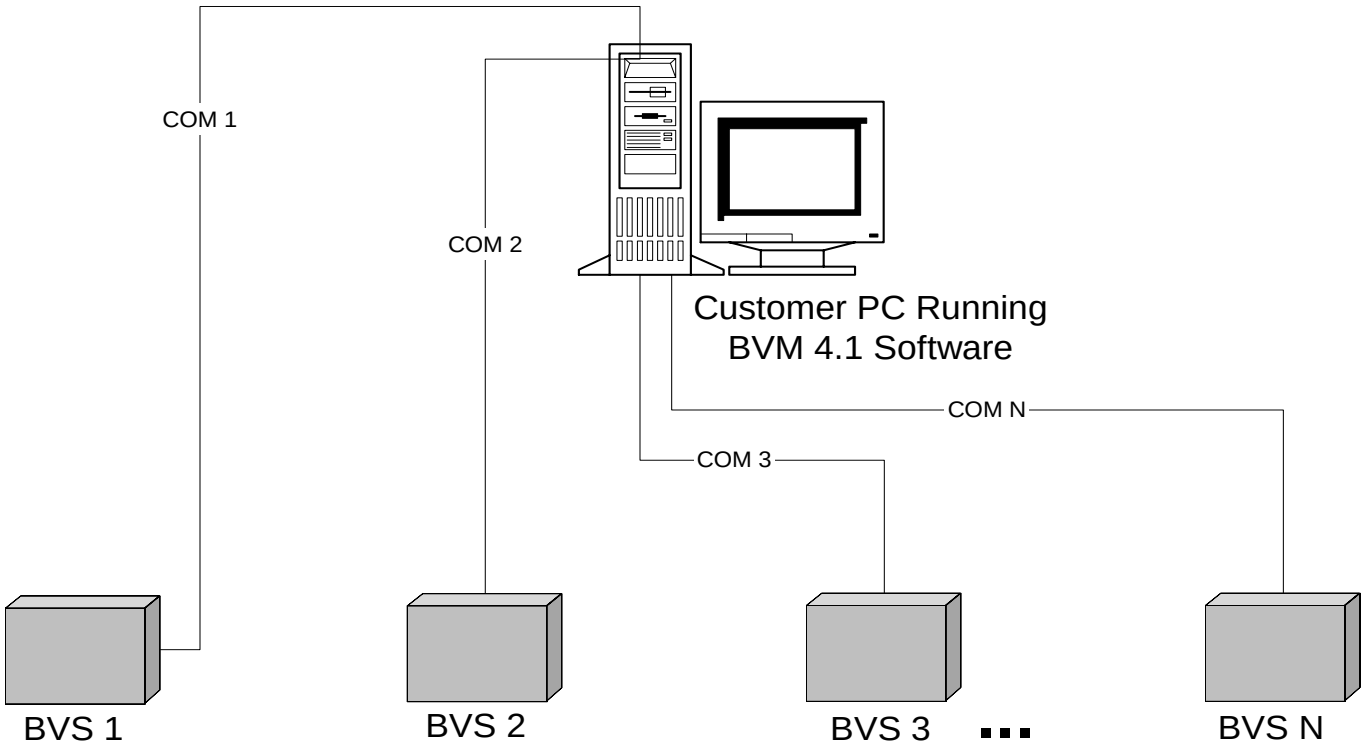
Serial and USB communication

These local ports are normally intended for on-site trouble-shooting and firmware upgrade. They are also an expedient way to connect several BVS's in close proximity to a monitoring computer running the BVM software. The limitations are determined by the distance from the BVS to the computer and the number of serial and USB ports available on the host PC. This option is viable for local monitoring for a site with no Ethernet connectivity. Figure 1 illustrates serial connection setup. Connecting via the USB port is similar. (See figure 1 and Communication Options flowchart)

Dial-up modem

The S5 is equipped with a built-in telephone modem; only requiring a phone line to gain access to the BVS. Any computer equipped with a modem and running the BVM software is able to connect to the S5 BVS and perform all the functionalities available. This is a viable option for customer remote access needs and for gaining access to BTECH's Remote Battery Monitoring Service. A modem connection in conjunction with a network connection offers redundancy for critical access needs.

There are two possible configurations for dial-up access that are dependent on phone line availability. A single phone line may gain access to multiple BVS via a Teltone switch. This switch works by using extra DTMF codes sent by the dialing modem to call a specific BVS attached to the switch. The limitation of this approach is that no two BVS's may be accessed simultaneously, since all BVS's share the same line, which makes it a less fault tolerant configuration. A better approach would be to connect a single phone line to each BVS. (See figure 2 and 3)



BVS Serial Connection

Fig 1

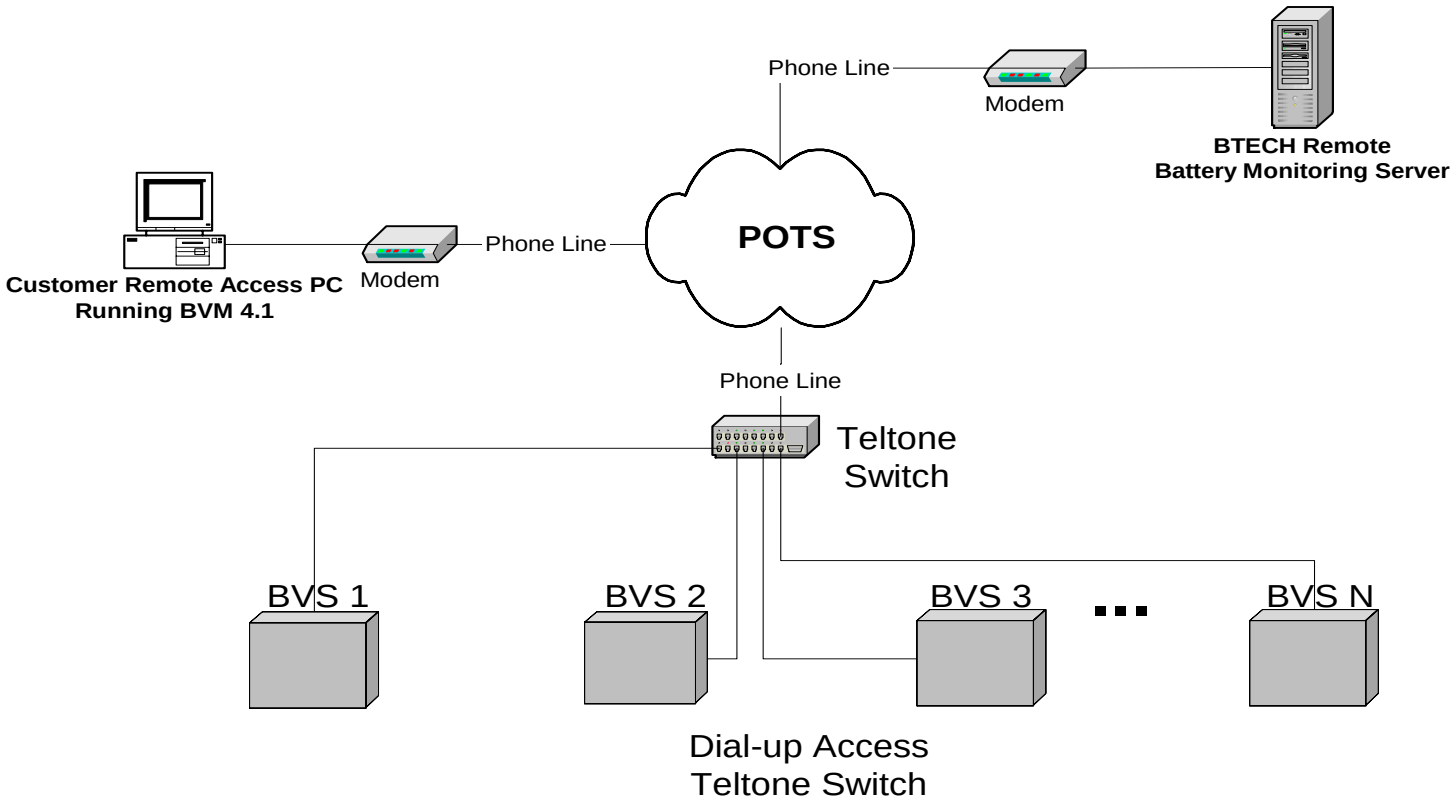
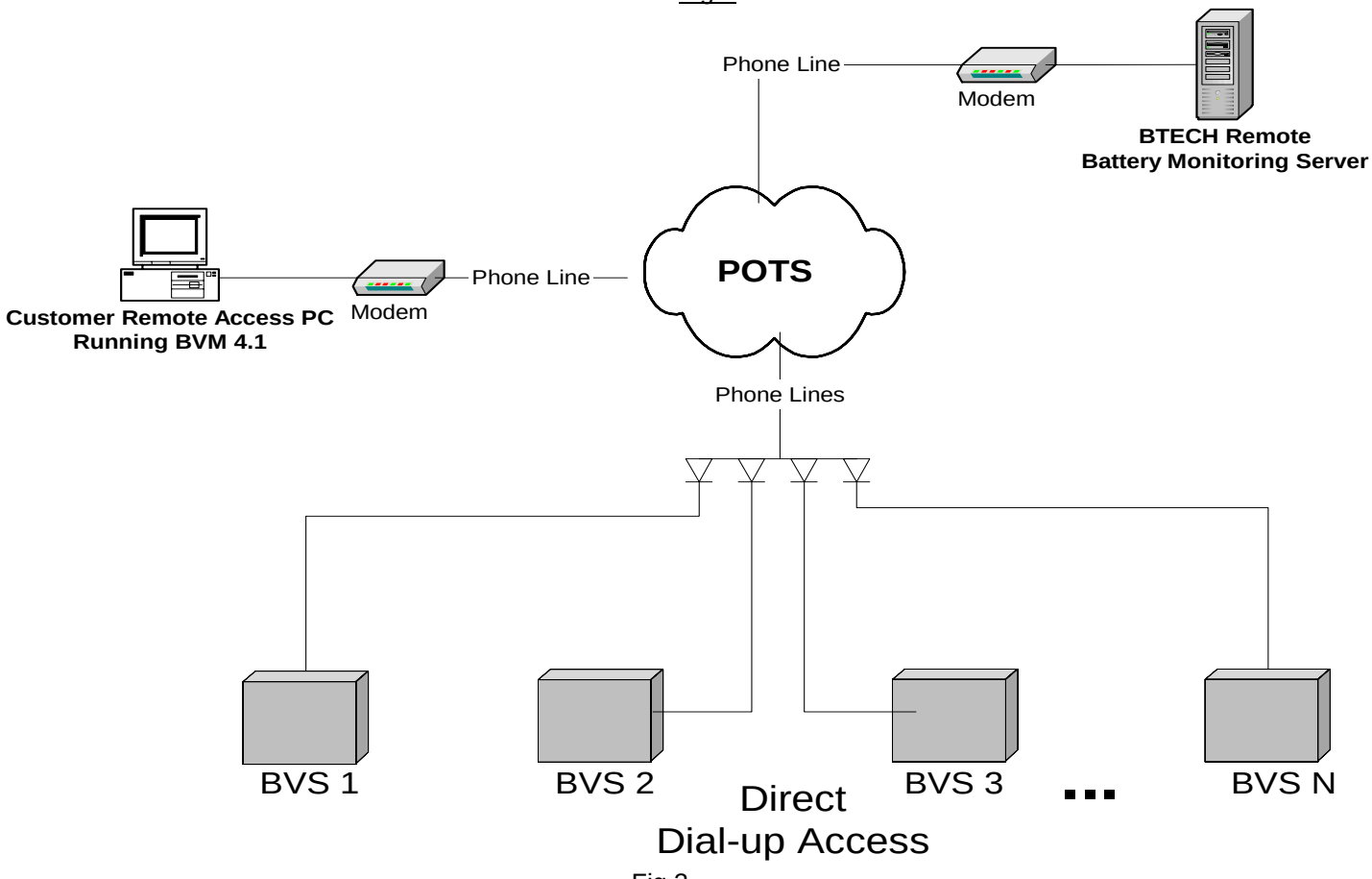

Phone Line
Modem
BTECH Remote
Battery Monitoring Server
POTS
Customer Remote Access PC
Running BVM 4.1
Modem
Phone Line
Phone Line
Teltone
Switch
BVS 1
BVS 2
BVS 3
BVS N
Dial-up Access
Teltone Switch

Fig 2


Phone Line
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BTECH Remote
Battery Monitoring Server
POTS
Customer Remote Access PC
Running BVM 4.1
Modem
Phone Line
Phone Lines
BVS 1
BVS 2
BVS 3
BVS N
Direct
Dial-up Access

Fig 3

Network Communications Overview

Networks are a collection of independent computers that communicate with one another over a shared network medium. Network protocols allow different computers to communicate using the same language. The physical network layer defines how the information being transferred over the network by the network protocol actually gets transferred. Each physical network layer uses one or more types of network media to carry the data by electrical impulses or light. Depending on the network media, the network can be arranged in different topologies.

Networks are usually classified into two different types: LANs and WANs. A LAN (local area network) is a network usually confined to a geographic area, such as a single building or a college campus. LANs may link many hundreds of computers and be used by thousands of users. A WAN (wide area network) is the connecting of multiple LANs that are separated geographically. The largest WAN in existence is the Internet.

Protocol

The most commonly used network protocol today is TCP/IP. TCP/IP is made up of a number of different protocols that are built upon one another. Each computer on the TCP/IP network is identified by one or more IP addresses made up of four bytes each. Each computer with an IP address also may have a number of ports or sockets that exist as part of the TCP/IP protocol. The protocol we are primarily interested in is the Transmission Control Protocol (TCP), a reliable, connection oriented byte-stream protocol. With TCP there is an end-to-end connection between the two communicating computers. Error correction is used to insure that all the data travels through the network without being corrupted. The TCP connection is made between a source and destination port on the two host computers to allow more than one connection to take place at one time on each computer.

Network Physical Layer

Ethernet is the physical layer most commonly used in TCP/IP LAN. This technology is only concerned with transferring a packet of data between two network cards on a network. Different types of media can be used for Ethernet. Currently, the most common type of media is twisted pair which uses unshielded twisted pair wiring for connecting nodes (A node is an active device connected to the network such as a computer, printer, or a piece of networking equipment such as a hub, switch or router.). A hub or switch is needed to join the twisted pair connection from each node together. Currently there are different speeds and duplex settings available. The S5 controller is 10 MB / second, half-duplex. Most switches or hubs automatically switch to match the communication properties of the device connected to it.

Another type of media is fiber. It is more expensive and used only in specialized applications, yet it allows a high level of noise immunity and isolation and can be used over longer distances.

Bridges and routers are complex network devices used to connect separate networks together. They perform filtering and forwarding operations to reduce the network traffic and improve the performance of large networks.

S5 Network Communications

The Battery Validation Manager 4.1 (BVM 4.1) software communicates over a TCP/IP network to the S5's standard network interface. The software requires Windows XP, Window Server 2003, or Windows Vista. The PC must also have a network interface and the TCP/IP protocol installed (which is part of the operating system). Configuring network communication requires setting parameters in the S5 BVS and BVM 4.1 software. The only parameters that need to be set in the software are the IP address of each S5 controller and the port number (the address on the S5 controller for BVM communication is 3001). It is important that the IP address assigned to the computer running the BVS Observer and receiving alarms from the S5 battery monitor via the network does not change. This can be done by assigning a static IP address to each S5, or if using DHCP, by "client reservation" which assigns the IP address based on the MAC address of the network interface.

The S5 network settings are set through the BVM 4.1 software, usually from a PC connected to the front panel of the S5 via the serial or USB port. Both static and dynamic IP addresses are supported. To use DHCP, set the S5's address to 0.0.0.0. Static IP address assignment for the S5's, as well as the subnet mask and gateway address, is set by the BVM software. If the S5 controller will be configured to send alarms to the BVS Observer software via the network, the Destination Address, i.e. the IP address of the computer running BVS Observer software, and Destination Port (default 8842) will also need to set.

Network communication offers the highest performance and is the most reliable communication option available. When choosing network communication options, consideration must be given to the scope of access and administrative responsibility over distributed BVS installations. The BVS network interface may be attached to any Ethernet LAN segment using TCP/IP. After proper configuration, it will provide the user with the full complement of features. For a comprehensive approach to battery monitoring and communication options refer to the Monitoring Option and Communication Option flowcharts.

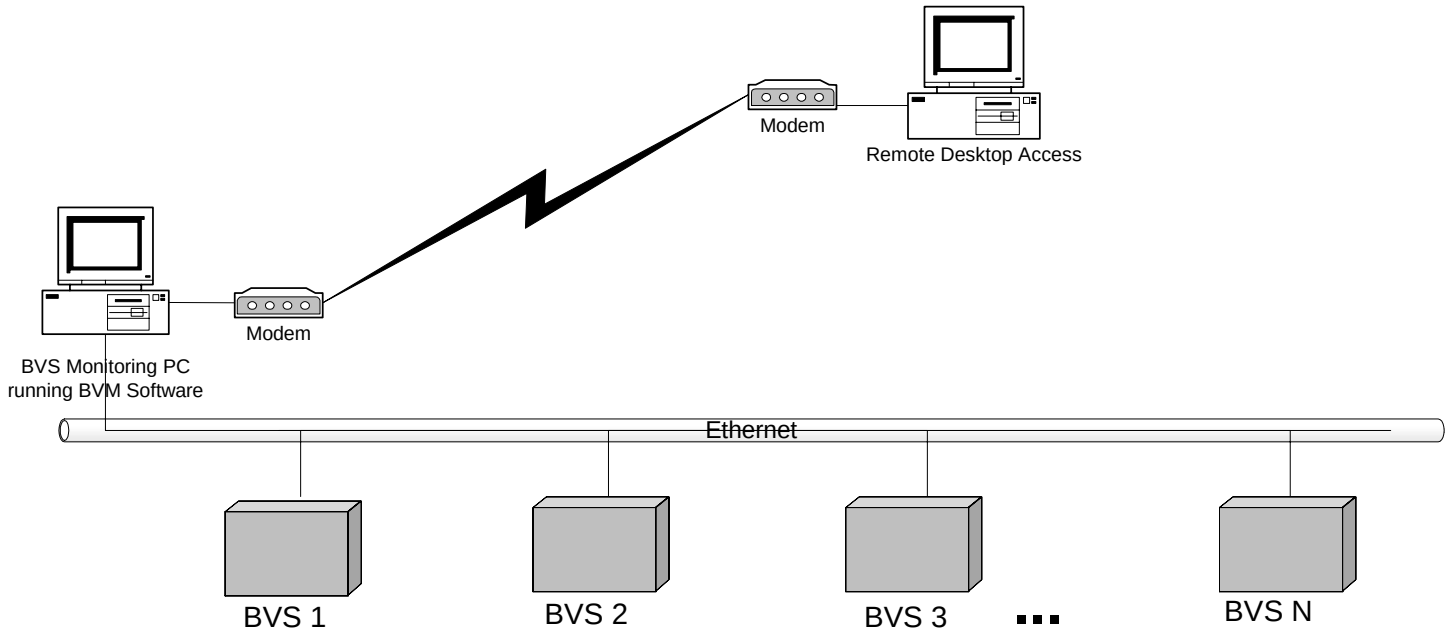
Standalone Network

A standalone network that is isolated from the company network offers the least administrative overhead to setup. The hardware required are a PC and a switch or hub. Linking multiple hubs or switches may be used to handle any number of S5 battery monitors. Any private IP class may be used to configure the network. This option is viable for local site management and monitoring of multiple BVS.

Remote monitoring of the standalone network can be performed via telephone modem or over the Internet. Modem access to the BVS may be established directly to the BVS or through a remote desktop session via two computers. If a BVS user wishes to access any BVS on the network, a modem equipped PC or laptop can dial into the host computer to establish a remote desktop session with a single phone line. The Remote Access application is available on most Windows' platforms. For direct BVS access via telephone modem, two options are available, single phone line via a Teltone switch or independent phone lines to each BVS. When multiple telephone lines are available, each BVS may be connected directly to establish a monitoring session without incurring the delays introduced by the Remote Access application. (See figures 3, 4, 5, and 6)

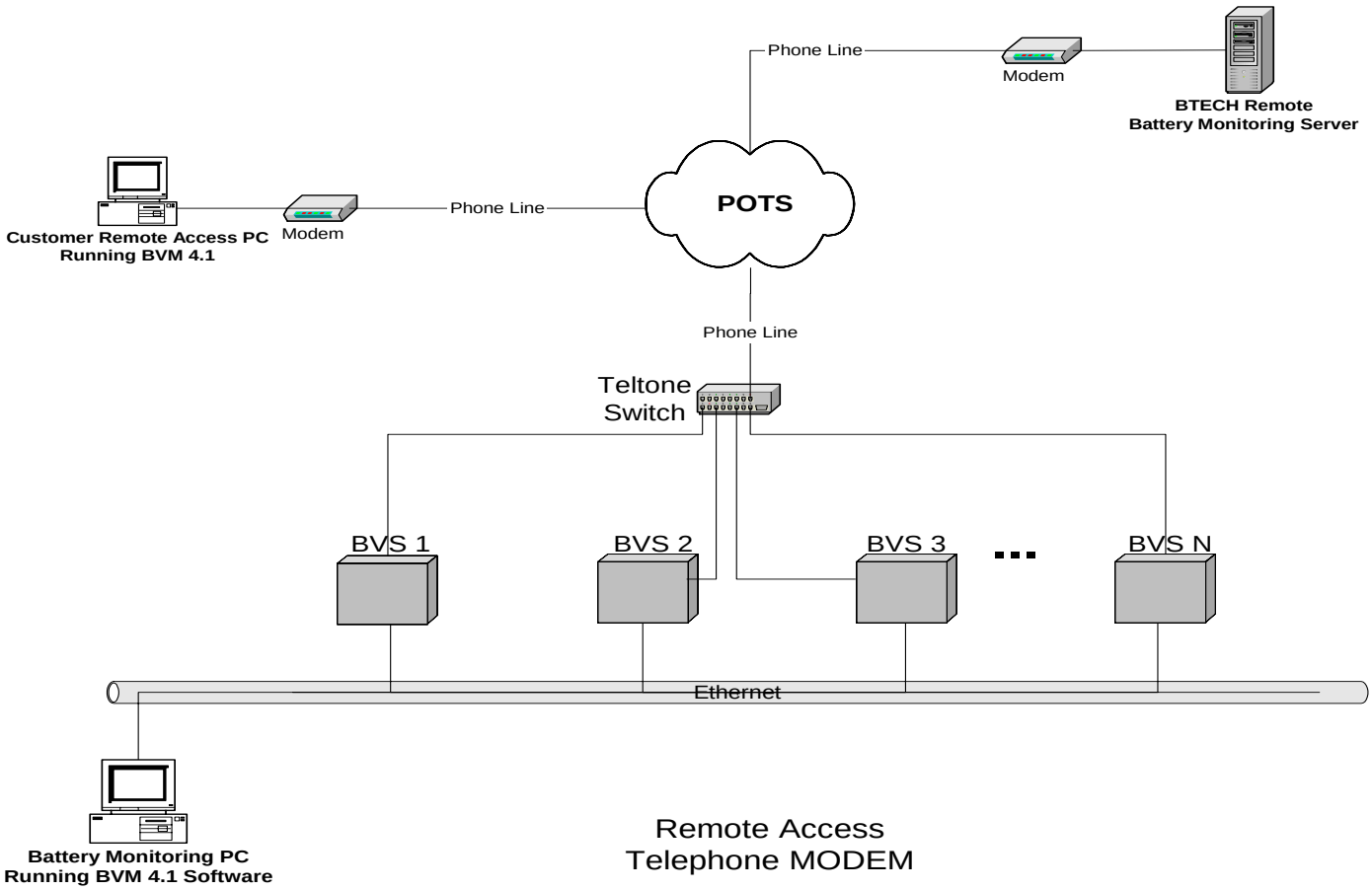
A more robust option would be a broadband connection to provide Internet access to the standalone network. This service is commonly referred to as business class DSL or Cable Internet access service with Static IP. With the correct router configuration, this option will allow direct access into any BVS over the Internet and will provide high performance communication for remote monitoring. Internet access to the BVS incurs less delay for relaying alarms and email alerts then a telephone modem connection. It is well suited for gaining access to BTECH's Remote Battery Monitoring Service. (See figure 7)

If remote access is unavailable, access to the BVS's will be limited to the local network and remote notification from the BVS Observer for alarms and analysis will not be possible.



Standalone LAN with
Remote Access Application

Fig 4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BVS 2
BVS 3
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Ethernet
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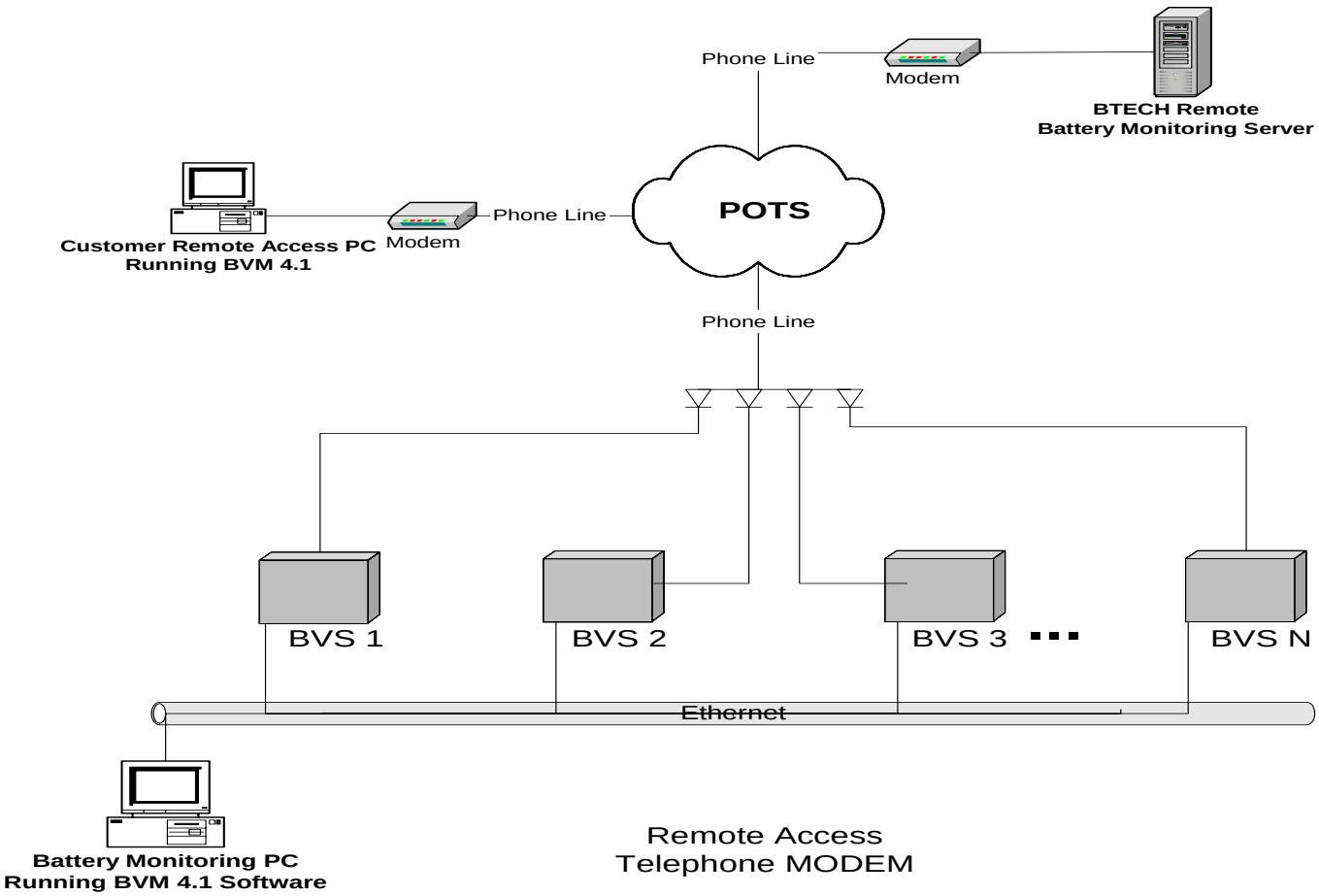
Running BVM 4.1 Software
Remote Access
Telephone MODEM

Fig 5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BVS 2
BVS 3
BVS N
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Running BVM 4.1 Software
Remote Access
Telephone MODEM

Fig 6

Integrating the BVS into the Corporate Network

Deploying the BVS within the organizational network provides high performance, ubiquitous access and a means of integrating the SNMP and MODBUS network services into the organization. The S5 BVS will instantly transmit alarms across the network. Users and administrators may connect to the BVS to interrogate their battery system or retrieve data on any computer running the BVM 4.1 software. BVS alarms may be directed to a Network Management System. A Building Management System or a MODBUS Master can access the BVS MODBUS protocol. Networks extending over the Wide Area (WAN) may notice minor delays for alarm relay or data retrieval from the S5 BVS. This will depend on the speed and the amount of traffic carried over the WAN link. In general, the delay is negligible given the low bandwidth demand from the S5 BVS.

The BVS may be configured for any subnet on the network or may connect to the network via the DMZ. This decision is dictated by company policy. DMZ deployment may require additional firewall configuration to access inbound and outbound traffic from the S5 BVS to internal computers. Several ports are used by the S5; TCP port 3001 and 8842 are use for inbound and outbound traffic, respectively. The BVM 4.1 application initiate communication to the S5 through port 3001 and the BVS Observer listens on port 8842 for outbound S5 connections. The S5 SNMP service uses UDP 161 for inbound queries and UDP port 162 for outbound traps. The S5 MODBUS protocol uses TCP port 502 for inbound and outbound connections. External access to the BVS must be explicitly granted via company network securities measures. External monitoring services may be leveraged with coordination from the appropriate network group to allow exterior connections to gain access to the S5 BVS.

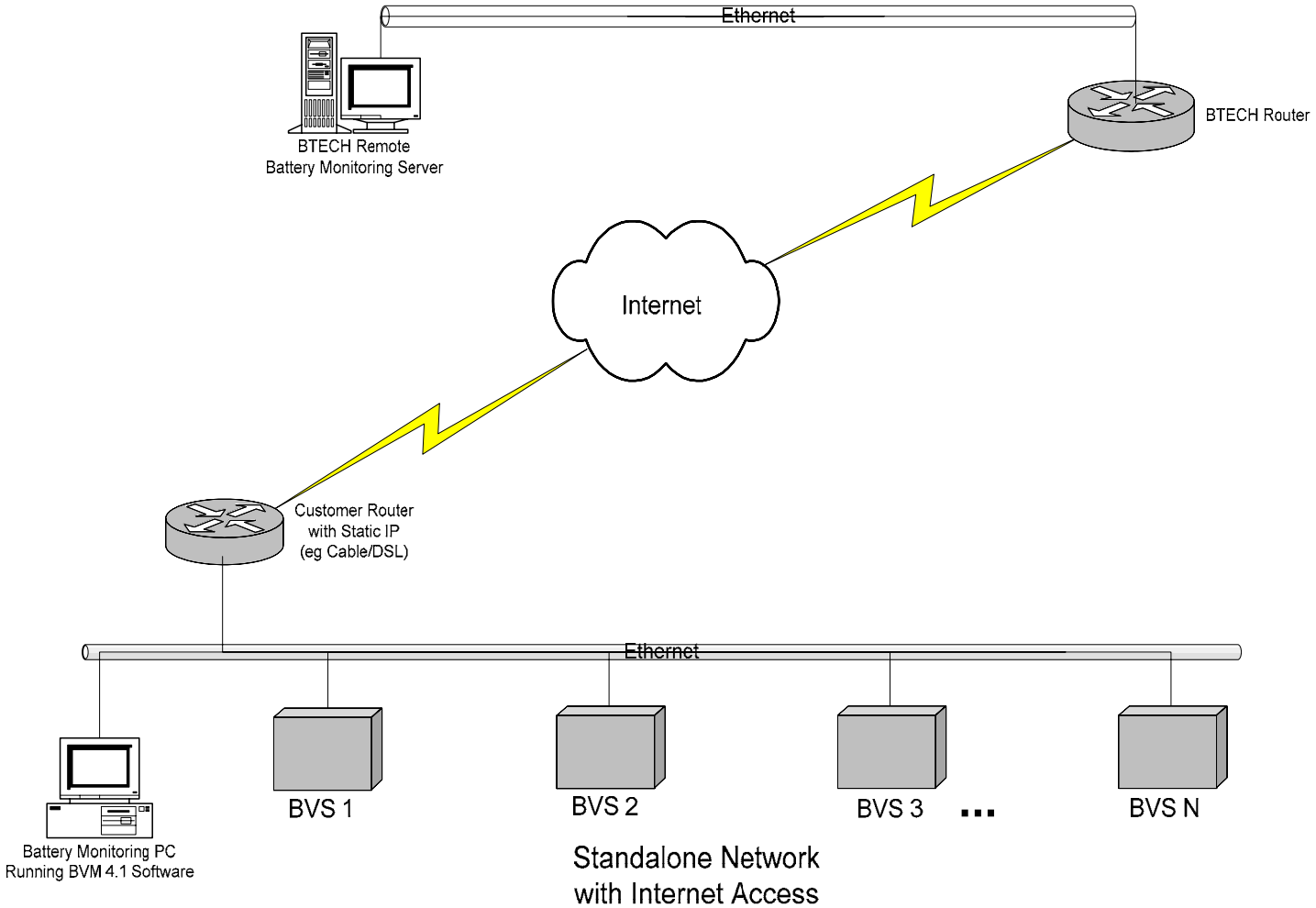
Communications to the S5 is limited to the user's internal network when it is configured on the inside firewall interface. Remote access to the BVS may be accomplished via a VPN (virtual private network). If external access to the BVS is not possible, the only way to use BTECH's Remote Monitoring Services is to enable the BVS Observer that is running within the user's internal network to email out the measurement data to BTECH's Remote Monitoring Server. The configuration is performed within the Observer Settings screen in the BVS Observer. Data is emailed out as comma delimited text files attached to an email. This occurs whenever the BVS Observer receives an alarm or gathers new data.

The BVS may also be connected to a perimeter network (also called a DMZ) for inbound connections from external networks, usually the Internet. The DMZ network will allow inbound connections from its internal or external networks to its hosts, but does not allow outbound connections from the DMZ to its internal networks. Servers that need to be accessible by external networks (Internet) such as web and email servers are typically placed on a DMZ network. Access to hosts on the DMZ network is usually limited by a firewall. Placing the BVS on the DMZ will allow monitoring by BTECH's Remote Monitoring Server as well as by machines on the internal corporate network. External access to the BVS must be explicitly granted via company network securities measures. Security risk from communicating over the Internet is reduced by limiting the connecting between only the BTECH's Remote Monitoring Server and the target S5 BVS. Inbound connections to the S5 BVS originate from the BVM and Observer software over TCP port 3001. Outbound connections, triggered by alarms from the S5 BVS are sent over TCP port 8842.

The following diagrams, figures 7 and 8, illustrate common network placement and connections for the S5 BVS.

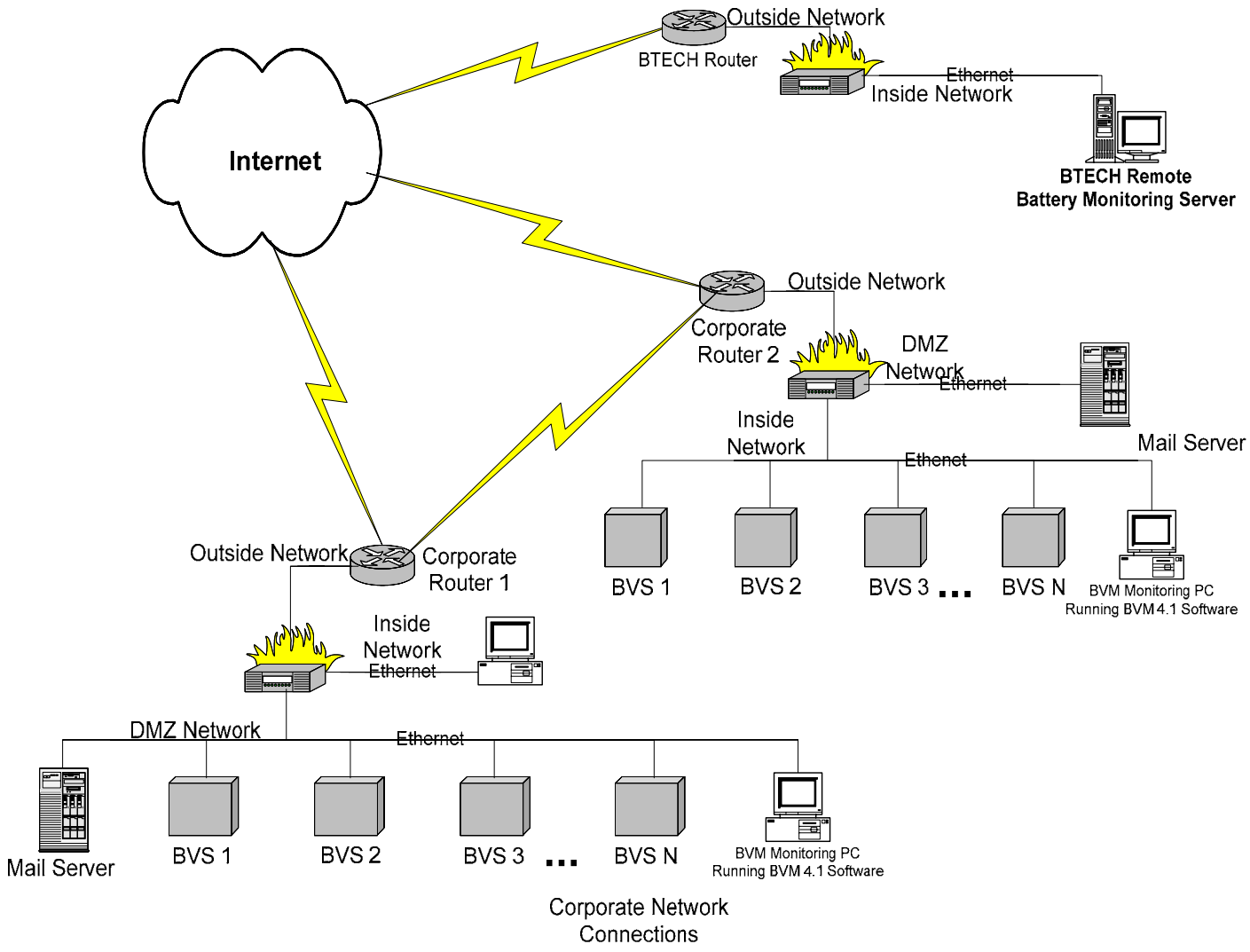
Conclusion

This explanation and the associated diagrams are designed to help you in understanding the different communication options available to communicate with the S5 BVS. Should you have any questions, please feel free to contact BTECH at 973-983-1120.



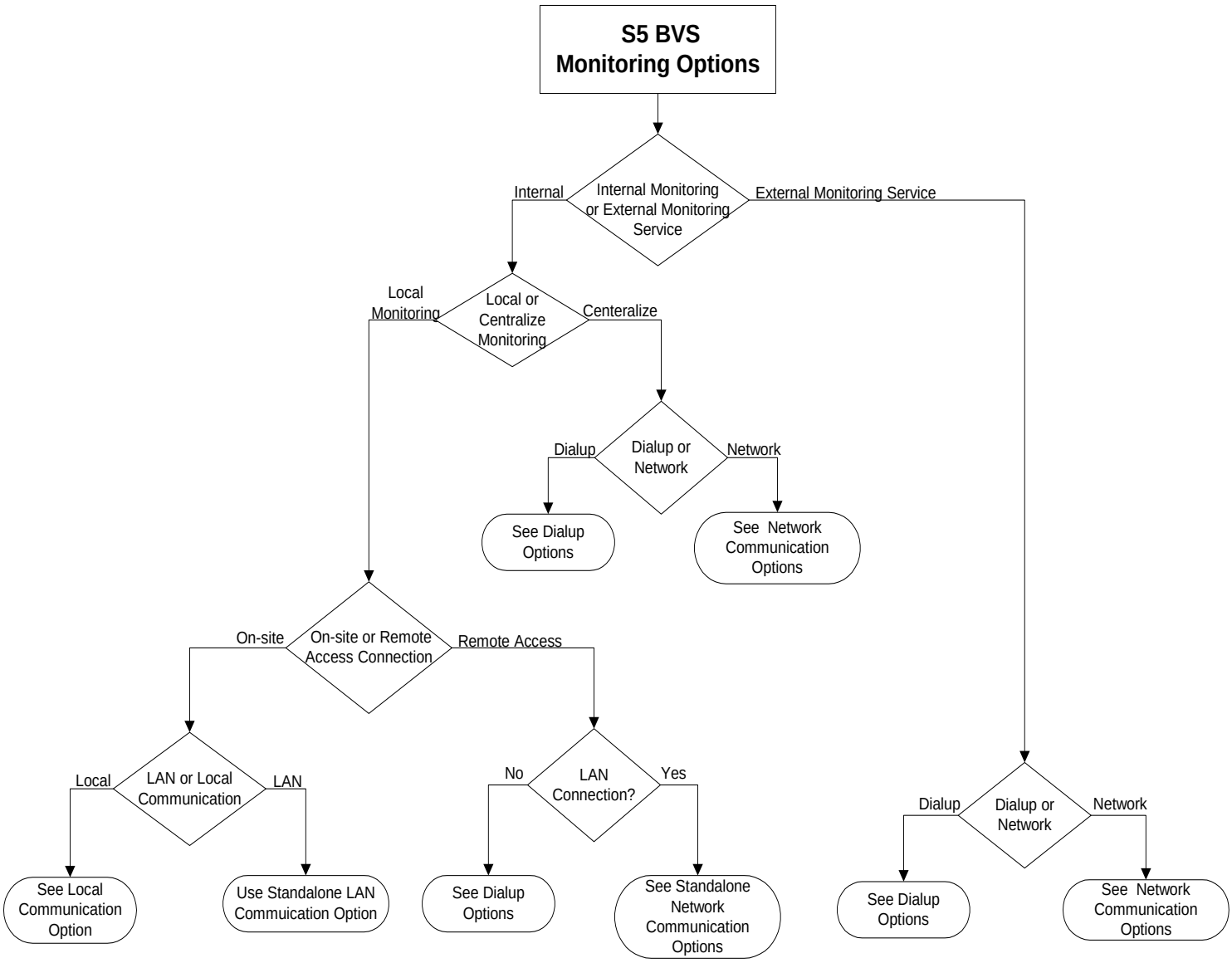
Standalone Network
with Internet Access

Fig 7

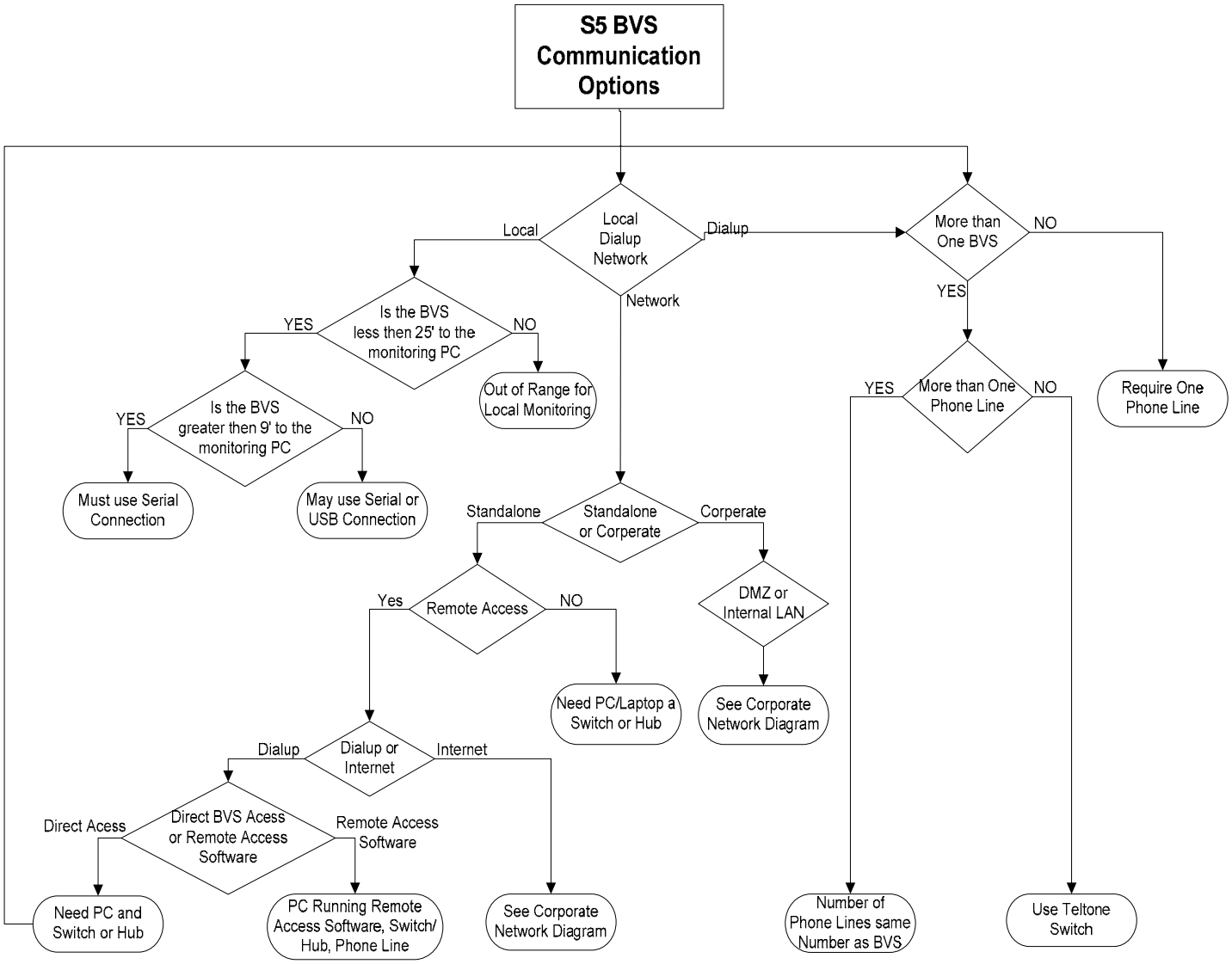


Corporate Network
Connections

Fig 8



Monitoring Options
Flowchart



Communication Options Flowchart