EXTENT OF SERVICES SUPPORTED BY Q-SIGNALING OVER IP

QSIG is a signaling protocol used for interconnection of various telecommunication systems in corporate networks. These networks are composed of homogeneous or heterogeneous elements. Basic procedures of connection and supplementary services are transferred through messages, which are defined in recommendations ETSI or ISO. QSIG can be used for transport proprietary signaling between the same PBXs and is supported in voice gateway of solution of Voice over IP too and environment of IP network is often chosen for interconnection between PBXs.

The main aim of this paper is to acquaint specialists with the result of the QSIG compatibility test between Siemens and Cisco. Siemens produces one of the most used telecommunication systems in the Czech republic and Cisco systems routers are the most used in IP solutions. In order to provide all supplementary services in telecommunication, Siemens developed a new protocol, called CorNet-NQ, which is a superset of QSIG and uses messages tunnelling through QSIG. For realization of this test the QSIG version PSS1V2 in agreement with the ISO standards was used.

1. Introduction

QSIG is a signaling protocol for controlling the establishment, maintenance and clearing of calls between PINXs, nodal entity known as Private Integrated services Network eXchange. It provides an extremely powerful method of connecting PINX equipment in a corporate network. QSIG is not a proprietary standard. It is an open, international standard and is supported by the world's leading PBX suppliers. Twelve of the world’s leading PBX manufacturers signed a Memorandum of Understanding (MoU) concerning the development and support of QSIG. The MoU, which came into effect on 1st February 1994, commits the signatories to facilitate the performance of interoperability tests and to:

- incorporate a Primary Rate interface (as defined in ETS 300 011) into its products,
- support a Basic Call (as defined in ETS 300 172),
- implement the generic procedures (as defined in ETS 300 239),
- implement QSIG supplementary services as far as each signatory considers to be economically viable,
- and participate in interoperability testing with the other signatories.

QSIG standards are developed within ECMA in Technical Committee 32 (TC32) for Communications, networks and systems interconnection. TC32 began to work on QSIG in 1988 and most of these standards were published also as ISO/IEC International Standards, endorsed by ETSI as European Standards and implemented by all major PBX vendors.

2. QSIG protocol stack

QSIG standards specify a signaling system at the "Q" reference point, which is primarily intended for use on a common channel;
e.g. G.703 interface. Within the public ISDN the two end PINXs are connected through two reference points using different ISDN protocols, namely DSS1 at the “T” reference point and ISUP within the public ISDN at the “N” reference point. For private ISDNs, only one protocol is necessary as the QSIG protocols have sufficient functionality to be used both within the network at transit nodes and on the outside at access nodes.

The architecture of QSIG signaling protocol agrees with the architecture RM OSI, see Figure 1.

The standard for Basic Call is ECMA 143 (ISO/IEC 11572). QSIG generic support for supplementary services is defined in ECMA-165 as a toolkit on which signaling for support of supplementary services can easily be built (ISO/IEC 11582). The QSIG protocol stack is identical in structure to the DSS1 protocol stack. Both follow the ISO reference model. Both can have an identical layer 1 and layer 2 (LAPD). However, at layer 3 QSIG and DSS1 differ.

In the last years significant part of work inside TC32 is concerned with the interoperation of Private Integrated Services Networks (PISN) with IP Networks, in particular with the two following aspects:
- Interworking of PISNs and IP networks via Gateway, primarily between QSIG and H.323 and between QSIG and SIP.
- Connection of PISN components via IP network infrastructures (i.e. QSIG tunnelling).

Inside the TC32 a new Task Group TG-17 was founded, known as TC32 – TG17, for standardization in the area of IP-based multimedia communications. This group considers possible future work in the area of NGN (Next Generation Networks), where close cooperation with ETSI is anticipated.

New ECMA standards allow tunnelling QSIG over IP network, see Figure 2, these standards are listed below.

Interworking between QSIG and H.323:
- **ECMA-332** – basic call
- **ECMA-307** – generic support for supplementary services
- **ECMA-308** – call transfer supplementary services

Tunneled QSIG over H.323, SIP or directly over TCP/IP

**Figure 2**: Tunnelling QSIG over IP network.

3. Conditions of QSIG test interoperability

User signaling services can be divided into two groups:
- **BASIC CALL** – to transfer the control information required for the set-up, monitoring and release of connection and the identification of a subscriber’s number,
- **SUPPLEMENTARY SERVICES** – to exchange signaling information for the control of the supplementary services and additional network features (ANFs)

| System components used in test | Tab. 1 |
|--------------------------------|--------|
| PBX model | Siemens HiPath4000 |
| PBX Release | Version 1-09 |
| Signaling | QSIG (PSS1V2/ISO) |
| Interface | ISDN BRI |
| Voice gateway | Cisco 1751-V |
| Gateway release | IOSTM 12.3(6a) |
| VoX protocol | ITU-T H.323 |

**Figure 3**: Reference model extended for corporate networks.
In this QSIG test interoperability individual supplementary services were tested and signalling messages were traced between interconnected equipment in all signalling path. [3], [4], [5], [6].

**3.1 Configuration of the voice gateway**

**Set up Notes**

The Cisco 1751V gateway with BRI-ISDN supports protocol QSIG, when the value of Switch-type parameter is set to `basic-qsig`.
The network side on the BRI is set by the following commands:
- `isdn switch-type basic-qsig`.
- `isdn overlap-receiving T302 5000`.
- `isdn protocol-emulate network`.
- `isdn layer1-emulate network`.
- `isdn incoming-voice voice`.
- `isdn static-tei 0`.
- `isdn timeout-signaling`.

A significant part of configuration in Cisco voice gateway is shown below as an example.

```plaintext
/* for interface BRI */
interface BRI0/0
  no ip address
  isdn switch-type basic-qsig
  isdn overlap-receiving T302 5000
  isdn protocol-emulate network
  isdn layer1-emulate network
  isdn incoming-voice voice
  isdn static-tei 0
  isdn timeout-signaling
  !
  voice-port 0/0,
  compand-type a-law
  cptone CZ
  bearer-cap 3100Hz
  !
```

**3.2 Configuration of the PBX**

**Set up Notes**

The Siemens HiPath 4000 supports the protocol QSIG when the value of parameter Protvar in TDCSU command is set to `PSSV1V2`, and the user side on the BRI is set by the following parameters:
- `MASTER = N`.
- `SMD = N`.

A significant part of configuration in Siemens HiPath 4000 is shown below as an example.

```plaintext
/* TDCSU - command for trunk configuration */

| DEV   | SDCONN | PEN | 1-01-103-1 | TGRP | 157 |
|-------|--------|-----|------------|------|-----|
| PROTVAR | PSSV1V2 | INS | Y | SRCMODE = CIR |
| CRTNO | 11 | COPNO = 10 | | DPLN = 0 |
| CTR | 0 | COS = 3 | | LCOSV = 1 |
| LCOSD | 1 | CCT = CISCO 157 | | DESTNO = 157 |
| SEGMENT | 8 | DEDSVCC = | | DEDSVCC = NONE |
| FACILITY | = | DITIDX = | | SRTIDX = |
| TRM | GDTR | SIDANI = N | | ATNTP = TIE |
| CHMATTR | NONE | NWUNXTM = 10 | | TCHARG = N |
| SUPPRESS | 0 | DGTFR | | CHIMAP = N |
| TSDNIP | - | TSCDNIP | | |
| PNPLIP | - | PNPLIP | | PNPC = |
| TRACOUNT | 31 | SATCOUNT = MANY | | NNO = |
| ALARMNO | 0 | FDIX = 1 | | CARRIER = 1 |
| ZONE |EMPTY | COTX = 11 | | FWX = 1 |
| DOMTYPE | = | DOMINNO | = | TROFNO = |
| NIGHT | = | CCHID = | | |
| USUSCCX | 16 | USUSCY = 8 | | FNIDX = 1 |
| CLASSMKR = EC & G711 | & G729OPT | SROGRP | | |
| TCCID | = | |

| MASTER | N | SMD = N | CNTRNA = 0 |
| SCNEG | = | Y |
```

`/* next commands RICHT, LDAT and WABE are needed, closed numbering scheme was used in configuration */`
3.3 Decoding of QSIG

To decode the QSIG messages, SW application the WinVisu was used. It supports CORNET-NQ decoding protocol too and all the contents of signaling are in detail displayed in accordance with the recommendation of the chosen protocol, see Figure 5.

4 Test result

In the table below, the tested supplementary services are listed including the results related to each of these services.

Only one service (of all 22 supplementary services), Call Completion Busy Subscriber – CCBS did not work properly because the SETUP message was not transferred correctly through the IP network.

Information element in SETUP message with CCBS

W-elem: (1CH) CCITT STANDARD FACILITY
Laenge 48
Protocol Profile : Networking Extensions (ETSI Qsig V2, ISO)
NETWORK FACILITY EXTENSION
sourceEntity endPTNX
sourceEntityAddress not present
destEntity endPTNX
destEntityAddress not present
INTERPRETATION APDU rejectAnyUnrecInvokePdu
COMPONENT PART
invokeComp
invokeID 23280
linkedID not present
operationValue ISOCcbsRequest
argument
numberA
presAllowedNumber 2722
unknownPartyNumber 3624
numberB
unknownPartyNumber 2722
service 0x04 0x03 0x80 0x90 0xa3 0x7d 0x02 0x91 0x81

This supplementary service was not transferred because the voice gateway incorrectly processed the CCBS signaling request in SETUP message. On the other hand, the CCNR – Call Completion to Subscriber (in idle state) was transferred properly as it was indicated through MWI facility (Message Waiting Indication). Supplementary CD service was not tested as it is not supported by HiPath 4000.
References:

[1] ISO/IEC Standards, http://www.iso.ch/iso/en/ittf/PubliclyAvailableStandards
[2] ETS 300 172, Inter-exchange signalling protocol, ETS Institute, France, 1996
[3] PETERS J., DAVIDSON J.: Voice over IP Fundamentals, Cisco Press, Indianapolis USA, 2000, ISBN 1-57870-168-6
[4] VOZNAK, M.: Comparison of H.323 and SIP Protocol Specification, International Conference “Research in Telecommunication Technology 2003”, STU Bratislava, September 2003, p. 45-47, ISBN 80-227-1934-X
[5] HiPath 4000 Service Manual, Siemens AG, Munich, 2002, P31003-H3101-K104-2-20
[6] Cisco Systems Inc., http://www.cisco.com