



White Paper:
BT Testing Strategy.

Gaining approval to BT's UK telephony network - an independent view



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1. Synopsis

This paper suggests that there should be in place an agreed common strategy for the testing and evaluation of suppliers 'Core' SS7 network equipment. This is to ensure that a uniform standard of product testing and planning is imposed on all network equipment before it is accepted as suitable for operational use.

This would have the purpose of ensuring that:

- All network equipment designed to the same interface specifications would inter-work with each other. Thus avoiding service problems, retrospective modifications and changes to contracts.
- The network interfaces on the supplier's network conform to the requirements imposed by the network operator and imposed by international specifications and national regulations.
- Minimise problems of achieving the 'goal' of interconnection and inter-working.

This strategy is consistent with the principles of 'Total Quality', aimed at providing a high quality test strategy for the supplier ensuring a high quality network for the operators. This must in turn minimise the suppliers interconnection surprises and subsequent network operator complaints to maximise revenue earnings for both.

2. Introduction

In the increasingly open and liberalised network environment within which BT operates, and steered by regulatory pressure¹, BT has increasingly adopted the policy of procuring its exchange equipment and services to strict specifications, from a number of suppliers. In a similar manner, because of the number of suppliers, BT has had to declare its network interfaces so that there can be commercial competition in the provision of network equipment and services.

It would thus seem to be essential for BT to have a standard quality procedure, to ensure that the various items of network equipment obtained from different suppliers, successfully and unconditionally inter-work with each other. This applies equally to BT's 'Access' network (BT/customer boundary), where network equipment should always present the same external interfaces to the customers, so that they can exercise their own choice of equipment supplier.

If these objectives are to be met, BT's network interfaces must be rigorously controlled from the initial specification through to acceptance testing and implementation. Further, BT as the major UK network operator, has issued its own network requirements², and declares whether a supplier reaches the standards for interconnection and certification.

¹ OFTEL Office of Telecommunications UK Regulatory Body

² BTNR British Telecom Network Requirements

3. Failure to Conform

3.1. BT view

Although BT's internal 'core' network interfaces are not strictly governed by regulation, failure to implement a strict programme to ensure standardisation can have serious technical and financial impact for the business:

- Failure to route calls between signalling points from different suppliers.
- Limited ability to provide the rapid deployment of high revenue earning supplementary services.
- Lost revenue, due to lower traffic arising from later service introduction, and loss of customers to other operators.
- High costs in proving failures of supplier's equipment and services.

BT as a network operator, for both the core and access networks generally buys in technology. The strategy to improve its dominance in the world markets is based on moving to being looked upon as a service provider, not just a carrier. It is just as capable of bringing to market a service, as it will take one out of service, if it fails for technological or commercial reasons.

3.2. Suppliers view

Even if a supplier has approval and acceptance by other national operators, BT will require the supplier to adhere to a quality testing strategy, before it allows interconnection.

For the supplier, failure to comply with BT's requirements will impact:

- Loss of support by BT and the responsible officer.
- Cost of retrospective changes.
- Failure to reach certification.
- Reach only part interconnection service levels.
- Loss of payments or withhold payments until agreed milestone compliance's are met.
- Incomplete rollout of service and credibility reduced.

4. The Procurement Process

Under BT's competitive purchasing policies, equipment being procured from different suppliers is selected by means of a 'black box' interface specification technique. This means that equipment could well be specified in terms of its external interfaces and the transfer function between those interfaces.

This enables BT, in theory to procure common equipment from a number of suppliers. However, this must be supported by a test programme that answers the following basic questions:

- Did we ask for the right thing?
- Did we get what we asked for?
- Will it inter-work with other network equipment?
- Does it conform and comply with agreed standards and specifications?

To achieve these aims a rigorous programme of quality assessments are set. These are designed to cover all aspects of acceptance, from the interface requirement specification, through to the actual acceptance testing of the procured equipment. This methodology is not new for BT, and was developed to create a standard that ensures that the same criteria are adhered to and applied by all suppliers. In particular for the core network interfaces, it is essential that this is placed under strict control, and will not be allowed to be varied for any technological or expedient commercial reason.

Although short term gains may be obtained in this way on individual contracts, it is inevitable that globally this approach will lead to higher costs. If only in resolving the incompatibility between systems, and any different call control procedures perceived by the supplier.

Therefore all network interfaces which support inter-system communication including the SS7 protocols must be subject to this vigorous verification and testing programme.

Implementing the testing programme to the requirements, are left to the supplier to achieve, and prove. But to ensure that a common benchmark is applied to all equipment suppliers, this programme is audited by an independent assessor. Since BT derived its own standards and requirements, in alignment with ITU-T and ETSI, this is carried out by BT and not devolved to a third party. Further, the criteria applied must rise above the parochial interests of a single procurement contract.

5. Introduction to Testing

To achieve the quality approach objectives, which are required by BT, the test strategy must be underpinned by a cycle of activities. This starts with the interface definitions and culminates in a standard means of testing, using a suitable (and approved) choice of tester. This ensures that the supplier can demonstrate conformance for each interface and aspect of the protocol, on the BT network.

The SS7 digital signalling network communicates via interfaces using complex multi-layer protocols. These are not tolerant of minor incompatibilities and must conform precisely for reliable communication to take place.

For telecommunication products required by BT, the testing strategy employed follows two main stages, Interface Validation Testing (IVT) and Inter-Working Testing (IWT). These are discussed later, but initially the interface between BT and the supplier needs to be discussed.

5.1. Supplier – BT Relationship

In the past BT had a select core of suppliers, from which BT procured exchange equipment, software and services. As BT had personal interests and was heavily involved in defining the initial SS7 protocols, it decided to perform the function of testing. This was successful, saved a lot of costly mistakes and it enriched its own expertise, but it was expensive and consumed a lot of internal resources.

Nowadays with the open market for suppliers, and that the protocol specifications (especially MTP and NUP) are mature, this responsibility has been passed to the supplier. In BT's words 'that is where it should have been in the past and it will now stay this way'. The only exceptions are the very new services, in the areas of broadband and IN. Still with BT's expertise developed from the past, it now uses this to oversee the final interconnection and proving phases.

From BT's expertise in testing, they can also accurately assess whether a supplier is undertaking the testing in a formal and quality manner. They may not offer advice in the first instance, and would expect a reasonable level already in place on any development.

5.1.1. SIRO

The System Interconnection Responsible Officer (SIRO) is appointed to any project, which requires involvement by BT. This is always the case for testing, and especially with a new supplier and/or new equipment.

The SIRO will expect a reasonable level of documentation and structure already in place by the supplier, and will report any deficiencies, which will impede success of the IVT and IWT stages to BT. This information should also be passed to the supplier, but is dependant upon a good relationship.

The SIRO responsibilities follow:

- Supplier contact and reporting interface – important feedback loop.
- Verification of suppliers understanding of Statement of Requirements (SOR).
- Authority and agreement of compliance milestones.
- Verify compliance's are met, and agree exceptions.
- Check test plan and strategy, and matches compliance schedules set.
- Report on structure and quality plans relating to the development, testing and supply set-up by the supplier. Highlight strengths and weaknesses to aid the supplier.
- Reporting to NIRO potential network related problems, and forthcoming inter-working testing requirements.
- Check on configuration management, documentation and build procedures.
- Sign off compliance and certification, with NIRO assessment.

5.1.2. NIRO

The Network Interconnection Responsible Officer (NIRO) is chiefly assigned the role of looking in to any envisaged requirements which may be placed on to the network when interconnection is achieved.

The NIRO responsibilities follow:

- Envisage interconnection problems, now and in the future for the product in the network.
- Report non-compliance's relating to network overview.
- Authority and agreement of compliance milestones.
- Check on configuration management, documentation and build procedures.
- Confirm with SIRO before compliance agreed and certification.

6. Interface Validation Testing Cycle

Validation testing is a pre-requisite specified in the initial Statement of Requirements (SOR), and will be performed by the supplier in all cases. This will be audited by the SIRO and the results of the testing will be informed to the NIRO.

The function of validation testing is to check that a given implementation conforms to the relevant CCITT/ITU-T/BTNR recommendations of the signalling system.

6.1. The Requirement Specifications

The interface requirement for BT is usually presented as a BTNR. This may be a refinement of an international standard or recommendation, or a unique standard to meet BT network requirements. For IVT and IWT testing this would be:

Specification	Description
BTNR 167 Interface specification for Signalling System No 7 (BT) National User Part (Issue 3 July 1987, Addendum 4 Issue 1, Issue 5 Draft 3)	BT specific and ISDN user parts with references to Q.721 – Q.725
BTNR 146 Message Transfer Part for Signalling System No 7 (BT) National User Part (Issue 3 August 1995)	Used by suppliers to make contractual statement of compliance against the requirements. Used to create the <i>compliance milestones</i> .
CCITT/ITU-T Q.700 – Q.707	Signalling System No.7 Specification
CCITT/ITU-T Q.780 – Q.783	Test Specifications
PNO-ISC 005	Public Network Operators – C7 Interconnect Message Transfer Part (MTP)
PNO-ISC 006	Public Network Operators – Interconnect User Part (IUP)
PNO-ISC 007	Public Network Operators – ISDN User Part (ISUP)

Additionally, the requirements from the operator may constitute new services, not previously specified.

The largest problems a supplier will face are related to understanding the requirements with the aim of:

- Resolving any conflicts in the requirements, documenting and reporting them back to the operator and the SIRO.
- Resolving the conflicts in the product implementation, documenting, applying build controls and correcting them. Keeping the SIRO informed.

The final stages of the product development and proving would therefore require a number of iterations to produce a working implementation. At the end of this sequence, the corrected suppliers' product specification may be produced by documenting the implementation. In addition, there will be a lot of information produced and available to be passed to a later stage, when it would be required to produce an exception list of compliance's.

6.2. Compliance Milestone Schedule

This is a document which the SIRO will be expecting to receive in one form or other. Whatever has been specified in the SOR, be it a CCITT/ITU-T or BTNR, this has to be addressed at this stage.

A preferred solution is to table all the sections in the SOR, and the actual specifications, and individually mark levels of compliance's. The levels of compliance should be marked where appropriate with categories such as:

<u>Categories</u>	<u>Meaning</u>
Full (F)	Full understanding of specification. Full compliance to section in specification.
Not Applicable (N/A)	Not applicable as this section will not be relevant for the product. Important to comment on why this is assessed as N/A.
No (N)	Not complying. Important to understand and comment on why this is N. This will be raised by the SIRO, and could be agreed as an exception.
Do not understand (?)	A possible misunderstanding or ambiguity to be raised. Important to note that the function of BT and SIRO are there to assist, but not educate.

6.3. Production of Test Plan

Even though it is the objective of any supplier to produce as near perfect product specification as possible, this does not remove the need for thorough testing to demonstrate conformance and IVT. Whilst it would be ideal to perform 100% testing for conformance, in practice it is mathematically demonstrable to be impossible due to the time involved in testing. This would in reality be likely to exceed the product life expectancy.

By using formal testing specifications produced by organisations such as the CCITT/ITU-T, and deciding on test platforms which use test scripts, this can be made easier. Regardless of the approach adopted, a value judgement still needs to be exercised in determining the range and complexity of tests necessary to give a high degree of confidence that the product implementation is functioning correctly.

It is desirable to:

- Use an optimised standard methodology.
- Use independent test engineers, away from the product development.
- Check that test cases are valid and truly are derived from the initial SOR.
- Comment on particular test specific data required, and what test environment is used, to allow for regression, follow-up testing.

It is only once this has been demonstrated, that the final stage of porting the test cases on to the test environment can be undertaken.

6.4. Test Environment

Up till this point in the testing cycle, the means of producing the initial requirements and test specification have been generic. However, once generated, the test cases now have to run in a specific test environment.

Whilst the purpose of this paper is not to specify a tester, both the Prosser Telecom Martinet tester and the Evo-P Protocol Management System have suitable test capability for running and writing test scripts to the CCITT/ITU-T and BTNR specifications.

6.5. Test Results

Given that the capability to conduct the designated test, the treatment of results should also be constrained by a standard methodology.

The principle underlying the test strategy has been to subject all equipment to the same level of testing to ensure a pre-determined degree of quality. It is essential therefore that a uniform rigor is applied to assessment of test results. To do otherwise invalidates the purpose of having a test strategy. In the extreme case ignoring inconvenient results calls into question whether it was worth testing at all.

The test specification must therefore make it unambiguously clear what the expected result is to be. The actual results must be compared point by point with the expected result. If the results do not tally with the expected result, then such exceptions must be subjected to the judgement of those responsible for the product specification, before alerting the SIRO. Such judgements must be made on a purely objective basis. If commercial pressures and considerations are taken into account, they must under no circumstances result in a distortion of the interface standard.

It may be necessary initially to recycle through the requirement specification as well as the test specification in order to produce a coherent suite of requirement and test specifications.

7. Other Supplier Testing

It is not reasonable to suppose that complex equipment can be tested at a single pass. Various attributes would be tested at different phases of an overall test plan. The phases of this hierarchy are identified in the next sections.

7.1. Interface Conformance Testing

Interface conformance is the keystone of all subsequent testing and hence is fundamental to the successful testing strategy. This has been covered in IVT.

7.2. Facility Testing

The main purpose of interface conformance testing was to ensure that the protocol has been correctly implemented. Facility testing probes the use to which the system puts the protocol in supporting the other services i.e. supplementary services, voice server applications.

Facility testing is carried out only after full interface conformance has been assured. Its purpose should be to test the services, not the protocol supporting them.

7.3. System Functional Testing

System functional testing is here defined to include those aspects of system performance, which are uniquely an intrinsic part of a particular system implementation.

It would be expected to cover such things as:

- Traffic testing – throughput and BHCA.
- Overload strategy.
- MML interaction – bringing resources into service etc.

These aspects should be highlighted by the supplier and discussed with the SIRO, as early as possible, so that the NIRO can be informed to make a judgement. These are aspects of system performance which only affect the system under test, and do not directly impact on the way in which the system communicates with the rest of the network. Failure of system functional test performance should not, by definition, propagate to the rest of the network.

8. Inter-Working Testing

At this point it should be possible to connect the system under test to the network, and have confidence that it would inter-work satisfactorily. In some cases BT may require this to be conducted in controlled simulated operational conditions. This is possible at the test facilities that BT has at Adastral Park, Martlesham Heath in the UK. If the earlier stages of testing have been diligently carried out, this stage should be a formality. Inconsistencies have already been flushed out, and we are now dealing with a system of known conformance and performance characteristics.

8.1. Compliance pass

Once the test results have been analysed, the approval and authority of the SIRO and NIRO are required before interconnection approval and license is given.

Even though certain areas may fail, an intermediate license may be given. This will raise a concession that will be discussed further to see what action the supplier requires. In many cases, this concession would be fixed by the time of the next upgrade release. It is for this reason, that it is suggested that this is an area appropriate for commercial decision and negotiation.

9. Conclusions

- As a responsible supplier, it will be expected that you should have a test strategy which endorses the following points:
- The order acceptance process for all products and services should include an IVT, IWT and acceptance programme.
- Such IVT testing should be carried out by the implementation of a standard test methodology.
- The testing methodology should be implemented with rigorous quality, documentation and software build control in place.
- Supplier contract managers should identify the SIRO and involve themselves in exchange of documents, specifications, and compliance results as soon as possible.

The BT testing strategy may seem difficult, but if planned, using the right resources and time, suppliers do make it through.

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Prosser Telecom is at the forefront in delivering high quality telecom products and business communications services. It has an unrivalled reputation for delivering total testing solutions.

Considerable experience gained over many years gives customers confidence that they are dealing with skilled engineers to provide the right product or service solution. Our Evo-P and Martinet products are used worldwide within public, intelligent, IP and mobile networks for testing, monitoring and development.

We specialise in protocol testing, traffic simulation and monitoring, fraud, revenue assurance, security, billing, traffic and performance testing. The company can also provide bespoke solutions, working closely with customers on their development or testing projects.

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