Amendment to DIS 10747 (IDRP) to Allow Interaction and Exchange of Routeing Information with ISO 10589 (IS-IS)

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This paper contains the preliminary editor's draft of the text for an amendment to DIS 10747 that will describe the optional functions allowing it to exchange inofrmation with ISO 10589. It is the editor's intent to submit the draft to the SC6 secretariat so that it can be discussed at the London WG2 meeting in February 1993. At this meeting, it is expected that the authorizing NP will be issued, and that the attached text, as modified after discussion in London, will serve as the DAM text.

1. Introduction

There are two IS-to-IS routeing information exchange protocols defined within the OSI Network layer: IS 10589,″Intermediate system to Intermediate system Intra-domain routeing information exchange protocol for use in conjunction with the protocol for providing the connectionless-mode Network Service (ISO 8473)″, defines the protocol used by intermediate systems (ISs) located within a single routeing domain, while DIS 10747, ″Protocol for the Exchange of Inter-Domain Routeing Information Among Intermediate Systems to Support Forwarding of ISO 8473 PDU″, defines the protocol used by boundary intermediate systems (BISs), which may be located in the same or adjacent routeing domains. The amendment to DIS 10747 that is described in this document will provide an optional facility for use within DIS 10747 that will allow IS 10747 to import routeing information from IS 10589, and conversely will allow IS 10747 to export routeing information into IS 10589. Since DIS 10747 does not require the use of IS 10589 within a routeing domain as the intra-domain routeing protocol, the functions described in this amendment are optional, rather than mandatory.

In order to fully make use of the functions described in this amendment, a system must also support the complementary amendment to IS 10589/DAM1, which allows IS 10589 to export routeing information into DIS 10747 and also allows IS 10589 to import routeing information from DIS 10589.

In order to avoid the need for one protocol to directly process internal state information maintained by the complementary protocol, all interactions between IS 10589 and DIS 1074 will be expressed, to the extent possible, through the representation of the information to be exchanged in terms of GDMO management data structures. To make use of the optional features described in this amendment, a system must contain an instance of both IS 10589 and DIS 10747 within a single open system.

The body of this amendment lists the changes that need to be made to the clauses of DIS 10747 to support this optional function. These changes are consistent with the technical approach discussed at the July 1992 meeting of the Routeing Group of SC6 WG2 at its San Diego meeting, as outlined in SC6 N7531.

2. Changes to ″1. Scope and Field of Application″

Add the following bullet item to the paragraph beginning ″This international standard specifies...″:

> *—the procedures for the exchange of routeing information with a co-resident implementation of ISO 10589*

Add the following bullet item to the paragraph beginning ″These procedures are specified...″:

> *—optional interactions between a Boundary Intermediate System and a Level 2 Intermediate System*

3. Changes to ″2. Normative References″

The reference to ISO 10589, now contained in informative Annex B, ″Bibliography″, should be deleted from Annex B and inserted into clause 2 as a normative reference.

4. Changes to ″3. Definitions″

Include the following terms to the list in clause 3.5 (″Intra-domain Routeing Definitions″), observing correct alphabetic order:

— *Area Address*
— *Circuit*
— *Level 1 IS*
— *Level 1 LSP*
— *Level 2 IS*
— *Level 2 LSP*
— *Reachable Address Prefix*
— *Virtual Adjacency*

In clause 3.6 (Additional Definitions), add the following new item:

> ***Tunneling:*** *When BISs in the same routeing domain are not each located on the same subnetwork, NPDUs can be forwarded from one BIS to the other by means of encapsulating the NPDU; the network layer addresses of the BISs are used as the source and destination addresses of the outer (encapsulating) NPDU. This form of forwarding is called tunneling.*

5. Changes to ″4. Symbols and Abbreviations″

No changes are needed,

6. Changes to ″5. General Protocol Information″

In clause 5.9 (″Routeing Information Exchange″), make the following changes:

a) Add the following item to the list in the first paragraph:

> *—rules for exchanging information with a co-resident Level 2 IS that is running an instance of ISO 10589*

b) In the last paragraph of the clause, add the words *″that is distributed to other BISs″* between ″Routeing information″ and ″is carried...″.

c) Add a new second sentence to the last paragraph, as follows:

> *Routeing information that is optionally exchanged with a co-resident Level 2 IS is structured according to the methods of clause 99.*

NOTE: ″Clause 99″ is used as a placeholder for the new normative material to be added. It is used to avoid confusion with the currently numbered clauses of DIS 10747. However, when the new material is integrated into the text of DIS 10747, the material in ″clause 99″ will probably appear as a new clause 9, and existing clauses 9, 10, 11, and 12 will be renumbered accordingly.

7. Changes to ″6. Structure of BISPDUs″

No changes are needed.

8. Changes to ″7. Elements of Procedure″

No changes are needed.

9. Changes to ″8. Forwarding Process″

Add the following new text at the end of the first paragraph of Note 39:

> *For example, when ISO 10589 is used as the intra-domain routeing protocol, the optional methods described in clause 99 can be used to ascertain the existence of such paths.*

10. Changes to ″9. Interface to ISO 8473″

No changes are needed.

11. Changes to ″10. Constants″

No changes are needed.

12. Changes to ″11. System Management″

The attribute definitions and ASN.1 descriptions presented in Appendix C of this draft amendment need to be included in the appropriate subclauses of DIS 10747′s clause 11.

13. Changes to ″12. Conformance″

Add a new clause 12.2.6, as follows:

> ***12.2.6 Information Exchange with a Co-resident Level 2 IS***
>
> *A BIS that claims to support exchange of routeing information with a co-resident implementation of a Level 2 IS that is running an instance of ISO 10589 shall do so in accordance with 99.*

14. New Clause 99

NOTE: Text for this clause will be based on SC6 N7531. The text that will comprise ″clause 99″ appears in Appendix A of this paper.

15. Changes to ″Annex A. PICS Proforma″

The material in Table 1 should be added as a new table in the PICS. When imbedded into the text of DIS 10747, it will appear as a new subclause A.4.10, and will be numbered as Table 16. The existing clauses and tables will be renumbered accordingly. The clause references in the table right now are local to this paper; when the table is imbedded in DIS 10747, they will be replaced with the correct references to ″clause 99″.

16. Changes to ″Annex B. Bibliography″

Remove the reference to ISO 10589, which will now appear as a normative reference in 2.

17. Changes to ″Annex F″

No changes are needed.

18. Changes to ″Annex G″

No changes are needed.

19. Changes to ″Annex H″

No changes are needed.

20. Changes to ″Annex I″

No changes are needed.

21. Changes to ″Annex J″

No changes are needed.

22. Changes to ″Annex K″

No changes are needed.

23. New Annex to be Added

A new informative annex will be added to DIS 10747 to address the topic of policies for use in deciding which NLRI to export for use by IS 10589. This proposed text for this new annex appears in Appendix B of this paper.

Table 1. PICS Proforma for IDRP: Information Exchange with ISO 10589				
Item	**Questions/Features**	**Refer-ences**	**Status**	**Support**
*IMPAA	Does the BIS support importation of area addresses from ISO 10589?	A.1	O	Yes __ No __
SUMPOL	Which summarization policies does BIS this BIS support? ISO 10589?	A.1.1	IMPAA: O.1	Yes __ No __
		A.1.2	IMPAA: O.2	Yes __ No __
		A.1.3	IMPAA: O.3	Yes __ No __
		A.1.4	IMPAA: O.4	Yes __ No __
IMPSRAP	Does the BIS support importation of static reachable address prefixes from ISO 10589?	A.2.	O	Yes __ No __
*XPNLRI	Does the BIS support exportation of NLRI to ISO 10589?	A.3	O	Yes __ No __
XPPOL	Does the BIS structure NLRI in accordance with ISO 10589's managed object **nLRIToExport**?	A.3.1, A.3.3	XPNLRI: M	Yes __
DEFNLRI	Does the BIS support exportation of a default route to ISO 10589?	A.3.2	XPNLRI: O	Yes __ No __

Appendix A. Information Exchange: ISO 10589 and DIS 10747

New Clause 99

This appendix contains the proposed text for the new clause ″99″ to be added to DIS 10747.

When a single open system acts simultaneously as a Level 2 IS running an instance of ISO 10589 and also as a Boundary Intermediate System running an instance of DIS 10747, it has the option to dynamically exchange routeing information between these two protocols. The methods described below allow a BIS to:

a) import routeing information from ISO 10589 about systems located within the BIS′s routeing domain and about statically configured reachable address prefixes
b) export routeing information to ISO 10589 about the reachability of systems located outside the BIS′s routeing domain.

Correct operation of IDRP requires that a BIS know the identities of the systems located within its own routeing domain. This configuration information is carried in managed object **internalSystems** (see 7.3). When the BIS also functions as a Level 2 IS according to ISO 10589, the BIS can optionally import information about internal systems from the intra-domain protocol (ISO 10589). The imported information can then be used to update IDRP′s managed object **internalSystems** dynamically.

ISO 10589 maintains this information in its managed objects **destinationAreas** and **externalDestinations**. Managed object **destinationAreas** contains information about the area addresses of the areas that are contained within the routeing domain, and managed object **externalDestinations**[1] contains information about systems located outside the local routeing domain, expressing this information in terms of *reachable address prefixes*.

A.1 Importing Area Addresses from ISO 10589

A BIS can optionally import information about area addresses from ISO 10589. In order to control the volume of imported information about the internal topology of the local routeing domain, the BIS shall summarize the available information according to one of the following summarization policies:

a) No Summarization
b) Automatic
c) Automatic with Entry Optimization
d) Pre-configured

The policy in force is specified by the managed object **intraDomainSummarizationPolicy**. The default value of the summarization policy is ″no summarization″.

NOTE: Information learned by importation is not subject to the internal update processes of 7.17.1, since this information has not been received from a BIS located in an adjacent routeing domain.

A.1.1 The No Summarization Policy

IDRP shall import all of the area addresses contained in managed object **destinationAreas**. Since area addresses are expressed in the form of prefixes, the BIS can use the information directly to form the NLRI that it will advertise for its own routeing domain.

A.1.2 The Automatic Summarization Policy

When the automatic summarization policy is in force, the BIS shall use the RDI of its local routeing domain as a template to determine which area addresses from the **destinationAreas** managed object of ISO 10589 can be summarized and which can not.

The BIS shall:

a) create a single NLRI prefix that is equal to the longest common prefix of all area addresses that match the RDI of the local routeing domain

b) import on an individual basis all area addresses that do not match the RDI of the local routeing domain.

A.1.3 The Automatic Summarization Policy with Entry Optimization

When automatic summarization with entry optimization is in force, the BIS shall use the RDI of its local routeing domain, its **intradomainCostThreshold** attribute, and ISO 10589′s **pathCost** attribute to determine which area addresses from the **destinationAreas** managed object of ISO 10589 can be summarized and which can not. The BIS shall:

a) import directly without summarization area addresses that match the RDI of the local routeing domain and have a path cost that is less than the threshold.

[1] This MO is not yet defined in ISO 10589. The assumption is made that it will contain statically configured reachable address prefixes as well as NLRI information imported from IDRP.

b) create a single NLRI prefix that is equal to the longest common prefix of all area addresses that match the RDI of the local routeing domain and have a path cost that is not less than the threshold.

c) import on an individual basis all area addresses that do not match the RDI of the local routeing domain.

A.1.4 The Pre-configured Summarization Policy

When the pre-configured summarization policy is in force, the BIS shall use **destinationsToImport** managed object as a template to determine which area addresses can be imported from ISO 10589:

a) If an area address contained in ISO 10589′s managed object **destinationAreas** is also listed in IDRP′s managed object **destinationsToImport**, then the BIS shall import that area address

b) Otherwise, the BIS shall not import the area address.

A.2 Importing Static Reachable Address Prefixes

A BIS can optionally import information about statically configured reachable address prefixes from ISO 10589. Correct operation of this optional feature requires that all BISs within a routeing domain must support the function.

NOTE: Information learned by importation is not subject to the internal update processes of 7.17.1, since this information has not been received from a BIS located in an adjacent routeing domain.

The local BIS shall proceed as follows:

a) If the IS that sent the L2 LSP is also a BIS[2], then the reachable address prefixes contained in the L2 LSP shall not be imported.

b) If the IS that sent the L2 LSP is not a BIS, then the local BIS shall import the reachable address prefix for use as NLRI. A reachable address prefix is associated with one or more of the ISO 10589 metrics (default, delay, expense, or error). The BIS shall not install the imported information in an Adj-RIB-In whose RIB-Att does not include the corresponding IDRP distinguishing path attribute. An IDRP UPDATE PDU that advertises routes whose NLRI includes an imported reachable address prefix shall contain the EXT_INFO path attribute.

QUESTION ON USE OF L2 LSPs

This seems to be the only function described in SC6 N7531 that is not done by having IDRP query MOs. Footnote 1 to SC6 N7531 raises the possibility of representing the LSP data bases as MOs. For consistency of approach, I′d prefer to have the LSP database be made ″management accessible″, with the ″I am a BIS″ tag carried in the database.

A.3 Exporting NLRI Information to ISO 10589

To avoid encapsulation of NPDUs that are travelling between an entry BIS and an exit BIS, both located in the same routeing domain, IDRP provides an optional function that allows a BIS to export NLRI information into ISO 10589. ISO 10589 can then use this information to construct reachable address prefixes that can be distributed to all Level 2 routers via the Level 2 LSPs.

For each of its NLRI address prefixes that it wishes to export for use by ISO 10589, the BIS shall create an ISIS Reachable Address Prefix managed object (see 11.2.12 in ISO 10589). This managed object contains information about the address prefix, the values of the associated ISIS metrics, and the types of the ISIS metrics.

The specificatiion of which NLRI is eligible for export is given by IDRP managed object **nLRIToExport**. NLRI that satisfies the criteria is eligible to be used to create ISIS Reachable Address Prefix managed objects. The maximum number of exportable ISIS Reachable Address Prefix MOs that can be simultaneously enabled by operation of the protocol defined in this international standard is listed in the ISIS managed object **MaxIDRPRoutes**.

If IDRP attempts to enable more Reachable Address MOs than the upper limit contained in **MaxIDRPRoutes**, the enable operation will fail due to insufficient resources. Under such circumstances, the action taken by IDRP is a local matter.

A BIS may export NLRI only for routes that have been received from BISs located in adjacent routeing domains, and that are in the BIS′s Loc-RIB. No other routes shall be exported. When a BIS determines that a previously exported NLRI is no longer available for use, the BIS shall disable the corresponding ISIS Reachable Address Prefix managed object.

2 It is anticipated that DAM1 to ISO 10589 will define a field in the L2 LSP which will indicate whether or not the source IS is also a BIS. The details of this encoding are not yet available.

The ISIS metric values that will be placed in the ISIS Reachable Address Prefix managed object shall be integer values, in the range from 1 to 63. The method used to map IDRP′s degree of preference for the route being exported into the associated ISIS metric is left as a local matter and is outside the scope of this international standard.

A.3.1 Export Criteria

Each BIS has a predetermined policy to select NLRI information that can be exported to ISO 10589. The details of this policy are contained in managed object **nLRIToExport**, which consists of a set of 5-tuples, one for each address prefix that is a candidate for exportation:

addressPrefix: This is a reachable address prefix that IDRP is willing to export.

exportLonger: This is a Boolean value that indicates whether or not the exported NLRI information[3] can include more specific (longer) prefixes than the value contained in addressPrefix:

- If TRUE, the BIS may export any NLRI having a prefix that matches the value in addressPrefix.
- If FALSE, the BIS may supply only NLRI that matches exactly the value in addressPrefix.

ISISMetricName: This defines the categories of the ISIS metric that can be used in the associated ISIS Reachable Address Prefix managed object. The allowable categories are Default, Delay, Expense, and Error.

metricType: This defines whether the associated ISIS metric is internal or external (see A.3.3).

useMultiExit: This is a Boolean that indicates whether or not IDRP can use the value of the MULTI-EXIT_DISC path attribute (rather than the degree of preference for the path) to determine the associated ISIS metric.

A.3.2 Default Route

The BIS managed object **exportDefaultRoute** defines whether or not the BIS can export a route that covers all possible destinations. If the attribute is TRUE and the BIS is adjacent to at least one other routeing domain, then the BIS shall create and enable a Reachable Address Prefix of length 0.

A.3.3 Mapping Metrics from IDRP into ISIS

The BIS shall set the 5-tuple for the prefix to be exported as follows:

- The BIS shall set **ISISMetricName** to correspond to the path attributes contained in the IDRP route:
  a) If the TRANSIT DELAY attribute is present, the corresponding ISIS metric is ″delay″.
  b) If the RESIDUAL ERROR path attribute is present, the corresponding ISIS metric is ″error″.
  c) If the EXPENSE path attribute is present, the corresponding ISIS metric is ″expense″.
  d) If the route does not contain the TRANSIT DELAY, RESIDUAL ERROR, or EXPENSE path attributes, then the corresponding ISIS metric is ″default″.
- The **metricType** field shall be set to internal or external, as appropriate.

A.4 Tunneling

For each BIS reachable in the local routeing domain that does not share a common subnetwork with the local BIS, the local BIS shall create an ISIS **Virtual Adjacency** managed object to represent a tunnel to that BIS. This shall be done for each such BIS, even if the intent is to export IDRP′s NLRI into ISO 10589 as reachable address prefixes. This is necessary since in some cases it may be necessary to use tunneling: for example, there may be more NLRI than can be simultaneously enabled by the local BIS in accordance with managed object **MaxIDRPRoutes**.

When IDRP recomputes its Forwarding Information Bases, it creates one or more Reachable Address Prefix MOs for each inter-RD circuit, and puts the prefixes for the destinations that can be reached over that circuit into this managed object. For those destinations for which tunneling is desired, the associated managed object is left disabled. For those destinations for which it is desired to have ISO 10589 compute a path, the assoicated managed object is enabled.

Appendix B. Dynamic Selection of NLRI to Export to IS 10589

[3] The actual exported NLRI information is contained in the ISIS Reachable Address managed objects that IDRP has enabled. See A.3.

New Annex for DIS 10747

This appendix contains the proposed text for a new informative annex to be added to DIS 10747.

(Informative)

A BIS can not simultaneously enable more than **MaxIDRPRoutes** for exportation to IS 10589. Hence, it needs to have a policy for choosing the routes to be exported. The specific approach to be used is left as a local matter. This annex discusses some possible methods, but does not require that any of them be used.

A relatively simple approach would be for the BIS to sort the prefixes by length, and then export them in either ascending or descending order of length. Another approach would be for the BIS to assign a preference value to each prefix, and them export them in order of decreasing preference. The drawback of both these techniques is that they are not coupled to the actual traffic matrix. Furthermore, the assignment of preference values would require extra configuration information; and if it were to be more effective than a random assignment, would imply that the network manager must perform traffic history analysis.

A third alternative is to observe the actual traffic flow, and make dynamic decisions about which NLRI to export. This could be accomplished as follows:

a) When the BIS receives an NPDU on an intra-domain circuit which is to be forwarded outside the routeing domain, the NPDU is handed to the forwarding machinery. The forwarding engine consults the FIB to determine the next hop. The FIB entry has a back pointer to the reachable address prefix MO that contains the longest matching prefix.

b) Each Reachable Address Prefix MO has an LRU (Least Recently Used) timer associated with it:

   — If the NPDU arrived directly, rather than over a virtual adjacency, then forwarding proceeds normally; in addition, the LRU timer is reset.

   — If the NPDU arrived over a virtual adjacency and was decapsulated, then the BIS looks at the state of the corresponding Reachable Address Prefix MO for the destination of the inner NPDU. If the reachable address prefix MO is enabled, then the LRU timer is reset.

     If the reachable address prefix MO is currently disabled, and the value of **maxIDRPRoutes** is not exceeded, and the ISIS managed object **I2NetOverload** is FALSE, then the BIS can enable the prefix. This will cause IS 10589 to propagate the routeing information throughout the level-2 subdomain. Once IS 10589 achieves convergence, subsequent NPDUs with the same destination address will arrive directly, rather than over the virtual adjacency.

c) When the LRU timer for a given enabled reachable address prefix expires, IS 10589 can disable it in order to remove the inactive routeing information.

Appendix C. New GDMO and ASN.1 Definitions

These are the new managed objects needed in IDRP (DIS 10747) to handle the exchange of information with ISIS (IS 10589):

```
intradomainSummarizationPolicy ATTRIBUTE
   WITH ATTRIBUTE SYNTAX IDRP.SummaryMethod;
   MATCHES FOR EQUALITY
   BEHAVIOUR intradomainSummarizationPolicy-B
         BEHAVIOUR DEFINED AS This variable specifies the
         policy that IDRP will use to summarize Area Address
         and Reachable Address Prefix information that is
         carried in the L2 LSPs of IS 10589.  Four
         summarization methods are possible: a) No summarization,
         b) Automatic, c) Automatic with Entry Optimization,
         d) Pre-configured;;
   REGISTERED AS {IDRP.atoi intradomainSummarization (46)};


destinationsToImport ATTRIBUTE
   WITH ATTRIBUTE SYNTAX IDRP.NSAPprefix;
   MATCHES FOR EQUALITY;
   BEHAVIOUR destinationsToImport-B
         BEHAVIOUR DEFINED AS If IDRP's summarization policy is
         "pre-configured", then only ISIS destination areas or
         reachable address prefixes that match this managed
         object are eleigible for importation into IDRP as
         NLRI;;
   REGISTERED AS {IDRP.toi destinationsToImport (47)};


intradomainCostThreshold ATTRIBUTE
   WITH ATTRIBUTE SYNTAX IDRP.IntraThreshold;
   MATCHES FOR EQUALITY, ORDERING;
   BEHAVIOUR intradomainCostThreshold-B
         BEHAVIOUR DEFINED AS A 4-tuple that gives threshold
         values for the intradomain metrics: delay, expense,
         error, and default.  If the ISIS pathCost attribute
         for a given destination area has a value less than
         the threshold, then the area address can be imported
         individually into IDRP, irrespective of the
         summarization policy in force.  Otherwise, it must
         be summarized according to the policy specified in the
         intradomainSummarizationPolicy.  This attriubte
         is used to make tradefoffs between summarization and
         optimal routeing;;
REGISTERED AS {IDRP.atoi intradomainCostThreshold (48)};


nLRIToExport ATTRIBUTE
   WITH ATTRIBUTE SYNTAX IDRP.ExportedNLRI;
   BEHAVIOUR nLRIToExport-B
         BEHAVIOUR DEFINED AS The NSAP address prefixes that
         can be exported to ISIS for use as reachable address
         prefixes.  This attribute also specifes the export
         policies that apply to the prefixes to be exported;;
   REGISTERED AS {IDRP.atoi nLRIToExport (49)};

maxEnabledRAPs ATTRIBUTE
   WITH ATTRIBUTE SYNTAX IDRP.MaxEnabledRAPs;
```

```
      BEHAVIOUR maxExportedRoutes-B
            BEHAVIOUR DEFINED AS The maximum number of IDRP
            reachable address prefixes that can be enabled
            simultaneously.  This effectively sets an upper limit
            on the number of exported prefixes that ISO 10589 will
            need to accept;;
      REGISTERED AS {IDRP.atoi maxEnabledRAPs (50)};

   exportDefaultRoute ATTRIBUTE
      WITH ATTRIBUTE SYNTAX BOOLEAN;
      MATCHES FOR EQUALITY
      BEHAVIOUR exportDefaultRoutes-B
            BEHAVIOUR DEFINED AS This attribute specifies whether
            IDRP can export a default route for use by ISO 10589,
            where a default route is defined to one through which
            all destinations can be reached.  The NLRI for such a
            route has a length of 0;;
      REGISTERED AS {IDRP.atoi exportDefaultRoute (51)};
```

These are the new ASN1 definitions associated with these managed objects:

```
   SummaryMethod ::=ENUMERATED {
      none(1)
      automatic(2),
      autoentry (3),
      preconfigured(4) }
   IntraMetric ::= INTEGER(0..63)
ISISMetricName ::= ENUMERATED {
      default(1),
      delay(2),
      expense(3),
      error(4)}
   ISISMetricType ::= ENUMERATED {
      internal(1),
      external(2) }
   IntraThreshold ::= SEQUENCE {
      delayMetric IntraMetric,
      errorMetric IntraMetric,
      expenseMetric IntraMetric,
      defaultMetric IntraMetric }
   ExportedNLRI ::= SET OF SEQUENCE {
      addressPrefix NSAPprefix,
      exportLonger BOOLEAN,
      ISISMetricName,
      metricType ISISMetricType,
      metricValue IntraMetric,
      useMultiExitMetric BOOLEAN }
     --The number of sequences that can be simultaneously
     --enabled is limited by the value specified in
     --ISIS managed object maxIDRPRoutes.
   MaxEnabledRAPs ::= INTEGER
```