Comments on the ISO/IEC 10747 BIS-BIS Protocol

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The following issues have been identified following review of the BIS-BIS protocol and the state table provided in the proposed DIS text of 10747.

1. Reacting to OPEN BISPDUs in the CLOSED State

The current specification only permits BIS-BIS connections to be opened during a short period after the issuing of a start event, and a start event must be issued at both sides of the connection i.e. by the Systems Managers of both BISs. This is satisfactory for BISs that are seven day a week, 24 hour a day systems, and BIS-BIS connection establishment is a rare event. However, BISs in smaller RDs may well be switched off overnight, say, or at weekends, and, on mobile subnetworks, BISs may only be in contact for a short time anyway. In such situations, there will typically be a BIS that is active most of the time, and another, adjacent BIS, which is online for shorter periods and needs to contact the other on demand; the current specification may then lead to excessive manual involvement in BIS-BIS connection establishment.

Even when there is synchronisation of the invocation of the "start event" action, the connection establishment procedures are still inefficient, as both BISs will often generate both Open PDUs and Open (Ack) PDUs. This may be costly if a public network is being used and synchronisation is poor i.e. one BIS is waiting in the OPEN-SENT state for an extended period, regularly sending OPEN BISPDUs to an unresponsive adjacent BIS.

1.1 Discussion

A solution to the above demands that one BIS adopts an essentially passive role and waits for incoming OPEN BISPDUs and reacts to them either accepting or rejecting the proposed BIS-BIS connection. Two possible ways of implementing this passive role have been identified:

1. revise the state table to include an "OPEN WAIT" state (c.f. ISO 8073 CLOSED state) in which an OPEN BISPDU may be received from a known BIS and from which a BIS-BIS connection may be established.

2. recognise that the current OPEN-SENT state is also an OPEN WAIT state and provide a mechanism to suppress the generation of OPEN BISPDUs, except in response to a received OPEN BISPDU, and also enable the FSM to remain in this state for an indefinite period, if required.

The second approach is favoured, essentially because it requires less change to the DIS text, while the first approach requires significant state table changes, and results in two states that largely duplicate each other. Modification of the "start event" would also be necessary to ensure the required state is entered.

The mechanism to suppress the generation of OPEN BISPDUs can be very simple i.e. adding a new attribute ("openRole") to the **adjacentBIS** MO, which may take the values of *active* or *passive*. If the openRole is passive, then an OPEN BISPDU is neither generated when the OPEN-SENT state is entered nor is it retransmitted on expiry of t_R. Without any further modifications to the text, when an OPEN BISPDU is received from the adjacent BIS, the OPEN (ack) will be returned, and the BIS-BIS communication established.

The FSM can remain indefinitely in this state if a conventional value for 'n' (see note 14) is adopted i.e. if n=0 then the self-generated stop event (clause 7.6.1.2.k) is never generated. It is further observed that both t_R and 'n' should be attributes in the **adjacentBIS** MO, otherwise they are not configurable by Systems Management.

1.2 Proposed Changes to DIS Text

1.2.1 Clause 7.6.1 1st Paragraph

Revise first sentence to read:

"A BIS shall maintain exactly one Finite State Machine (FSM) for each adjacent BIS for which an NET is listed in the **internalBIS** or the **externalBISNeighbor** attributes of the **idrpConfig** Managed Object; each such FSM shall be independent of each other".

- this is actually a minor editorial, but it's useful to identify it here the original reference to "BIS-BIS connections" is not believed to be as clear it could be.

1.2.2 Clause 7.6.1.1.b

Replace current text with:

(b) When the FSM receives a Start Event, the action taken then depends upon the value of the openRole attribute in the corresponding **adjacentBIS** MO i.e.

i. passive: The FSM shall enter the OPEN-SENT state.

ii. active: the local BIS shall first generate an Initial Sequence Number (ISN) (see 7.5.2). An OPEN BISPDU shall then be generated and sent to the remote BIS identified by the BisNET attribute in the corresponding **adjacentBIS** MO. The sequence field of the OPEN BISPDU shall contain the ISN, and the acknowledgement field shall be set to zero. The FSM shall enter the OPEN-SENT state.

1.2.3 Clause 7.6.1.2.k

Replace the current text with:

(k) If the BIS has an openRole set to *active* and does not receive an OPEN BISPDU that acknowledges its own OPEN BISPDU within a period identified by the openBispduRetransmissionTimer attribute in the corresponding **adjacentBIS** MO, then the OPEN BISPDU shall be retransmitted. However, if the maxRetransmissions attribute in the corresponding **adjacentBIS** MO is non-zero and the number of retransmissions exceeds the value of this attribute then a CEASE BISPDU shall instead be

```
generated and sent to the remote BIS, and the local BIS shall
enter the CLOSE-AWAIT state.
```

1.2.4 Table 2

Replace entry for Start Event received in CLOSED state with:

```
If OpenRole = passive,
     S=OPEN-SENT
     A=none

If OpenRole=active,
     S=OPEN-SENT
     A=send OPEN PDU
```

1.2.5 Clause 11.3

Add the following attributes:

```
openRole GET REPLACE,
openBispduRetransmissionTimer GET-REPLACE,
maxRetransmissions GET-REPLACE,
```

1.2.6 Clause 11.4

Add the following GDMO:

```
openBispduRetransmissionTimer ATTRIBUTE
     WITH ATTRIBUTE SYNTAX IDRP.RetransmissionTime;
     MATCHES FOR EQUALITY, ORDERING;
     BEHAVIOUR retransmissionTime-B
           BEHAVIOUR DEFINED AS The number of seconds between
successive             retransmissions of unacknowledged OPEN
BISPDUs;;
     REGISTERED AS {aoi openBispduRetransmissionTime (46)};

maxRetransmissions ATTRIBUTE
     WITH ATTRIBUTE SYNTAX IDRP.NonWrappingCounter;
     MATCHES FOR EQUALITY, ORDERING;
     BEHAVIOUR maxRetransmissions-B
           BEHAVIOUR DEFINED AS The maximum number successive
           retransmissions of unacknowledged OPEN BISPDUs
permitted;;
     REGISTERED AS {aoi maxRetransmissions (47)};

openRole ATTRIBUTE
     WITH ATTRIBUTE SYNTAX IDRP.OpenRoles;
     MATCHES FOR EQUALITY, ORDERING;
     BEHAVIOUR openRole-B
           BEHAVIOUR DEFINED AS The role of the BIS during
connection
           establishment;;
     REGISTERED AS {aoi openRole (48)};
```

1.2.7 Clause 11.9

Add:

```
OpenRoles := ENUMERATED {
     active(0),
     passive(1)}
```

2. Public Access BISs

There should be no reason why a BIS should not be configured to accept a BIS-BIS connection with any other BIS. Such a BIS could be regarded as a Public Access BIS and has routing policies designed to ensure that such access is neither abused nor exceeds the scope of the service offered. This can be implemented with the current specification by Systems Management reacting to the "packetBomb" notification by setting up an adjacentBIS MO, etc. However, the notification is somewhat aggressively named for such a use, and wording of the specification is negative, in the sense that this reads as an abuse of the protocol rather than a possible facility. Furthermore, the parameters specified for the notification imply that a packetBomb is always an OPEN BISPDU (i.e. RDI and RDC information is present), while it could, in theory, be any rogue BISPDU.

2.2 Discussion

It is proposed that a new notification is introduced "connectRequestBISUnknown" and that this has the same parameters as the current packetBomb. The notification is generated whenever an OPEN BISPDU is received from an unknown BIS.

The packetBomb notification is then used for all other BISPDUs from unknown source, and is therefore restricted to a single parameter, the NET of the source BIS.

These changes, while largely editorial, tone down the perceived consequences of an OPEN BISPDU from an unknown source, and properly distinguish the different BISPDUs that could be received from an unknown source and the parameters that should be provided.

It is also believed useful to specify a further notification to report that an OPEN BISPDU has been received from an known adjacent BIS in the CLOSED state when otherwise it would be ignored. This is both for completeness, and can enable appropriate remedial action to be taken if necessary.

2.3. Proposed Changes to DIS Text

2.3.1. Clause 7.6.1.1 ordered list

Inset new list item (c) as follows:

(c) If the BIS receives an OPEN BISPDU without errors then the BIS shall send a notification ("connectionRequested") to Systems Management, but otherwise ignore the BISPDU.

Renumber the current list item (c) to list item (d) and insert "other" after "receives any".

2.3.2. Clause 7.20 4th para

Revise to read:

However, if the source address of the NPDU is not an NET listed in the **internalBIS** or the **externalBISNeighbor** attributes of the **idrpConfig** Managed Object, then:

a) if the NPDU is an OPEN BISPDU without errors, then the BIS shall send a notification ("connectRequestBISUnknown") to Systems Management, otherwise

b) if the NPDU is any other BISPDU with or without errors, then the BIS shall send a notification ("PacketBomb") to Systems Management.

The NPDU shall then be discarded.

2.3.3. Clause 11.2

Add to list of notifications:

connectionRequested: generated when the local BIS has received an OPEN BISPDU from an adjacent BIS and the FSM for BIS-BIS connections with the adjacent BIS is in the CLOSED state. The RemoteBIS-NET is reported in the AdditionalInformation field using the "notificationRemoteBIS-NET" parameter

connectRequestBISUnknown: generated when the local BIS has received an OPEN BISPDU from an unknown BIS. In addition to the parameters specified by ISO/IEC 10733, the following information shall be reported by the AdditionalInformation field, with the parameters:

a) notificationSourceBIS

b) notificationSourceBISrdi

c) notificationSourceBISrdc

The parameter descriptions are the same as those currently specified for the PacketBomb notification.

Replace the current specification of PacketBomb with:

packetBomb: generated when the local BIS has received a BISPDU other than an OPEN BISPDU, from unknown BIS. The SourceBIS-NET is reported in the AdditionalInformation field using the "notificationSourceBIS-NET" parameter.

2.3.4. Clause 11.6

Add GDMO for new notification:

```
connectionRequested NOTIFICATION
     BEHAVIOUR connectionRequested-B
           BEHAVIOUR DEFINED AS The indication that the local BIS
has received an        OPEN BISPDU from an adjacent BIS and the FSM
for BIS-BIS connections            with the adjacent BIS is in the
CLOSED state. Such BISPDUs are otherwise             ignored by the
receiving BIS.;;
     WITH INFORMATION SYNTAX IDRP.NotificationInfo;
     REGISTERED AS {noi connectionRequest(8)};

connectRequestBISUnknown NOTIFICATION
     BEHAVIOUR connectRequestBISUnknown-B
           BEHAVIOUR DEFINED AS The indication that the local BIS
has received an        OPEN BISPDU from an unknown BIS. Such BISPDUs
are otherwise ignored        by the receiving BIS.;;
```

```
     WITH INFORMATION SYNTAX IDRP.NotificationInfo;
     REGISTERED AS {noi connectionRequest(9)};
```

Replace packetBomb GDMO with:

```
packetBomb NOTIFICATION
     BEHAVIOUR packetBomb-B
          BEHAVIOUR DEFINED AS the local BIS has received a BISPDU
other than             an OPEN BISPDU, from unknown BIS. Such
BISPDUs are otherwise ignored           by the receiving BIS.;;
     WITH INFORMATION SYNTAX IDRP.NotificationInfo;
     REGISTERED AS {noi packetBomb (7)};
```

3. BIS-BIS Frozen Timer

The current specification requires that an immutable 150 seconds must elapse between the end of one BIS-BIS connection and the start of another between the same pair of BISs. This is potentially a serious problem if a transitory condition caused the loss of communications.

The problem is compounded as inspection of the state table appears to demand that a BIS-BIS connection is terminated if an OPEN BISPDU is received out of sequence. This is highly undesirable and may cause intermittent service whenever alternative paths exist e.g. if an OPEN PDU gets duplicated in the network.

3.2 Discussion

It is believe that the period 150 seconds has been chosen to avoid any problem of cross-talk between successive BIS-BIS connections between the same pair of BISs. The concept of a frozen reference exists in ISO 8073 TP4, and for good reason. TPDU sequence numbers are only 4-bit and there is a high probability of cross-talk if two transport connections with identical references were allowed to exist with no "quarantine period" between them.

A frozen reference has a limited implication for the transport layer as there can be many transport connection references. However, there can only be one BIS-BIS connection and demanding a quarantine period of 150 seconds can cause useability problems. Furthermore, BISPDU sequence numbers are 32-bit integers, and if the sequence numbers are not reset to zero at the start of every connection, as is the case, then there is only a very very small probability of cross-talk occurring if appropriate checks are made.

It is thus proposed that the 150 second closeWaitDelay is deleted, as it serves no useful role.

Then, in order to avoid cross-talk from a previous connection, the text is further amended to ensure that all received OPEN BISPDUs with a sequence number less than or equal to the last sequence number received on the preceding connection (if any) are ignored, and that outside of the CLOSED state, all other BISPDUs with an acknowledgement less than the local BIS's ISN are also ignored.

The first change is necessary to ensure that "old" OPENs are ignored, and the second to ensure that all other "old" BISPDUs are ignored. The acknowledgement field is used in the second case, as it saves having to remember the remote ISN for each connection.

3.3 Proposed Changes to DIS Text

3.3.1 Table 2

Delete column headed CLOSE-WAIT and change all remaining references to the CLOSE-WAIT state to CLOSED.

Replace entries in ESTABLISHED state for Receive OPEN PDU with or without errors by:

```
S=ESTABLISHED
A=none`
```

3.3.2 Clause 11.3

Add new attribute:

```
lastSeqNumberRecvOnPreviousConnection GET,
```

3.3.3 Clause 11.4

Add new attribute:

```
lastSeqNumberRecvOnPreviousConnection ATTRIBUTE
     WITH ATTRIBUTE SYNTAX IDRP.NonWrappingCounter;
     MATCHES FOR EQUALITY, ORDERING;
     BEHAVIOUR lastSeqNumberRecvOnPreviousConnection-B
           BEHAVIOUR DEFINED AS The last valid sequence number
received on the        preceding connection, if any;;
     REGISTERED AS {aoi maxRetransmissions (49)};
```

3.3.4 Clause 7.6.1.2

Replace first paragraph with:

While in the OPEN-SENT state, any BISPDU received other than an OPEN BISPDU, with an acknowledgement less than the local BIS's ISN shall be ignored, otherwise, the BIS shall take one of the following actions:

Replace (e) with:

(e) If the BIS receives an OPEN BISPDU with no errors that does not acknowledge its own previously sent OPEN BISPDU then:

    i. if the received OPEN BISPDU's sequence number is less than or equal to the lastSeqNumberRecvOnPreviousConnection attribute of the corresponding **adjacentBIS** MO, then the OPEN BISPDU shall be ignored, otherwise

    ii. the local BIS shall resend its own previously sent OPEN BISPDU with the same ISN as before, but with the value of the acknowledgement field set to the sequence number of the received OPEN BISPDU.

The FSM shall then enter the OPEN-RCVD state.

3.3.5 Clause 7.6.1.3

Replace first paragraph with:

While in the OPEN-RCVD state, any BISPDU received other than an OPEN BISPDU, with an acknowledgement less than the local BIS's ISN shall be ignored, otherwise, the BIS shall take one of the following actions:

Replace (i) with:

(i) If the BIS receives an OPEN BISPDU with no errors that does not acknowledge its own previously sent OPEN BISPDU then:

    i. if the received OPEN BISPDU's sequence number is less than or equal to the lastSeqNumberRecvOnPreviousConnection attribute of the corresponding **adjacentBIS** MO, then the OPEN BISPDU shall be ignored, otherwise

    ii. the local BIS shall resend its own previously sent OPEN BISPDU with the same ISN as before, but with the value of the acknowledgement field set to the sequence number of the received OPEN BISPDU.

The FSM shall remain in the OPEN-RCVD state.

3.3.6 Clause 7.6.1.4

Replace third paragraph with:

While in the ESTABLISHED state, any BISPDU received other than an OPEN BISPDU, with an acknowledgement less than the local BIS's ISN shall be ignored, otherwise, the BIS shall take one of the following actions:

Replace (g) with:

(g) If an OPEN BISPDU with or without errors is received from the remote BIS then it shall be ignored, and the FSM shall remain in the ESTABLISHED state.

3.3.7 Clause 7.6.1.5

Delete this clause.

3.3.8 Clause 7.6

Change all remaining references to CLOSE-WAIT to CLOSED.

3.3.9 Clause 7.6.2

Append the following paragraph:

The lastSeqNumberRecvOnPreviousConnection attribute of the corresponding **adjacentBIS** MO shall then be set to the value of the sequence number of the last BISPDU received without errors.

3.3.10 Clause 10

Delete entry for CloseWaitDelay.