

## EARN Document

Title: Evaluation of IXI -- test specification for NJE/OSI  
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### 1 Introduction

The tests to be performed in evaluating IXI for EARN traffic using NJE/OSI are described in broad terms in the document EARN-IXI DOC90-10. The present document specifies these tests in more detail. It is expected that experience will suggest additions and improvements to the test procedures. This document shall be revised accordingly.

### 2 General Description

Tests shall be conducted in well-defined phases, each phase to be completed before the following phase is started. Each NJE link shall be tested separately, as differences are expected in the type and configuration of the equipment in the path of each link. Where possible, independent testing shall proceed in parallel.

The tests shall be run under co-operation between local staff and EARN staff.

Four phases of testing are defined.

Phase 1 comprises connection of the EARN NJE/OSI system to IXI, either directly or via a co-operating subnetwork, demonstration using X.29 or other suitable simple protocol that the connection is working, and the establishment of one or more working NJE links to other systems via IXI.

Phase 2 comprises tuning of the parameters for optimum performance, confidence testing of the link, and establishment of benchmark performance figures.

Phase 3 comprises live testing of the link by diverting real traffic over the link under test. This shall be done in co-operation with the Country Co-ordinators (NCC's) of the countries involved, and after notification to the Network Operations Group. The link shall remain "unofficial" during this phase, and existing routes and links shall remain

available as a "hot backup".

Phase 4 comprises permanent transfer of traffic to IXI. This shall be subject to satisfactory results from the earlier phases, and in accordance with the EARN change control regime. Where a change in the topology is introduced, the EARN Routing Project Group (EARN-RPG) shall be involved.

There shall be a report at the end of each phase recording the test results including any problems encountered and their solutions, and also the manpower required to to conduct the tests.

A final report at the conclusion of phase 3 for the lead sites shall be presented.

### 3 Phase 1 Testing -- Initial Connection

Phase 1 comprises connection of an EARN NJE/OSI system to IXI, either directly or via a co-operating subnetwork, demonstration using X.29 or other suitable simple protocol that the connection is working, and the establishment of one or more working NJE links to other systems via IXI.

Connection of the system to IXI is done once only per system. For each new link to be established over IXI, the per-link testing specified below shall be repeated.

#### 3.1 Objectives

The objectives of this phase of testing are:

- to establish an X.25 connection between an EARN NJE/OSI system and IXI, directly or via a co-operating subnetwork;
  - to demonstrate that the X.25 connection is working;
  - to establish an NJE/OSI link over IXI to another NJE/OSI system;
- and
- to demonstrate that the NJE/OSI link is working.

#### 3.2 Preparation

For an NJEOSI system connected to IXI via an intermediate sub-network, a port shall be identified on a local switch connected to the subnetwork.

This port shall be configured to support the NJEOSI system. The switch and any intermediate switches in the path to IXI shall be configured with routing information to switch calls between the NJEOSI system and IXI.

A port shall be identified on the NJEOSI system. This port shall be configured for connection directly to the IXI access point or to a local switch connected to the subnetwork over which IXI access is to be provided.

A COSINE address, and where necessary a DTE address on the local sub-network, shall be obtained for the NJEOSI system.

The appropriate cabling, including line-drivers and/or modem-eliminators, shall be identified, installed, and labelled for future reference.

The appropriate version of operating-system and networking software, including any required modifications or patches shall be installed on the NJEOSI system.

It is strongly recommended that test applications be available and enabled on the NJEOSI system which shall allow verification of the network, transport, and session services. Examples of such applications for the network service are the X.29 client and server applications. For the transport and session layers, installation verification procedures may include suitable applications.

For each link which is to be tested, the link definition shall be prepared on each of the nodes, taking care that the specifications at either end are compatible. In particular, attention must be given to the version of NJE/OSI to be used -- with or without flow-control, and to the direction in which the network connection will be established.

The bandwidth nominally available for the link shall be determined. This shall be taken to be the bandwidth of the hop of least bandwidth along the communications path which will actually carry the link.

Configuration details may be found in the relevant EARN Document for the particular kind of NJEOSI system:

for G-boxes: EARN-IXI DOC90-2,  
for E-boxes: EARN-IXI DOC90-11.

### 3.3 - Procedures and Criteria

#### 3.3.1 - Per-node testing

### 3.3.1.1 - Verification of cabling

This test procedure shall be performed in all cases.

After installation of the cabling, synchronization between the NJEOSI system and the switch to which it is connected shall be verified by using a system-resident utility and/or a switch-resident utility.

In case no such utility is available, test equipment such as a data analyzer shall be used instead.

If the NJEOSI system is not synchronized with the switch, this is a fault condition which shall be investigated and cleared before further testing can be performed.

This test procedure indicates satisfactory operation if the NJEOSI system and the switch to which it is connected become synchronized and remain synchronized with each other for not less than ten (10) minutes.

### 3.3.1.2 - X.29 loopback over local subnetwork

This test shall be performed when the NJEOSI system is connected to IXI via a local subnetwork and when the system is able to support both incoming and outgoing X.29 calls.

An X.29 call shall be placed from the NJEOSI system over the local sub-network using the system's own DTE address in the local subnetwork as the target address.

The test indicates satisfactory operation if the following conditions are met:

the X.29 call is received by the calling system; and

it is possible to conduct an X.29 call without loss of data, resets or unexpected call clearance.

If the test does not indicate satisfactory operation, this is a fault condition which shall be investigated and cleared.

### 3.3.1.3 - X.29 loopback over IXI via local subnetwork (if any)

This test shall be performed when the NJEOSI system is able to support both incoming and outgoing X.29 calls.

An X.29 call shall be placed from the NJEOSI system over IXI

using the system's own COSINE address as the target address.

The test indicates satisfactory operation if the following conditions are met:

the X.29 call is received by the calling system; and

it is possible to conduct an X.29 call without loss of data, resets or unexpected call clearance.

If the test does not indicate satisfactory operation, this is a fault condition which shall be investigated and cleared.

#### 3.3.1.4 - OSI Transport loopback over local subnetwork (if any)

This test shall be performed if a suitable test application is available on the NJEOSI system and the NJEOSI system is not directly connected to IXI.

The test application shall be used to establish a transport service connection from the NJEOSI system to a TSAP on the same system over the local subnetwork.

The test indicates satisfactory operation if the following conditions are met:

the transport service connection is established to the calling system; and

data is successfully passed across this transport connection.

If the test does not indicate satisfactory operation, this is a fault condition which shall be investigated and cleared.

#### 3.3.1.5 - OSI Session loopback over local subnetwork (if any)

This test shall be performed if a suitable test application is available on the NJEOSI system and the NJEOSI system is not directly connected to IXI.

The test application shall be used to establish a session service connection from the NJEOSI system to a SSAP on the same system over the local subnetwork.

The test indicates satisfactory operation if the following conditions are met:

the session service connection is established to the calling system; and

data is successfully passed across this session connection.

If the test does not indicate satisfactory operation, this is a fault condition which shall be investigated and cleared.

#### 3.3.1.6 - OSI Session loopback over IXI (via local subnetwork (if any))

This test shall be performed if a suitable test application is available on the NJEOSI system.

The test application shall be used to establish a session service connection from the NJEOSI system to a SSAP on the same system over the local subnetwork.

The test indicates satisfactory operation if the following conditions are met:

the session service connection is established to the calling system; and

data is successfully passed across this session connection.

If the test does not indicate satisfactory operation, this is a fault condition which shall be investigated and cleared.

#### 3.3.1.7 - Additional tests

In order to investigate a particular fault condition, it may be found necessary to devise additional tests not specified here.

### 3.3.2 - Per-link testing

#### 3.3.2.1 - X.29 access between systems

This test shall be performed if one of the systems between which an NJEOSI link is to be established is able to support outgoing X.29 calls and the other is able to support incoming X.29 calls. This test shall be performed in both directions if each of the systems supports both incoming and outgoing X.29 calls.

An X.29 call shall be placed from one NJEOSI system over IXI using the other NJEOSI system's COSINE address as the target address.

The test indicates satisfactory operation if the following conditions are met:

the X.29 call is received by the other NJEOSI system; and

it is possible to conduct an X.29 call without loss of data, resets or unexpected call clearance.

If the test does not indicate satisfactory operation, this is a fault condition which shall be investigated and cleared.

### 3.3.2.2 - OSI Transport access between systems

This test shall be performed if a suitable distributed test application is available. Such an application shall provide for one of the systems to initiate a transport connection, for the other to respond, and for data to be transferred across the transport connection. This test shall be performed in both directions if the available distributed test application supports this.

The test application shall be used to establish a transport service connection from one of the NJEOSI systems to a TSAP on the other NJEOSI system over IXI.

The test indicates satisfactory operation if the following conditions are met:

the transport service connection is established to the target system; and

data is successfully passed across this transport connection.

If the test does not indicate satisfactory operation, this is a fault condition which shall be investigated and cleared.

### 3.3.2.3 - OSI Session access between systems

This test shall be performed if a suitable distributed test application is available. Such an application shall provide for one of the systems to initiate a session connection, for the other to respond, and for data to be transferred across the session connection. This test shall be performed in both directions if the available distributed test application supports this.

The test application shall be used to establish a session service connection from one of the NJEOSI systems to a SSAP on the other NJEOSI system over IXI.

The test indicates satisfactory operation if the following conditions are met:

the session service connection is established to the target

system; and

data is successfully passed across this session connection.

If the test does not indicate satisfactory operation, this is a fault condition which shall be investigated and cleared.

#### 3.3.2.4 - NJE link between systems

An NJE link shall be defined on each of the NJEOSI systems, using the appropriate driver, local and remote N-, T-, and S- SAP addresses, and other parameters as necessary. Details of this procedure depend on the kind of NJEOSI system involved and are specified in the relevant EARN document:

for G-boxes: EARN-IXI.DOC90-2  
for E-boxes: EARN-IXI.DOC90-11

The NJE link so defined shall be started at each end, and the exchange of SIGNON records verified. Satisfactory operation is indicated if the SIGNON records are exchanged within 5 minutes of the time when the later of the commands to start the link is issued; otherwise a fault condition is indicated which shall be investigated and cleared.

#### 3.3.2.5 - Exchange of NMR commands and responses

A simple NMR command shall be issued across the link from one of the NJEOSI systems to the other, and also in the opposite direction. Satisfactory operation is indicated if the response is received at the system where the command was issued within 5 seconds; otherwise a fault condition is indicated which shall be investigated and cleared.

#### 3.3.2.6 - Exchange of files

Files shall be exchanged in either direction across the link, and a rough estimate obtained of the transit delay. Special files shall be used, with a record size of 80 bytes, and composed so that data compression is avoided. Files of 50, 500, and 5000 records shall be sent separately, first in one direction, and then in the other.

The test indicates satisfactory performance if the following conditions are met:

- file transit times correspond to an effective throughput of no less than twenty-five percent of the bandwidth nominally available for



the link; and

- file transit times observed in either direction for files of the same size differ by no more than ten percent.

Otherwise a fault condition is indicated which shall be investigated and cleared.

The following table shows transit times corresponding to twenty-five percent of the bandwidth nominally available for different file sizes and nominally available bandwidths. A per-file overhead of two seconds is included in the times shown.

Bandwidth Nominally Available	File Size (records)		
	50	500	5000
64000	4	22	202
9600	16	142	1402

### 3.3.2.7 - Additional tests

In order to investigate a particular fault condition, it may be found necessary to devise additional tests not specified here.

### 3.4 Report

The report for phase 1 shall show, for each test specified in section 3.3, whether the test was performed, and whether the specified criteria were met.

If a particular test was not performed, a reason shall be given in the report. It may be, for example, that a test application was not available on one of the systems involved.

If a fault condition was indicated, a description shall be given in the report of the measures taken to isolate and correct the fault. This shall include a description of any additional test procedures not described above which were found necessary or useful.

## 4 Phase 2 Testing -- Capacity and Reliability

Phase 2 testing comprises measurement of the performance of an NJE/OSI link to establish its capacity and reliability. Additional measurements shall

be made at lead sites to determine optimal configuration parameters and protocol overhead.

Phase 2 testing shall be repeated for each new NJE/OSI link.

#### 4.1 Objectives

The objectives of this phase of testing for all sites are:

- to establish the capacity of the NJE/OSI link using a standard load test; and
- to establish the reliability of the NJE/OSI link using a standard stability test.

Additional objectives for lead sites are:

- to identify the parameter profile for optimum performance;
- to determine protocol overhead at the different OSI levels for the standard configuration;
- to determine file-handling overhead in the NJE application;
- to determine protocol overheads with different available transport service protocols; and
- to establish operational procedures for monitoring long term performance changes.

#### 4.2 Preparation

The NJE/OSI link to be tested shall be set up and demonstrated to be working. The tests specified for Phase 1 above shall normally be used for this demonstration.

#### 4.3 Procedures and Criteria

##### 4.3.1 Lead Sites

##### 4.3.1.1 Parameter Optimization

Repeated tests shall be made with a large file using different values of the parameters. The file shall be constructed so that its records are not compressible. It is suggested that the file be of 5000 eighty-byte records.

The file shall be transferred across the link in each direction for each set

of parameter values. Trace data shall be gathered and used to confirm the effective parameter settings. It is recommended that representative trace data be kept for other tests in this phase.

The parameters to be varied shall be: the X.25 packet size, the X.25 window size, the transport protocol data unit (TPDU) size, and the NJE block size.

X.25 packet sizes used in this test shall include 128 and 256. Other packet sizes supported by the NJE/OSI systems and networks involved may also be used. Tests shall be conducted using the same packet size in each direction. Tests may also be conducted using different packet sizes.

X.25 window sizes used in this test shall include 2, 4, and 7. Other window sizes supported by the NJE/OSI systems and networks involved may also be used. Tests shall be conducted using the same window size in each direction. Tests may also be conducted using different window sizes.

TPDU sizes used in this test shall include 128 and 2048. Other TPDU sizes supported by the NJE/OSI systems involved may also be used. Tests shall be conducted using the same TPDU size in each direction. Tests may also be conducted using different TPDU sizes.

NJE buffer sizes used in this test shall include 1000, 1024, and 2048. Other buffer sizes supported by the NJE/OSI systems involved may also be used.

#### 4.3.1.2 Protocol Overhead

With optimal configuration parameters in effect, trace data shall be gathered while files are transferred across the link under test. The files used shall be of different sizes: one of 50 eighty-byte records and one of 5000 eighty-byte records shall be included. The files used shall be constructed so that their records are not compressible.

The protocol overhead at the different levels shall be determined from the trace data.

#### 4.3.1.3 File-Handling Overhead

With optimal configuration parameters in effect, trace data shall be gathered as specified under 4.3.1.2 above, but using a single large file and a series of small files.

The file-handling overhead shall be determined from the trace data and/or from the link log files.

#### 4.3.1.4 Comparison of Transport Protocols

With optimal configuration parameters in effect, and Transport Class 0 selected, trace data shall be gathered as specified under 4.3.1.2 above, using a single large file.

The test shall be repeated with Transport Class 4 selected.

The actual use of the desired Transport Protocol shall be verified and the overhead of each protocol shall be determined from the trace data.

#### 4.3.1.5 Establish Performance Monitoring Procedures

Operational procedures for monitoring long term performance changes shall be established. It is expected that factors outside EARN's control, such as competing traffic, will affect performance.

### 4.3.2 All Sites

#### 4.3.2.1 Application-Level Throughput

Application-level throughput shall be established by using a standard load test. While the link under test is inactive, a standard load shall be generated and queued for transmission at each end of the link. This load shall include a number of files of different sizes. When all files have been queued, the link shall be started.

Throughput shall be determined from the Jnet link log files or from the console log, as appropriate for the particular system.

It is recommended that the BIGTEST procedure developed by Harri Salminen be used for this test, and that files of 50, 500, and 5000 incompressible 80-byte records be used. It is recommended that the 'count' parameter of this procedure be chosen as 5.

REXX and DCL versions of BIGTEST and appropriate test files are available

from EOC.

The test indicates satisfactory operation if the following conditions are met:

- the link remains in the CONNECT state while seventy-five thousand (75,000) incompressible 80-byte records are transmitted simultaneously in either direction; and
- the mean file transit times observed satisfy the conditions specified under 3.3.2.6 above.

Otherwise a fault condition is indicated which shall be investigated and cleared.

#### 4.3.2.2 Reliability

A small continuous load shall be imposed on the link so that it is kept busy.

The test shall last for a period of one hundred and sixty-eight hours free of scheduled outages; that is, a period of seven days augmented as necessary to compensate for scheduled outages.

It is recommended that a dummy node be defined at each end of the link, and routed to the other end, so that a file destined for this dummy node will be passed back and forth across the link as long as the link remains in the CONNECT state. A small number of files queued for the dummy node will then suffice to keep the link busy.

The test indicates satisfactory operation if the following conditions are met:

- over the test period, without counting scheduled outages, the link shall remain in the CONNECT state for not less than one hundred and sixty (160) hours;
- over the test period, without counting scheduled outages, the number of interruptions in service is no more than ten (10).
- the mean file transit times observed satisfy the conditions specified under 3.3.2.6 above.

Otherwise a fault condition is indicated which shall be investigated and

cleared.

#### 4.4 Report

The report for phase 2 shall show, for each test specified in section 4.3, whether the specified criteria were met.

If a fault condition was indicated, a description shall be given in the report of the measures taken to isolate and correct the fault. This shall include a description of any additional test procedures not described above which were found necessary or useful.

#### 5 Phase 3 -- Pilot Operation

In this phase of testing, real traffic is diverted progressively to the NJE/OSI link under test, whilst maintaining existing production link(s) as a fallback route.

##### 5.1 Objectives

The objectives of this phase of testing are:

- to confirm using real traffic the throughput and reliability of the link;
- to demonstrate that the capacity is adequate for the offered traffic; and
- to identify any unforeseen problems before committing the link to production use.

##### 5.2 Preparation

The capacity and reliability tests specified above for phase 2 shall be performed and satisfactory results obtained.

A plan shall be developed for gradual transfer of production traffic to the link under test. This plan shall specify operational procedures for reverting to existing production links in the event of disruption of service caused by the use of the link under test.

[What is required in terms of EXEC authorization ??? (NOR)]

NOG and RPG shall be notified no less than two weeks in advance of the beginning of this phase of testing.

Line monitoring shall be set up to implement the EARN Traffic Directives,

file queueing by size, and automatic restarting for the link under test.

### 5.3 Procedures and Criteria

### 5.4 Report

The technical objectives are:

To move live traffic to the IXI network as a pilot operation.

Of particular importance is to study the effect of complex traffic patterns or the effect of other non EARN traffic. It should be remembered that EARN traffic may be disadvantaged on IXI as traffic will be spread evenly between the competing calls on a well loaded network even though the EARN traffic is transmitted on behalf of many users while other calls will be on behalf of a single user.

Traffic will probably be moved a part at a time to IXI. A fall back position shall be maintained in case of problems.

## 6 Phase 4 -- Operation

### 6.1 Objectives

Traffic shall be moved permanently to IXI. This shall be subject to satisfactory results from the earlier phases, and in accordance with the EARN change control regime.

### 6.2 Preparation

Satisfactory results shall first be obtained from Phase 3 (Pilot Operation).

EARN EXEC shall authorize any topology change and also the change of transport technology.

EARN RPG shall have agreed appropriate link weightings so that no undesired traffic perturbations are caused.

EARN NOG shall be notified by the NCC's of the countries involved.

The NCC's of the countries involved shall submit nodes file updates to reflect the new links.

### 6.3 Procedures

Standard tools shall be used for monitoring, and alarms shall be delivered to local personnel at each site and to EOC.