MSA Link™ Pro Software
Technical Overview

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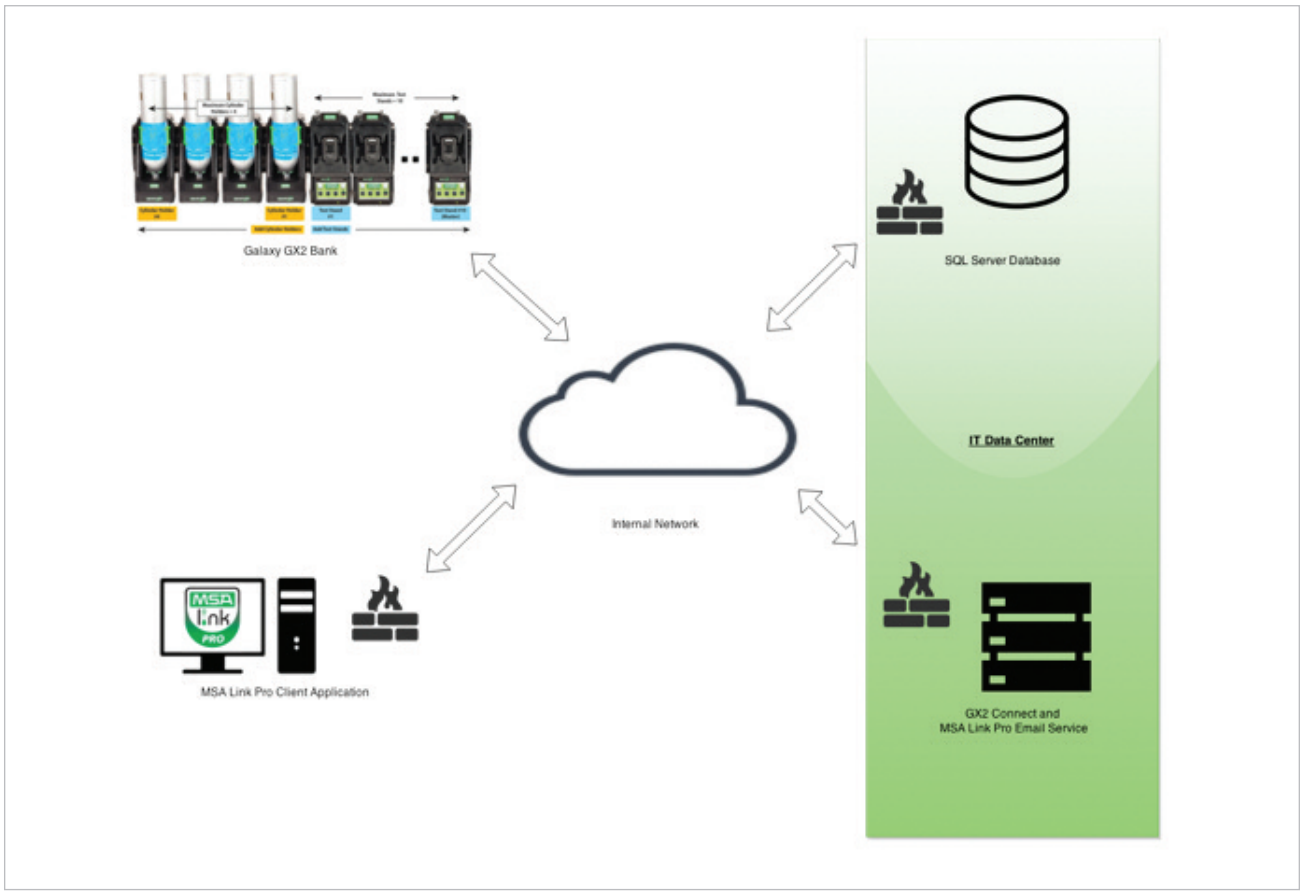
Summary

This summary provides details of GALAXY® GX2 System information technology-related components and offers a consolidated system outline for successful setup of MSA Link Pro Software.

Key Terms

Term	Meaning
BANK	A group of connected calibration stands. A calibration stand bank has 1-10 calibration stands.
MASTER CALIBRATION STAND	The right-most calibration stand within a bank. Master calibration stand provides primary communications functions for the bank and SD card storage location.
SLAVE CALIBRATION STAND	Any calibration stand that is included within the bank but is not the master. Slave calibration stands perform all instrument tests and calibrations, but provide limited external communication.
SESSION LOG	Detailed log of significant instrument-related events; examples include exposure alarms, low battery alarms and bump tests performed.
PERIODIC LOG	Detailed log of instrument gas measurements.

General System Component Diagram



Note: GX2 Connect Server and SQL Server database may reside on different servers or virtual machines.

Component Overview and Summary

MSA Link Pro Software includes the following components:

Name	Primary Responsibilities	Recommended Location
CALIBRATION STAND	• Performs instrument bump and calibration procedures. • Downloads instrument session and periodic data logs. • Stores bump and calibration results to SD card. • Communicates real time event updates (such as cylinder low or calibration stand errors), test records (bump and calibration results) and downloaded data logs to GX2 System Connect Service.	Repair shop or other location where end users have direct access to test their gas detectors. Note: Calibration stand is a stand-alone hardware appliance.
GX2 CONNECT SERVICE (WITH MSA LINK PRO SOFTWARE EMAIL SERVICE)	• Maintains constant network connection with all configured GALAXY GX2 System calibration stands. • Stores received data from GALAXY GX2 System calibration stands to SQL Server database. • Provides login authentication for all MSA Link Pro Software Client Application connections. • Centralizes communication with GALAXY GX2 System calibration stands. • Sends email notifications of key system events (such as instrument alarms, overdue or failed instrument tests or low cylinder pressure).	IT server room (specifically on any Windows application server)
SQL SERVER DATABASE	• Provides long-term storage for any data collected through GALAXY GX2 System calibration stands. • Centralizes configuration of email settings and GALAXY GX2 System calibration stands.	IT server room (specifically on any database server)
MSA LINK PRO SOFTWARE CLIENT APPLICATION	• Provides user interface for viewing stored and real time data within MSA Link Pro Software. • Facilitates creation of reports based upon calibration data. • Allows calibration stand configuration.	End user computers or tablets

Installation Requirements

Name	Installation Requirements	Notes
CALIBRATION STAND	N/A. This hardware solution contains Windows CE 6.0 embedded on the device.	
GX2 CONNECT SERVICE (WITH MSA LINK PRO SOFTWARE EMAIL SERVICE)	Software is compatible with: • Windows 7 SP1 • Windows 8/8.1/10 • Windows Server 2008 R2 • Windows Server 2012/2012R2 Requires .NET Framework 4.5	System is designed to support 1:1 configuration of GX2 Connect Service and SQL Server database
SQL SERVER DATABASE	The following SQL Server versions are supported: • SQL Server 2008 R2 • SQL Server 2012 • SQL Server 2014 Note that full express installation automatically installs SQL Server 2014 Express. All SQL Server editions listed above and including Express are supported for custom installations. **Note: SQL Server database need not be installed on the same server as GX2 Connect Service.** **Note: MSA recommends that users implement a backup policy for the SQL database itself. Due to availability of easily available database backup tools, MSA does not provide a recommended tool for SQL Server backup generation and recommends that company best practices are followed.**	The following special configurations must be completed within SQL Server: • Only SQL authentication is supported. • File streams must be enabled.
MSA LINK PRO SOFTWARE CLIENT APPLICATION	Software is compatible with: • Windows 7 SP1 • Windows 8/8.1/10 • Windows Server 2008 R2 • Windows Server 2012/2012R2 Requires .NET Framework 4.5	MSA Link Pro Software client requires a USB hardware key to be in place to license the application.

SQL Server Permissions

After installation of MSA Link Pro Software, the SQL Server account may be modified for the following permissions on the GX2AllTables database:

- db datawriter
- db datareader

Note: During installation, upgrade or maintenance of the SQL Server database, temporary permission elevation is required as MSA continues to evolve database design as needed to support new features or enhancements; database migrations will be required. If a DBA desires to perform database migration manually, a SQL migration script can be provided by request only.

System Communications within MSA Link Pro Software

All communications within MSA Link Pro Software conform to these standards and guidelines:

- All messages are sent using TCP/IP messages. Use of TCP/IP messages allows robust configuration options to optimize system performance and security. The following options are system-configurable:
  - GALAXY GX2 System calibration stand communications port
  - MSA Link Pro Software Client Application communications ports
  - Message timeout
  - Heartbeat interval
  - Retry interval (on calibration stand)
  - Session timeout (on calibration stand)
- All messages are encoded and compressed to reduce message size and ensure data integrity.
- All data log transfers from calibration stands to GX2 Connect Service are compressed using zip format prior to transmission to reduce bandwidth and network strain.

Sensitive Data Protection

MSA Link Pro Software uses the following methods to protect sensitive information:

- AES Encryption of SQL Server user name and password. Note: SQL Server credentials are stored only on GX2 Connect and MSA Email Service. Upon successful login to MSA Link ProSoftware, GX2 Connect will send the MSA Link Pro Client the SQL Server connection information (with AES encrypted user name and password).
- MD5 hashing of user passwords. MSA Link Pro Software does not store raw passwords within the system or database; rather it simply stores the MD5 hash of the user password. This one-way hash is verified upon login to MSA Link Pro Software.

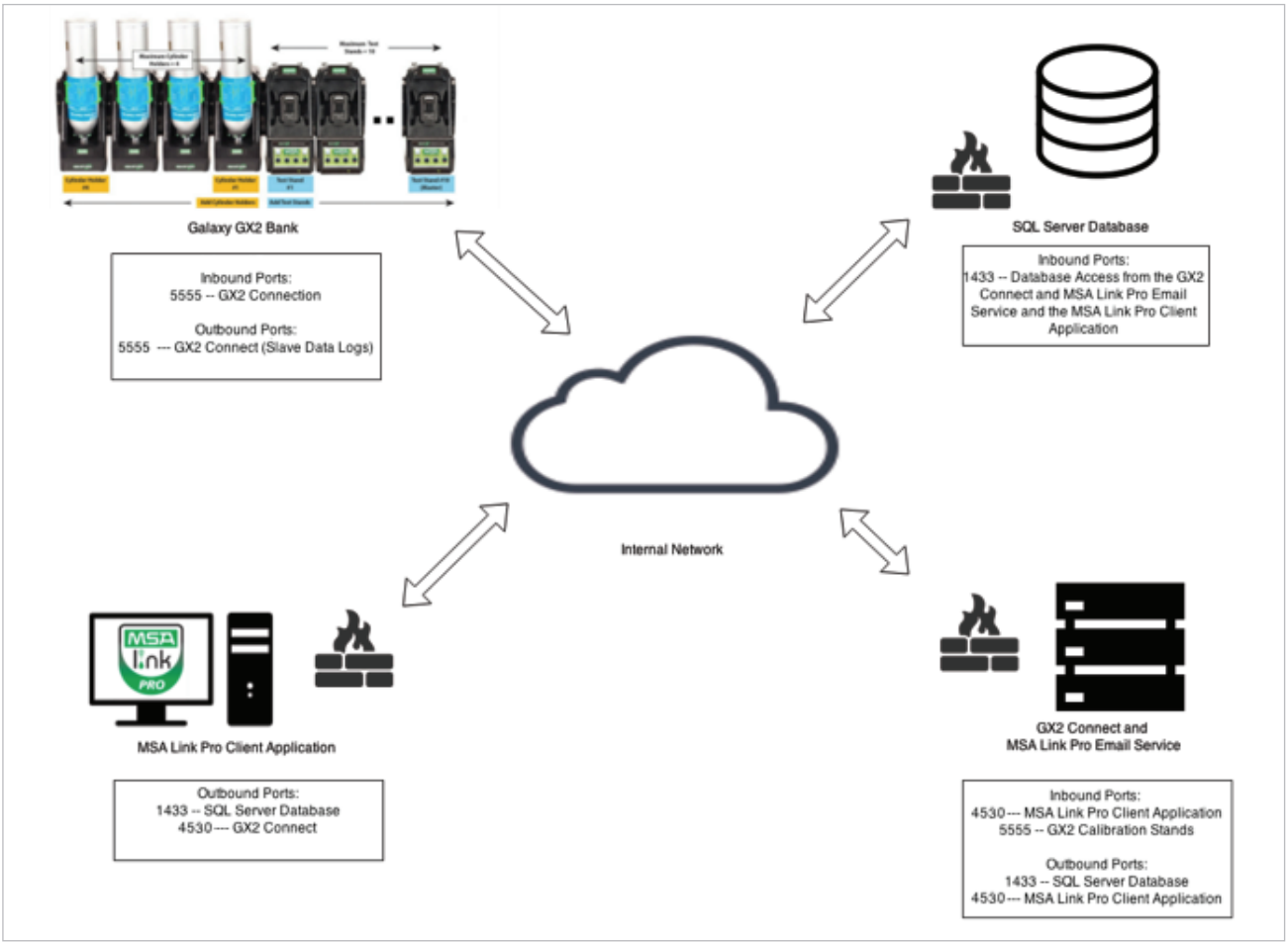
Firewall and Connectivity Overview

This table provides a firewall and connectivity overview. Summarized data also displays as a diagram following detailed overview.

Name	Inbound Connectivity	Outbound Connectivity	IP Addressing Required
GALAXY GX2 SYSTEM CALIBRATION STAND	Master calibration stands: • *Port 5555 from GX2 Connect Service.* GX2 Connect Service initiates connection via TCP/IP calibration to monitor for events. Slave calibration stands: • None	All calibration stands: • *Port 5555 to GX2 Connect Service.* Connection transfer test data and device logs to GX2 Connect Service for database storage.	Static or DHCP reserved by MAC address
GX2 CONNECT SERVICE (WITH MSA LINK PRO SOFTWARE EMAIL SERVICE)	• *Port 5555 from calibration stands.* Port allows calibration stands to transfer data. Constant connection is not always provided, as slave calibration stands connect only when data log has downloaded. Note: Initial communication and negotiations occur on port 5555, but session communications port is established. • *Port 4530 from MSA Link Pro Software user interface.* Port provides all clients with central location to obtain database connection method and brokers calibration stand configuration changes.	• *Port 5555 to calibration stands.* GX2 Connect Service initiates *handshaking* protocol and provides first contact with master calibration stands. Note: Initial communication and negotiations occur on port 5555, but session communication port is established. • *Port 1433 to SQL database.* GX2 Connect Service must access database server to store any device information retrieved. • *Port 25 to SMTP relay server.* Email service provides alarm summary emails as configured to end users.	Static or DHCP reserved by MAC address
SQL SERVER DATABASE	• *Port 1433 from the GX2 Connect Service, MSA Link Pro Software Email Service and MSA Link Pro user interface.* All applications listed require direct database access.		Static or DHCP reserved by MAC address

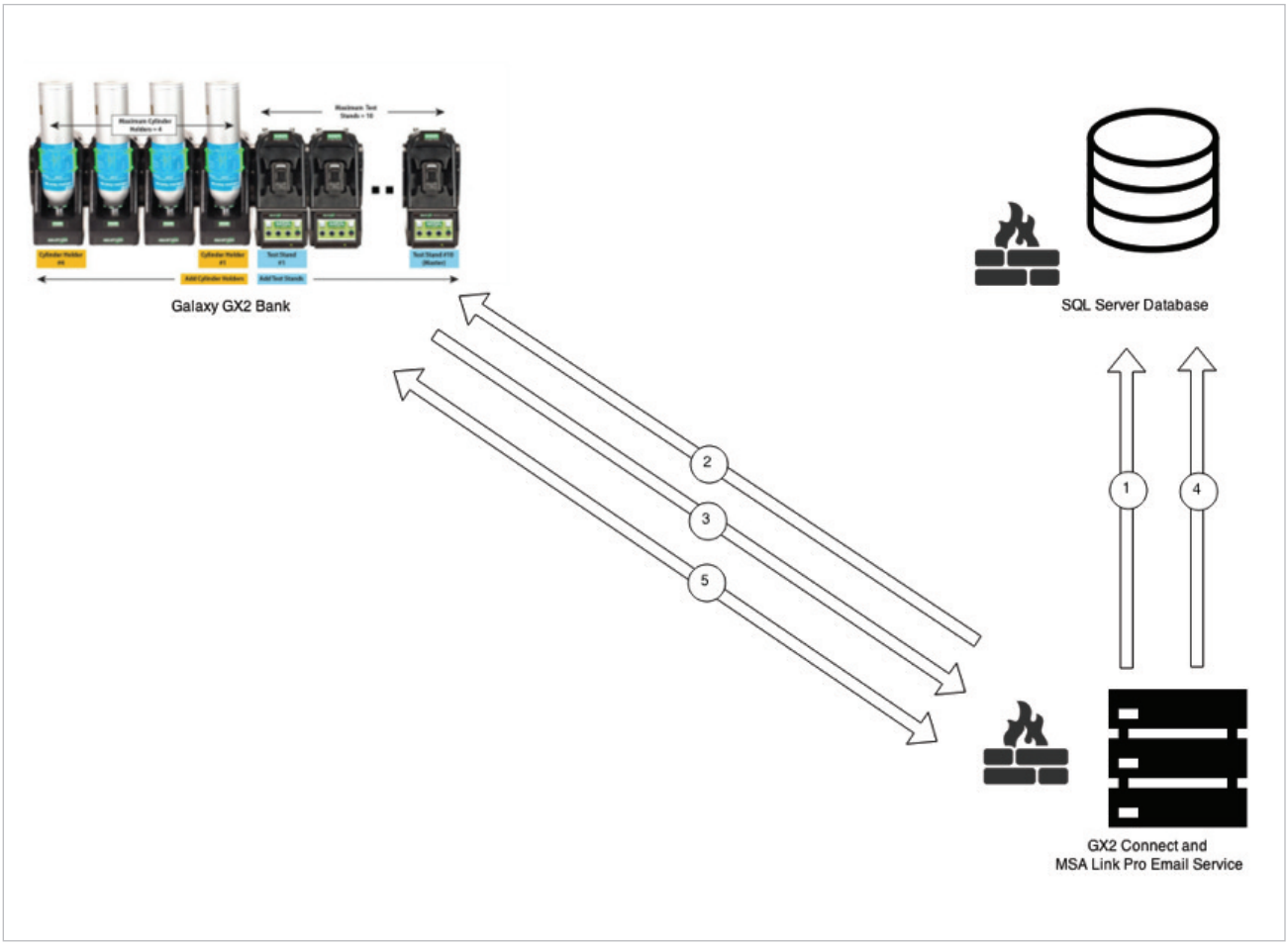
Firewall and Connectivity Overview *(continued)*

Name	Inbound Connectivity	Outbound Connectivity	IP Addressing Required
MSA LINK PRO SOFTWARE CLIENT APPLICATION		• *Port 4530 to GX2 Connect Service.* Allows for discovery of database location and connection information; creates information bridge to calibration stands. • *Port 1433 to SQL database.* User interface connects directly to database to display stored data and generate reports.	No



Network Diagrams and Sequence Diagrams

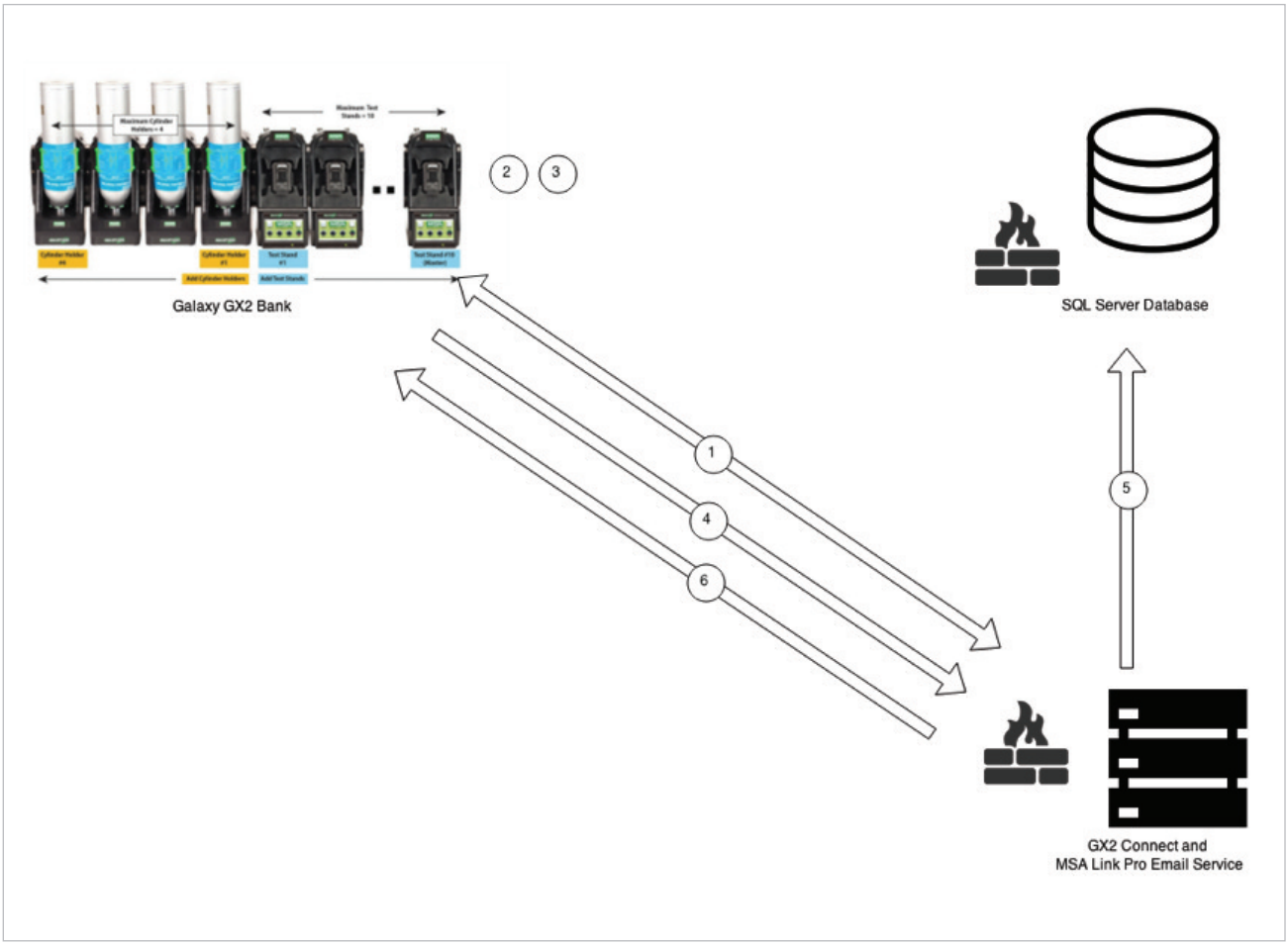
Sequence #1: Calibration Stands and GX2 Connect Service Communications



1. GX2 Connect Service queries database for configured banks and obtains bank IP addresses.
2. GX2 Connect Service attempts to create TCP/IP connection to bank's master GALAXY GX2 System calibration stand.
3. GALAXY GX2 System calibration stand accepts connection and transfers status updates, test results and data log information to GX2 Connect Service.
4. GX2 Connect Service accepts data and stores data in SQL Server database.
5. GALAXY GX2 System calibration stand and GX2 Connect Service continue to exchange small heartbeat messages to maintain connection.

Network Diagrams and Sequence Diagrams

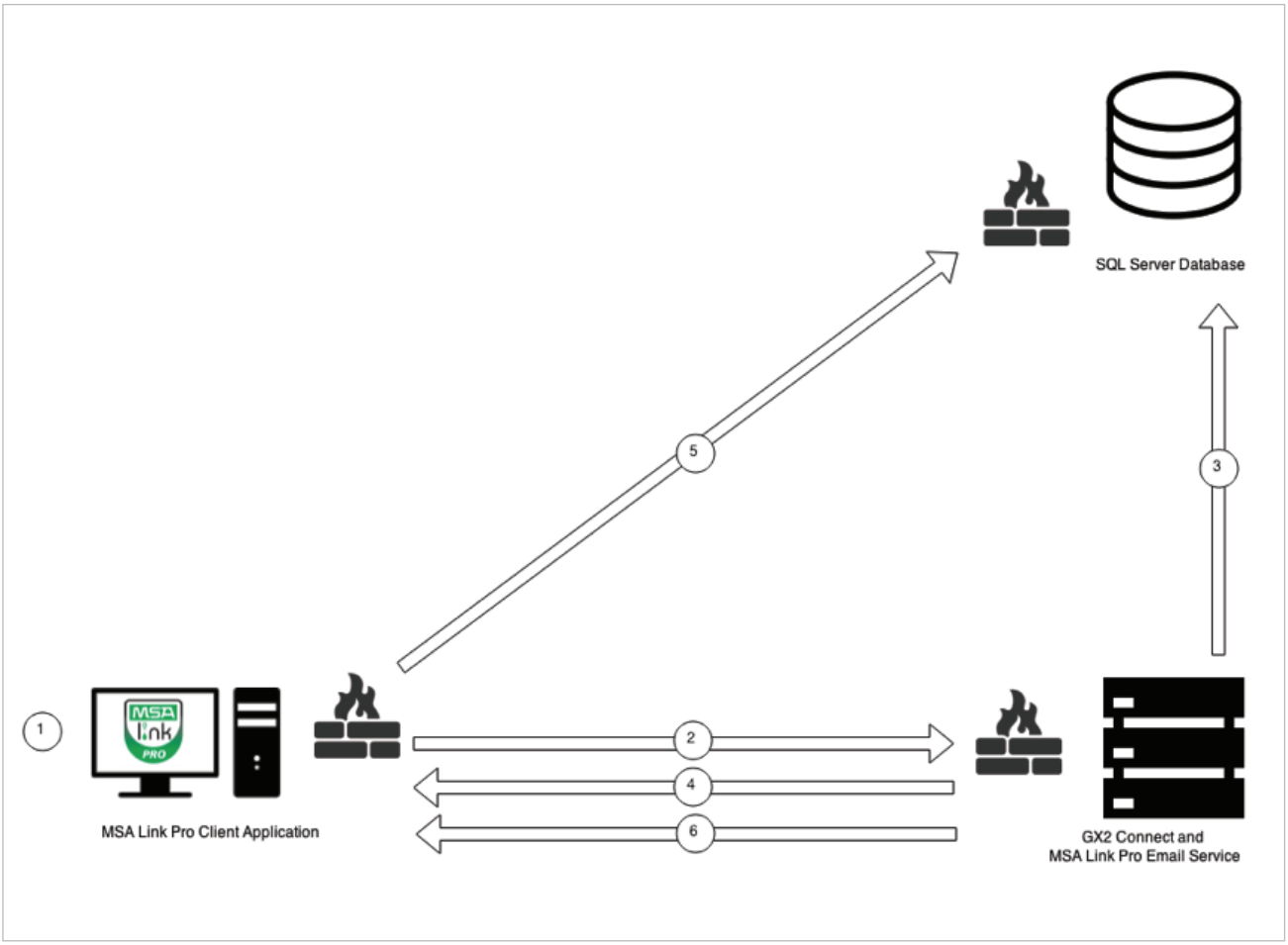
Sequence #2: Calibration Storage with MSA Link Pro Software



1. GALAXY GX2 System calibration stand and GX2 Connect Service communicate and maintain constant connection.
2. End user performs calibration on GALAXY GX2 System calibration stand.
3. Calibration record is saved to SD card in master GALAXY GX2 System calibration stand (if SD card is present).
4. Master GALAXY GX2 System calibration stand transmits test result record to GX2 Connect Service. If GALAXY GX2 System calibration stand does not have connection established to GX2 Connect Service, test result is queued and retried when connection is re-established.
5. GX2 Connect Service processes test results and records results within SQL Server database.
6. GX2 Connect Service sends acknowledgement of received message to calibration stand.

Network Diagrams and Sequence Diagrams

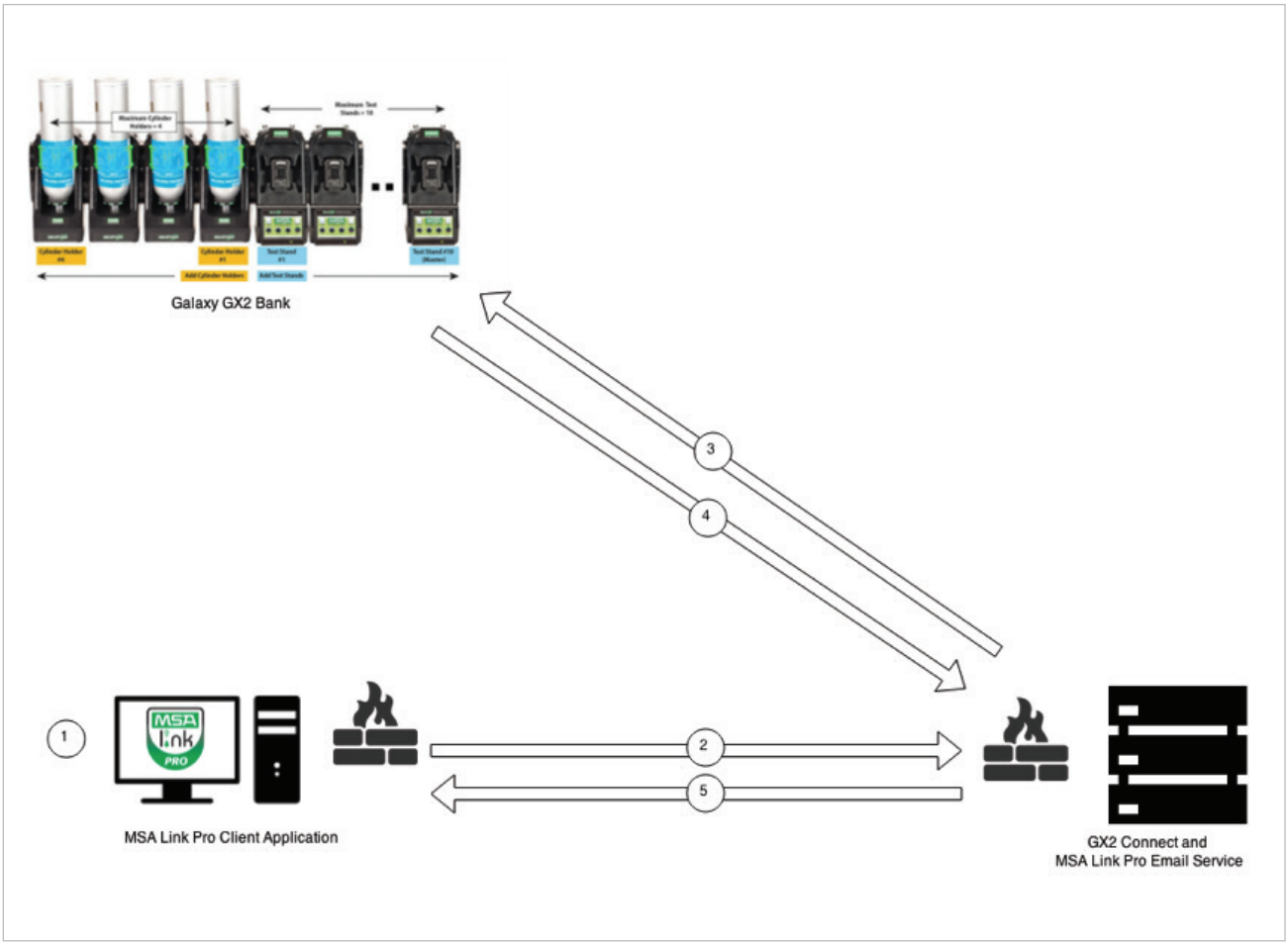
Sequence #3: Logging into MSA Link Pro Software



1. User opens MSA Link Pro Software Client Application and configures GX2 Connect Service IP address.
2. MSA Link Pro Software application initiates connection to GX2 Connect Service.
3. GX2 Connect Service authenticates user with SQL Server database. End user will not progress past login screen if SQL Server database is unreachable.
4. GX2 Connect Service returns SQL Server database connection information.
5. MSA Link Pro Software application creates new database connection to access system data.
6. GX2 Connect Service publishes system updates to MSA Link Pro Software application as events arrive from GALAXY GX2 System calibration stand.

Network Diagrams and Sequence Diagrams

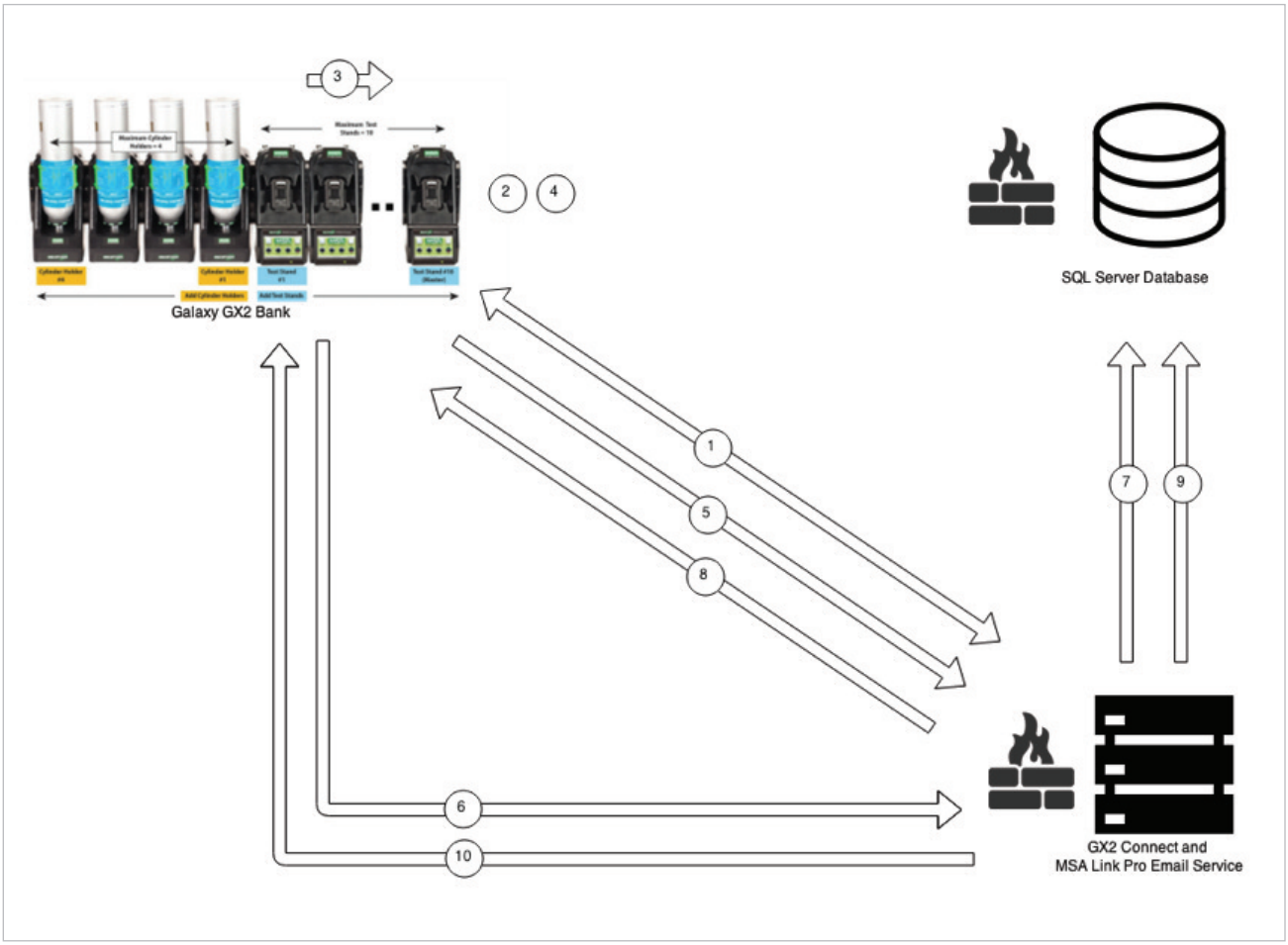
Sequence #4: Changing Calibration Stand Setting within MSA Link Pro Software



1. User navigates to fleet management page within MSA Link Pro Software and changes desired setting.
2. MSA Link Pro Software Client Application creates update message and transmits message to GX2 Connect Service.
3. GX2 Connect Service creates new update message and delivers message to desired master calibration stand on bank.
4. GALAXY GX2 System calibration stand replies to message with updated settings applied. If update fails, failure status message is sent by GALAXY GX2 System calibration stand.
5. Updated state or error message is propagated by MSA Link Pro Software client application. If error is returned, failure message displays to end user.

Network Diagrams and Sequence Diagrams

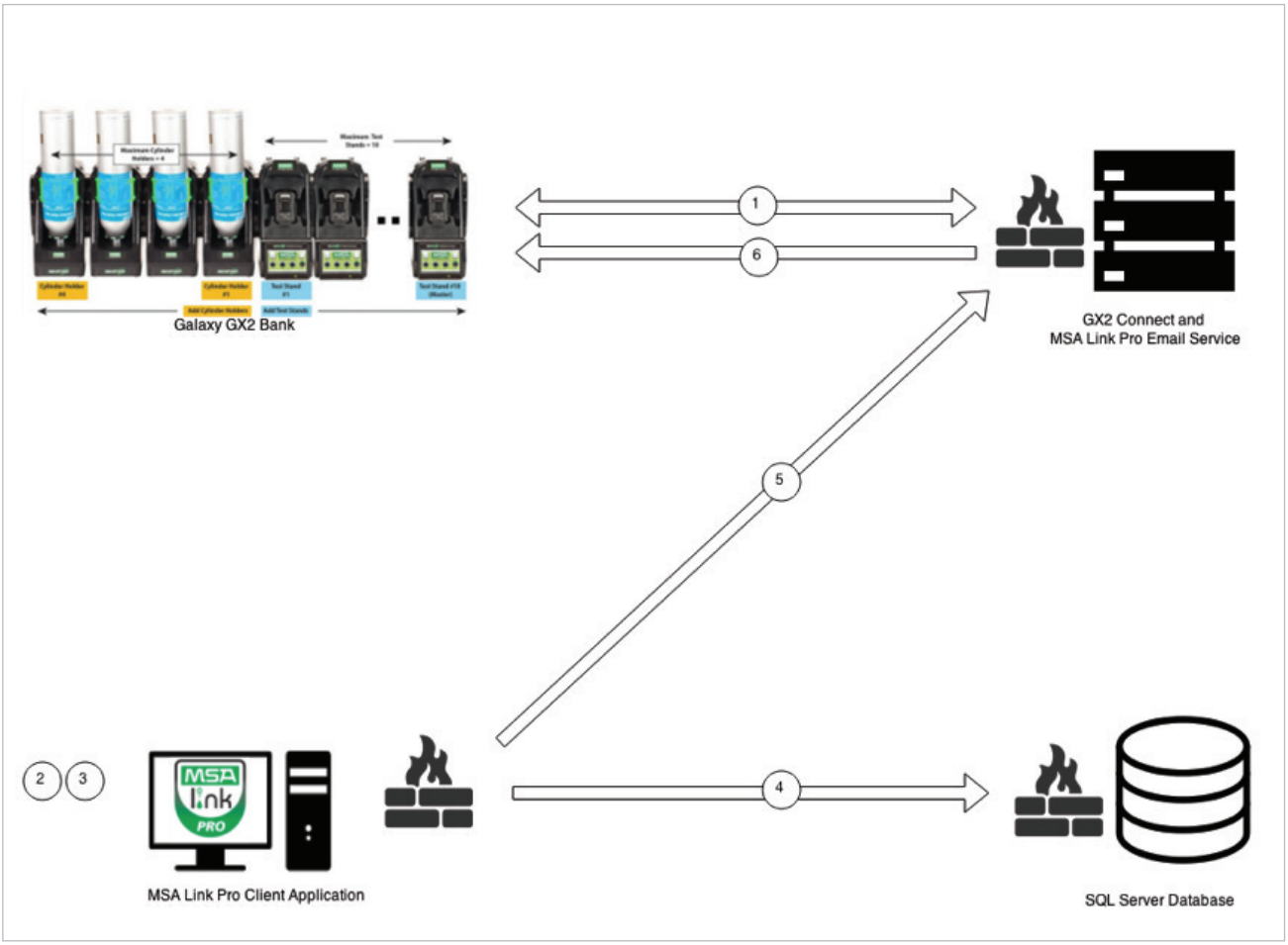
Sequence #5: Slave Calibration Stand Calibration Data and Data Log Storage



1. GALAXY GX2 System calibration stand and GX2 Connect Service communicate and maintain constant connection.
2. End user performs calibration on slave GALAXY GX2 System calibration stand.
3. Slave GALAXY GX2 System calibration stand transfers calibration record to master GALAXY GX2 System calibration stand via internal communications bus.
4. Calibration record is saved to SD card in master GALAXY GX2 System calibration stand (if SD card is present).
5. Master GALAXY GX2 System calibration stand transmits test result record to GX2 Connect Service. If GALAXY GX2 System calibration stand does not have connection established to GX2 Connect Service, test result is queued and retried when connection is re-established.
6. Slave GALAXY GX2 System calibration stand transmits compressed data logs to GX2 Connect Service.
7. GX2 Connect Service processes test results and records results within SQL Server database.
8. GX2 Connect Service sends acknowledgement of received message to calibration stand for calibration record.
9. GX2 Connect Service processes data logs and stores events or readings in SQL Server database.
10. GX2 Connect Service sends acknowledgement of received message to calibration stand for calibration record.

Network Diagrams and Sequence Diagrams

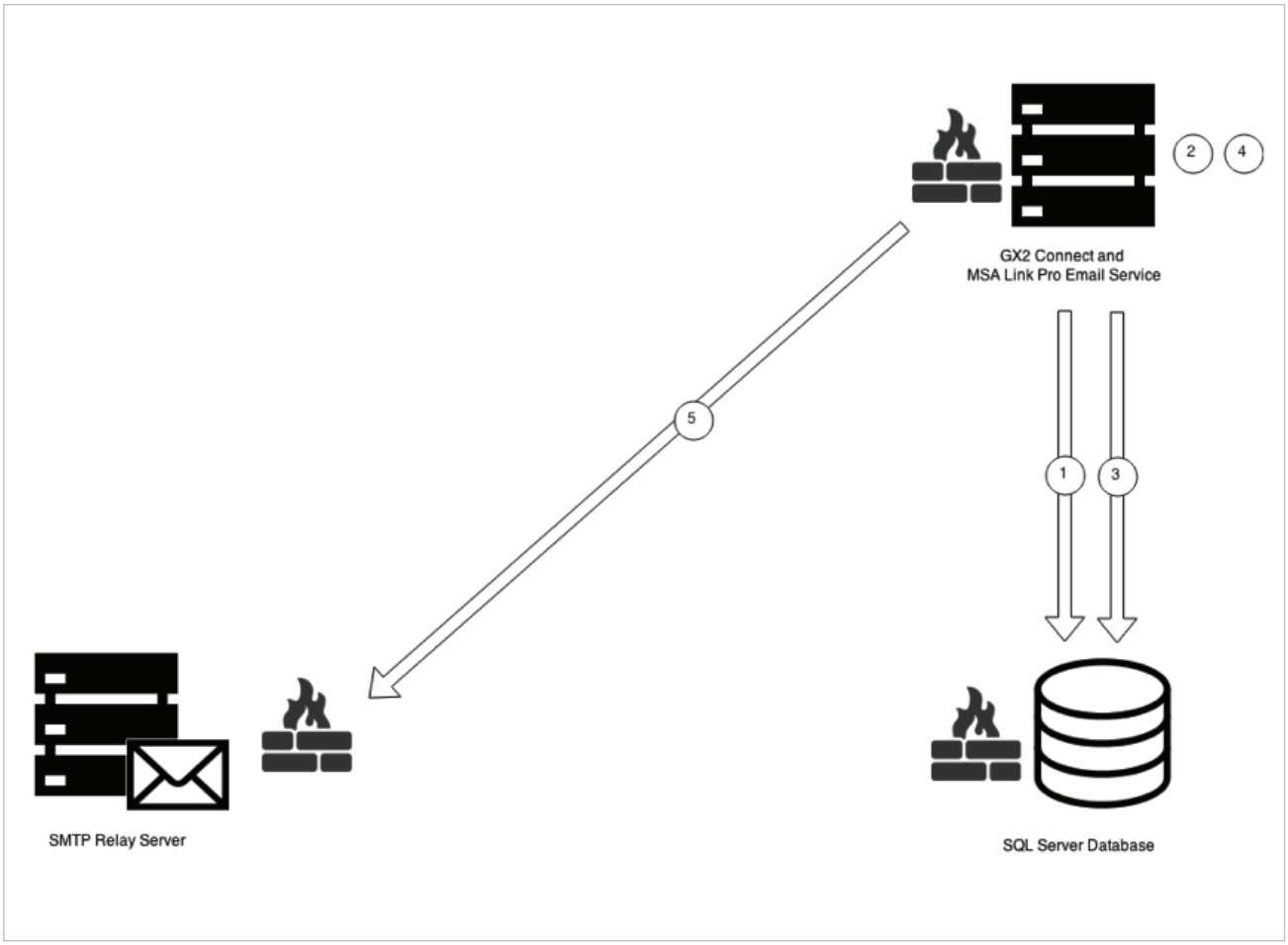
Sequence #6: Configuring Email within MSA Link Pro Software



1. GALAXY GX2 System calibration stand and GX2 Connect Service communicate and maintain constant connection.
2. End user logs into MSA Link Pro Software Client Application and navigates to settings page.
3. End user configures email server settings as well as events of interest for each bank.
4. MSA Link Pro Software Client Application saves changes to SQL Server database.
5. MSA Link Pro Software Client Application sends update message to GX2 Connect Service with updated email settings.
6. GX2 Connect Service sends update message to all attached GALAXY GX2 System test stands with new email settings.

Network Diagrams and Sequence Diagrams

Sequence #7: MSA Link Pro Software Email Capability



1. MSA Link Pro Software Email Service queries SQL Server database's email schedule based upon banks.
2. MSA Link Pro Software Email Service determines banks that are due to send summary email.
3. MSA Link Pro Software Email Service queries SQL Server database for all recorded email events for bank that triggers email.
4. MSA Link Pro Software Email Service creates localized notification email.
5. MSA Link Pro Software Email Service sends email to SMTP relay server.

MSA Link Pro Software Example Bandwidth Information

Background

This section lists common actions within MSA Link Pro Software and calibration stands, as well as approximate data consumption metrics. Specific metrics listed are database growth amount, network bandwidth consumed and storage side of data on an external device (such as an SD card).

Measurement Tools

Data Measured	Tool Used	Source
NETWORK BANDWIDTH	Networx	https://www.softperfect.com/products/networx/
DATABASE SIZE	Custom SQL script	Adapted from *http://stackoverflow.com/questions/18014392/select-sql-server-database-size* Available upon request.
FILE SIZE	Windows Explorer	Included with Microsoft Windows 8.1

Test Setup

All testing was conducted on a simulated worst case system, with configuration as follows:

- GALAXY GX2 System bank of 10 calibration stands and 4 multigas cylinders (maximum system capacity)
- ALTAIR® 5X Multigas Detector with all sensors installed (6 sensors), (maximum gas detector system capacity)

Results

- All bandwidth readings include heartbeats gathered during testing.
- Network used for bandwidth measurement was a direct connection between calibration stands and computer that held the database.
- Instruments were configured with default factory periodic and session logging settings.
- When downloading data logs, database log size is proportional to the number of downloaded data logs.

Test Number	Test Description	Record Information	Bandwidth Usage	Database Usage (KB)		External Media Usage (KB)
				Data	Logs	
1.	Perform and store calibration record with empty database	First record	150 KB	192	80	1
		Subsequent records	100 KB	1	16	
2.	Perform and store calibration record, bump then calibration on fail where calibration is executed	First record	200 KB	192	80	1
		Subsequent records	175 KB	1	16	
3.	Perform bump, download and store session log and calibration record	First record	125 KB	192	80	1 Note: Session log is not stored to external media.
		Subsequent records	100 KB	1	32	
4.	Download and store periodic log. NOTE: Periodic log contains 8 hours of data on default 3-minute sampling interval.	First record	100 KB	192	80	N/A; periodic log is not stored to external media.
		Subsequent records		1	24	
5.	Download and store session log for typical system without gas exposure	First record	100 KB	192	80	N/A; logs are not stored to external media.
		Subsequent records		1	32	
6.	Download and store session log for typical system with gas exposure	First record	100 KB	192	96	N/A; logs are not stored to external media.
		Subsequent records		64	16	
7.	After successfully pairing GALAXY GX2 System and MSA Link Pro Software, system remains idle while maintaining connection. (Test idle sampling period = 30 minutes.)	N/A	1 MB	N/A		
8.	Make bank configuration change (such as changing language from GALAXY GX2 System)	N/A	25 KB	N/A		
9.	Save instrument profile to USB drive for use in GALAXY GX2 System	N/A				1
10.	Update GALAXY GX2 System firmware via FTP	N/A	11 MB	N/A		

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Note: This Bulletin contains only a general description of the products shown. While uses and performance capabilities are described, under no circumstances shall the products be used by untrained or unqualified individuals and not until the product instructions including any warnings or cautions provided have been thoroughly read and understood. Only they contain the complete and detailed information concerning proper use and care of these products.

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