



SPINAL TAP®
Specification paper

Spinal Tap Overview

The changing face of the healthcare market at both a local and national level requires healthcare organisations to meet the requirements of national IT programs. These programs aim to enable greater availability of patient data across healthcare organisations, including centralised medical records, electronic transmission of prescriptions and electronic booking. It is critical that healthcare organisations take part in these programs and gain access to the centralized electronic record repositories in order to use the services that these initiatives offer.

Many healthcare organisations have already made a significant investment in IT systems and wish to leverage this existing investment while adding the capability to integrate with the national programs.

In the UK a Department of Health body, Connecting for Health (CFH), is responsible for delivering the National Programme for IT. CFH requires that existing system suppliers interface with the NHS Care Record Service (NCRS) also known as the Spine.

Quicksilva's Spinal Tap Product is designed to enable existing healthcare systems to easily connect to, and communicate with, both central electronic record repositories (such as the NCRS Spine) and to each other.

A few of the challenges facing Existing System Suppliers (ESPs) wishing to connect to the Spine are:

- The different forms of communication involved (LDAP, SOAP, ebXML), each of which have to be correctly implemented in accordance with their associated Specification.
- The construction and interpretation of HL7 (Health Level 7) messages.
- The HL7 messaging format itself. This can appear cumbersome and verbose as it is made from generic components and as such, many of the XML nodes appear to be unnecessary with names that are often obscure with regard to their purpose.

Spinal Tap can help to overcome these challenges by hiding the complexities required to communicate via HL7 messaging format. Spinal Tap includes Message Handling Services for handling all of the different forms of communication, and enables the sending and receiving of messages from central data repositories.

It also offers a scalable Application Programming Interface (API) to facilitate communication with client systems, requiring only the implementation of calls to this common API. Thus enabling the integration of legacy systems with new national and local HL7 based systems.

Spinal Tap consists of the following Services

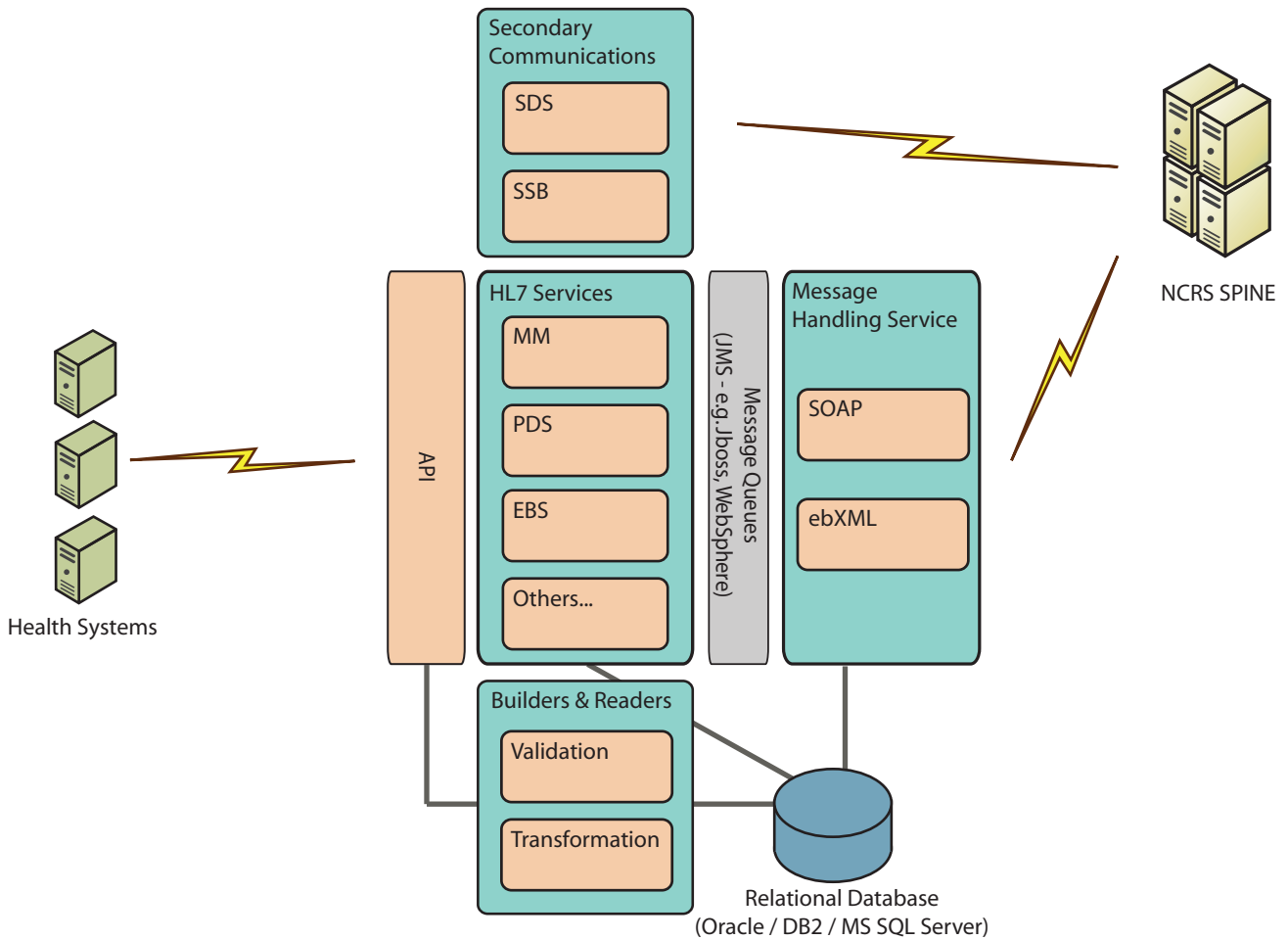
- **API Services** offering a common and scalable interface to enable communication with client systems.
- **Security and Secondary Communication Services** enabling data retrieval from Spine services for authentication services and security validation.
- **HL7 Services** to facilitate the processing of messages between the API and the central services.
- **Message Building and Reading Services** to construct and Interpret HL7 messages in addition to validating the messages against known schemas.
- **Message Queues** to manage incoming and outgoing messages and to balance and prioritize message traffic.
- **Message Handling Services** to send and receive messages from central data repositories.
- **Relational Database** for data persistence.

Spinal Tap can be deployed in one of 2 modes:

Centralised Mode. In this mode of operation Spinal Tap operates in a server/client arrangement with many instances of an existing system (or different systems) connecting to the Spinal Tap server over a secure connection. This mode has obvious advantages in terms of ease of maintenance and deployment and as such is the most often deployed configuration. In order to operate as a high load, highly available system Spinal Tap has been built from a group of modules that can be run in a clustered environment. This modular design also facilitates the implementation of the various messaging domains (e.g. in the case of the CFH program: Medication Management, Personal Demographics Service, Electronic Booking Service) and their versions and also the potential for custom APIs tailored to ESP's requirements.

Local or distributed mode. In this mode of operation a one to one relationship exists between Spinal Tap and the existing system. The Spinal Tap system will probably reside on the same server as the existing system.

The following diagram illustrates Spinal Tap's main modules and their relationships to each other:



API Services

Spinal Tap's API enables client systems to communicate with a data Spine through a simple set of calls, thus simplifying the interactions required to communicate with the Spine services, each of which has a bespoke message format. This module exposes the API through which a system can initiate communication with the Spine. It is also designed to keep the bandwidth used for communication to a minimum, and help minimise the impact of any failure of the client system.

In centralised mode Spinal Tap supports various TCP/IP protocols such as :

- HTTP
- SOAP
- ebXML
- Remote Procedure Calls (RPC)
- Remote Method Invocation (RMI)

In local mode all of the above are possible and in addition Java can be used to access the API.

In addition the Spinal Tap Client DLL, a .NET Dynamic Link Library, can be used. This resides local to the connecting system and manages the connection on its behalf.

Additionally Spinal Tap can support multiple API messaging formats e.g. one system could connect using SOAP whilst another could connect to the same instance via a proprietary XML format.

The API helps to maintain security within the system, with connections from client system to the Spinal Tap API being encrypted via Transport Layer Security (TLS).

Security and Secondary Communications Services

Spinal Tap provides Security Services at multiple levels, the first of these being access to the API over TCP/IP is via TLS to ensure that the data is secure and encrypted.

At a second level it provides client authentication through the use of client certificates. The client authentication not only ensures that the connecting healthcare systems are trusted, but provides a means for identification. The unique client certificate 'thumbprints' are registered within the instance of Spinal Tap against the healthcare systems' organisation and their allocated API.

Some of the data required to construct or interpret HL7 messages may be held on the data Spine in services that are accessed differently to the main messaging transport mechanisms. Messages sent to and received from these services are handled within the Spinal Tap secondary communications layer.

At this third level Spinal Tap enables data retrieval from Spine services for authentication services and security validation in line with Information Governance (IG) requirements. Two of these services are the Spine Security Broker (SSB) and the Spine Directory Service (SDS). Each of these has a corresponding module within Spinal Tap:

Spine Security Broker

The Spine Security Broker (SSB) controls authentication of health workers by means of smartcards, delivering Single Sign On (SSO) Tokens and managing the sessions of users who have been successfully authenticated. The Spinal Tap SSB module can check that a user has been authenticated (by means of a SAML assertion) and discover more information about them, such as their name, job role and which organisation they are working for. It also registers a callback listener with the Spine SSB so that if the user removes their smartcard then they are subsequently invalidated within Spinal Tap and are no longer allowed to communicate through the API.

Spine Directory Services

The Spine Directory Service (SDS) holds information about organisations, health workers and their job roles. The SDS can be used to obtain extra information about an authenticated user and their organisation, which the Authority may deem necessary to make appropriate data access decisions. Registration of Spinal Tap's message handlers also requires information held in SDS.

It also holds details of the HL7 messages supported by the connected systems and the parameters required by the communication protocols. The information is held on a Lightweight Directory Access Protocol (LDAP) server and so the Spinal Tap SDS module is used to communicate with LDAP specifically for retrieving SDS data.

This information is used by Spinal Tap to expand on HL7 data before constructing an API response, such as filling in a doctor's details from a National Administrative Codes Service (NACS) code.

HL7 Services

The HL7 services take care of the main processing of the messages, and provide a link between the API and the NCRS Spine communication layers. The services are split into the different messaging domains of the NCRS Spine: e.g. Medication Management (MM), Electronic Booking Service (EBS, also known as Choose and Book). Each of these service modules can take incoming API messages and convert them into HL7 or digest incoming HL7 messages from the NCRS Spine ready to be output to a client over the API.

Message Building and Reading Services

Builders and readers are used to construct and digest HL7 messages. They help to take the complexities of HL7 messaging away from the services layer. Also within the builders and readers layer are transformation and validation modules.

Transformation

Within Spinal Tap the HL7 messages are represented by an internal lightweight format that is Message Implementation Manual (MIM) version independent. These are converted into or from full version specific HL7 using eXtensible Stylesheet Language Transformations (XSLT). This abstracts the actual HL7 and version from the inner workings of Spinal Tap and also allows it to be backwards compatible and easy to upgrade when new versions of the MIM are published.

Validation

All messages that are built or read are validated against eXtensible Schema Definition (XSD). This validation ensures that all messages sent to or received from the SPINE are in the correct format and is therefore useful in preventing errors that can occur through schematic mistakes. The validation is specific to the version of the MIM.

Message Queues

Message traffic between the client systems and the spine is likely to vary in intensity over different periods of time and it is important that the system can manage these changes in traffic volume and ensure valuable message information is not lost. Spinal Tap offers Message Queues to balance and prioritize message traffic.

The message queues act as a conduit between Spinal Tap and the messaging services that deliver messages to, and receive messages from, a central data repository (such as the NCRS Spine). The separation they provide between the API and the HL7 messaging service enables these two parts of the system to operate independently. They are also used to handle the timing of urgent and non urgent messages.

By separating the API, HL7 message construction and HL7 message interpretation from the main transport layer (i.e. the Message Handling Service) ensures that any errors encountered on either side of the message queues do not adversely affect the other.

The message queues ensure robustness within a high load, clustered environment. A successful API call to send an HL7 message means that a message has been successfully placed on the queue. Similarly a message read from the queue by either the HL7 service (incoming) or Messaging Handling Service (outgoing) is either processed successfully or remains on the queue if an error occurs. In this way a message can never be lost.

Spinal Tap uses the Java Message Service (JMS) framework to access message queues, which allows different implementations of JMS to be substituted with impunity, e.g. JBoss MQ, WebSphere MQ.

Security is also a consideration in this implementation and all connections with the message queues are encrypted over TLS if supported by the JMS implementation.

Message Handling Service

The Message Handling Service (MHS) is responsible for sending messages to a data Spine using either SOAP or ebXML protocols. These two protocols are handled in separate modules within the MHS.

SOAP

Simple Object Access Protocol (SOAP) is used for synchronous calls to the Spine. An example of an HL7 message that utilises this protocol is the Personal Demographic Service (PDS) Trace Query which is used to retrieve information about a patient from PDS.

ebXML

Electronic Business eXtensible Markup Language (ebXML) is used to transport messages reliably and asynchronously between Spinal Tap and the data Spine. ebXML messaging builds on SOAP to offer a reliable messaging protocol, if a message fails to be received or processed by the recipient then the ebXML message handler enters a retry mode to ensure that the message is successfully delivered. It also allows messages to be sent which do not have an immediate response. For these a response can be received separately at some time in the future (in case the processing takes a while). Examples of this are a prescription release response after a prescription release request or a dispense rejection after a dispense notification.

Security

All messages sent to from Spinal Tap are encrypted over TLS with client/server authentication.

Relational Database

Spinal Tap offers a Relational Database which stores data about messages, messaging protocol parameters, Spinal Tap clients and their organizations and individual system users. This ensures the system meets IG requirements for data persistence and creates an audit trail of message details that have been handled by the system. This audit trail of message interactions can be easily accessed through Spinal Tap's Management Interface. The database can run on Microsoft SQL Server, Oracle and DB2.