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(54) Titre : METHODE DE TRANSMISSION DE L'INFORMATION
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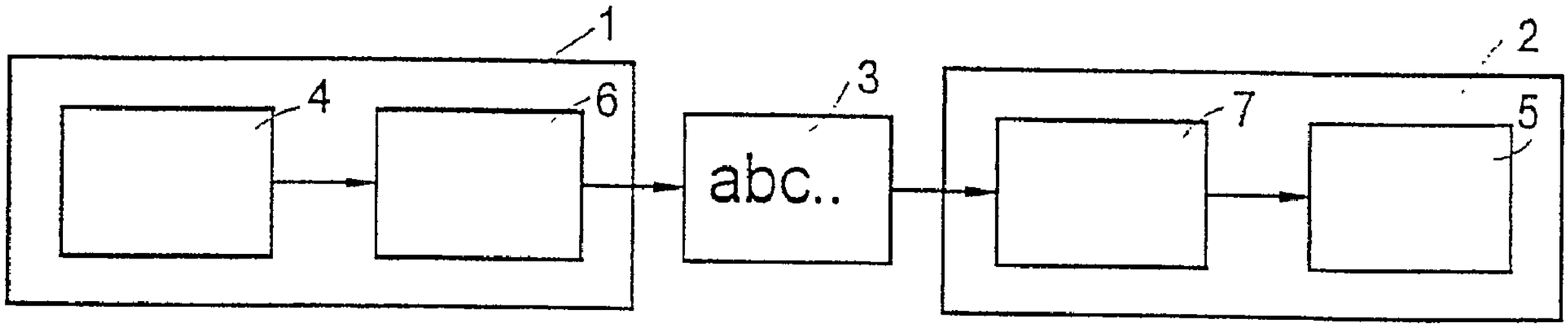

(57) Abrégé/Abstract:
With a method for the transmission of information using a data structure that is defined by the formal language called Abstract Syntax Notation One (ASN.1), the information is transmitted encoded as text, generally as plain-text encoding. This enables the use of text-based transmission media, which are in widespread use. Furthermore, it enables debugging without the use of additional tools.

Abstract

With a method for the transmission of information using a data structure that is defined by the formal language called *Abstract Syntax Notation One* (ASN.1), the information is transmitted encoded as text, generally as plain-text encoding. This enables the use of text-based transmission media, which are in widespread use. Furthermore, it enables debugging without the use of additional tools.

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Method for the transmission of information

The invention involves a method for the transmission of information using a data structure that is defined by the formal language called *Abstract Syntax Notation One* (ASN.1).

Reference is made to the following documents:

[NMFTR107] Network Management Forum
Forum TR107: ISO/CCITT and Internet Management:
Coexistence and Interworking Strategy
Issue 1.0 September 1992
+
[M.3010] ITU-T Recommendation M.3010
Maintenance: Telecommunications Management Network
Principles for a Telecommunications Management Network 10/92
+
[X.160] ITU-T Recommendation X.160
Data Networks and Open System Communications
Public Data Networks - Maintenance
Architecture for Customer Network Management Service for Public Data Networks 7/94
+
[X.200] Data Networks and Open System Communications
Open System Interconnection -
Model and Notation
Information Technology -
Open System Interconnection
Basic Reference Model
Geneva, 1994
+
[X.208] ITU-T Recommendation X.208
Specification of abstract syntax notation one (ASN.1)
Information technology
Open System Interconnection 1988
+
[X.209] ITU-T Recommendation X.209
Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)
+
[X.710] ITU-T Recommendation X.710
Data Communication Networks
Open Systems Interconnection
Common Management Information Service Definition for CCITT Applications
Geneva, 1991
+
[X.711] ITU-T Recommendation X.711
Data Communication Networks
Open Systems Interconnection
Common Management Information Protocol Specification for CCITT Applications
Geneva, 1991
+
[X.722] ITU-T Recommendation X.722
Data Communication Networks
Open Systems Interconnection
Structure of Management Information
Guidelines for the Definition of Managed Objects

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Geneva, 1992
+
[RFC1157] Network Working Group RFC 1157
Simple Network Management Protocol(SNMP)
+
[RFC1085] Network Working Group RFC 1085
ISO Presentation Services on top of TCP/IP-based internets
M. Rose, Performance Systems International
K. McCloghrie, Hughes LAN Systems
December 1988
+
[RFC1189] Network Working Group RFC 1189
Common Management Information Services and Protocols for the Internet (CMOT and CMIP).
U.S. Warrier, L. Besaw, L. LaBarre, B.D. Handspicker.
historic protocol, not recommended status
Oct-01-1990.
+
[RFC1214] Network Working Group RFC 1214
OSI Internet Management: Management Information Base
L. Labarre
historic protocol, not recommended status
April 1991
+
[RFC0793] Network Working Group RFC 0793
Transmission Control Protocol
J. Postel. September 1981

OSI Abstract-Data Manipulation API (XOM)
CAE Specification
Issue 3
x/Open Company Ltd
ISBN 1 85912 175 6

+The following abbreviations are used:

ASN.1 Abstract Syntax Notation One [X.208]
BER Basic Encoding Rules [X.209]
CMIP Common Management Information Protocol [X.711]
CMIPDU Common Management Information Protocol Data Unit [X.711]
CMIS Common Management Information Service [X.710]
CNM Customer Management Network [X.160]
DCF Data Communication Function
DCN Data Communication Network
GDMO Guidelines for the Definition of Managed Objects [X.722]
OSI Open System Interconnection [X.200]
SNMP Simple Network Management Protocol [RFC1157]
TCP/IP Transmission Control Protocol / Internet Protocol [RFC0793]
TMN Telecommunication Management Network [M.3010]
XOM X-OPEN, Interface for handling ASN.1

Abstract Syntax Notation One (ASN.1) [X.208] permits the formal specification of data types. It is used for the platform-independent definition of a variety of services and protocols of the OSI 7-layer model (Open System Interconnection [X.200]), among other things. To transmit the stored information, whose structure is defined by ASN.1, there exists a series of methods to encode ASN.1 values, such as the Basic Encoding Rules (BER) [X.209]. The BER-encoded information can then be transmitted in binary form with the help of any desired method. In general, transmission protocols from the TCP/IP or OSI family are used.

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Currently, transmission with the help of a purely OSI-based protocol stack of the various Protocol Data Units (PDUs) from layer 7 of the OSI 7-layer model as defined in ASN.1 is very involved. For this reason, the use of these protocols is often avoided, or the lower layers of the OSI protocol stack are replaced with an already existing TCP/IP protocol. As an example of a number of these methods, one might mention CMIP over TCP/IP (CMOT) [RFC1189].

The task of the invention is to avoid these disadvantages involved in the binary transmission of information using a structure defined with ASN.1.

This task is carried out according to the invention by transmitting the information encoded as plain text. A form of plain-text encoding is generally to be used which allows the encoded contents to be read without additional tools.

The advantages of the method according to the invention lie primarily in the fact that text-based transmission protocols are generally in very widespread use and correspondingly lower in price than binary transmission procedures. In addition, debugging is much simpler with plain text, and that keeps the implementation costs of any given application much lower. The advantages in summary:
- Thanks to the widespread use of text-based transmission protocols, such as e-mail, the number of computers that can be reached using such protocols is much larger than when using binary transmission procedures.
"- Firewalls used to insulate companies' internal networks are often open only for text-based transmission protocols.
"- No additional tools are needed to look for errors in encoded ASN.1 information, since the encoded information is in a form that can be read by human programmers.
"- The use of very simple protocols means that no great demands are made in terms of the computing power needed for encoding and transmission, and that means that even lower-end PCs can be used.
"- Sending and receiving facilities need not contain complex protocol stacks. The software needed for text-based transmission is already a part of many operating systems.
"

Unlike BER encoding, the method according to the invention makes it possible to decode the data received without having to access an application-internal reference of the ASN.1 definition.

A particularly advantageous further development of the method according to the invention is the fact that each piece of information transmitted has its data type according to ASN.1 transmitted with it, with the data type generally preceding the information and being separated from it by a predefined separator, typically an equals sign.

This further development allows a use of the method according to the invention that is particularly useful, in that the information is encoded as plain text and thus can be output with standard output devices. It also allows simple entry by the user as well as long-term storage of the information in plain-text form.

The protocol that will be generally used in the future for managing public telecommunications networks – called networks in the following – is CMIP [X.711]. In this context, telecommunications networks can be networks for the transmission of voice, data and images. The structure of the CMIPDU has been defined formally using ASN.1. The management information transmitted via CMIPDUs is encoded in conformance with the Basic Encoding Rules. Particularly for long distances or due to high quality requirements, the advantages of an OSI protocol stack are indispensable for transmitting the CMIP-based management information. At the same time, however, there are applications for which a much simpler and more affordable solution is sufficient for the transmission of management information. In addition to the implementation of CMIP for SNMP, which is in widespread use in local networks, CMIP is currently also transmitted via TCP/IP, which is technologically simpler than the OSI protocols at the lower protocol layers.

Another further development of the method according to the invention is therefore provided for wherein the information to be transmitted via CMIP relates to the management of public telecommunications networks. This further development makes it irrelevant whether the plain-text encoding used is based on the fact that CMIP was defined in ASN.1, or the text-based encoding rules were created independently of that fact.

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In addition to the above-mentioned advantages of the method according to the invention, this further development, i.e. text-based CMIP transmission, makes it possible to use CMIP even in cases where cost considerations rule out the more involved transmission via an OSI protocol stack.

In future, operators of public networks will provide their customers with a management interface by means of which the customers can trigger management operations affecting the part of the public network which they have leased. All data which the customers want to exchange with the operator can then be transmitted via this interface.

As an example, take a case in which a dedicated line is to be requested between site A and site B of a private network. The two sites are to be connected via the public network. To this end, another further development of the method according to the invention provides that the information is transmitted between a subscriber and a public network and/or its management systems and that it relates to subscriber-performed management of the network.

In particular, the invention can be further developed in such a way that an e-mail interface is created for text-encoded information. This further development provides the customer with an affordable yet reliable interface to the network operator. It does so without excluding the advantages of CMIP as a management protocol.

Such an interface between the customer's management system and that of the network operator lets customers execute management operations not just on their own local network, but also on that part of the public network which they use. This is called Customer Network Management. A typical application is, for example, customer-specific configuration of the network. Immediate reporting of identified faults to the customer is another example of CNM, as is the provision of certain statistical data.

Another further development of the invention is the fact that the use of character tables for encoding and decoding the information allow a simple and flexible adaptation to the limited character set of the transmission system. If, for example, a transmission protocol cannot transmit the characters "{" and "}", another typical character can be used in its place without requiring a fundamental modification of the encoding rules. The parallel use of different character tables thus enables support without additional technical effort of several transmission media with different character sets within one and the same application.

Another further development of the method according to the invention is the fact that the encoding and sending of management information as well as the receiving and decoding of that information take place automatically.

In the network operator's area, automatic conversion of the text-based transmission to an OSI protocol stack is thus possible at any time. The advantage of this architecture is the fact that not all customers have to administer their own OSI stacks, but rather that the network operator can offer this service centrally for all customers.

Embodiments of the invention are shown in the drawing using several figures and explained in more detail in the following description. It shows:

Fig. 1 First embodiment of a facility for realizing the method according to the invention,

Fig. 2 Second embodiment, also as a block diagram,

Fig. 3 Schematic representation of the management of the part of a public telecommunications network used by a subscriber, and

Fig. 4 Schematic representation of the text-based transmission of CMIP-based management information between a CNM customer and the network operator.

In the embodiment shown in Fig. 1, the two management systems 1 and 2 are connected to each other to exchange information via a text-based transmission system 3. The information to be transmitted can exist in the sending and receiving applications 4 and 5 for the management systems 1 and 2 in a variety of proprietary data formats. The structure of these data formats is determined by

the tools used to create the applications. In 6 and 7 this information is encoded and decoded in conformance with ASN.1 and the method according to the invention.

Fig. 2 shows a possible realization of the architecture shown in Fig. 1. Information is transmitted from C data structures residing on one management system 11 at 13 to the management system 12, where they are stored as C/C++ data types at 18.

The information resident on 13 is first passed to an XOM interface 14 and encoded there as XOM objects so that they can be dealt with in conformance with ASN.1. These objects are then transformed using the method according to the invention into text-based transmission protocols, which are transmitted as e-mail 19 and received by the management system 12. There they are first decoded at 16 and transformed into C++ objects and then stored at 18 as C/C++ data types.

Fig. 3 shows a scenario with the request of a customer to the operator of a public network to connect two sites (A and B) via a dedicated line. The customer makes the request 24 via the customer's management system 21 at site A to the management system 22 of the network operator N. The operator checks in its own network to see if the request is feasible and passes it to the management system 23 at site B of the customer (25). Once the message 26 is received from there that the corresponding part of the dedicated line has been set up, the through connection is performed in the public network and the result "Line set-up" is related to site A (27).

Fig. 4 depicts the text-based transmission of CMIP-based management information between a CNM customer and the network operator. The management system 21 at site A and the customer's management system 23 at site B are connected to the management system 22 of the network operator N, each via a CNM interface 36 and 37, by means of which the information that has been encoded as plain text in conformance with the method according to the invention is transmitted.

Each of the customer's management systems 21 and 23 has access to the customer's network elements 34 and 35. For example, this takes place at site A with the help of CMIP via TCP/IP, while at site B SNMP is used. The management system 22 of the network operator N, whose domain is shown by the dotted lines in Fig. 4, has access to the network elements 31 to 33 of the public network. This access is performed using CMIP via a 7-layer OSI protocol stack.

The network operator N offers the customer a CNM service with which the customer can use a management application of its own or one provided by the network operator to pass its management requests to the management system 22 of the public network. The management information to be transmitted is automatically encoded as plain text at the customer's site in the customer's management application and transmitted via a text-based protocol to the network operator's management system 22. This message is either received automatically by the management system 22 of the network operator or that of a CNM service provider and processed directly, or a conversion at 36 and 37 to an OSI protocol stack and OSI-based transmission to the network operator's management system take place.

The transmission of management information to the customer's management systems 21 and 23 can also be handled advantageously using the method according to the invention. To this end a plain-text message is automatically passed from the network operator N. The management application of the CNM customer automatically receives and decodes the message before passing along the transmitted management information.

The ASN.1 encoding according to the invention is performed according to a fixed procedure. For each ASN.1 type, the tag is first encoded in the form of a conveniently chosen name in conformance with the ASN.1 standard (e.g. "INTEGER" for the Universal Tag 2), and a "=" character is inserted as a separator. The value is then encoded in the way predetermined for that type. If an ASN.1 data type itself is made up of other data types, then, when its value is encoded, the tags and values of the data types it contains are also encoded.

Two variants are defined for the encoding rules, both of which are contained in this patent claim. The standard variant suffices completely for encoding the ASN.1 version and is simple to implement. With the extended variant, the encoded text is provided with additional information taken from the ASN.1 type definition. This dramatically simplifies the search for errors, in comparison to both the standard variant of plain-text encoding and the binary-encoded form. However, the use of the extended variant increases the implementation effort involved in application development. For that

reason, it is also permissible to use only selected parts of the extended encoding, as long as these parts are used consistently by the sending and receiving parties. If the extended variant is permissible for encoding a special data type, it is explained below in the description of the appropriate data type.

The following sections specify the relevant ASN.1 definition in describing the encoding rules for the individual data types and give one or more encoding examples.

BOOLEAN
Encoding of a Boolean data type is performed by encoding the text "BOOLEAN" for the type and the text "TRUE##" or "FALSE##" for the value:

ASN.1 definition	Encoding (several examples)
Bol ::= BOOLEAN	BOOLEAN=TRUE##
	BOOLEAN=FALSE##

INTEGER
An integer value is designated by the text "INTEGER" and the corresponding value in the format of a decimal number. Only negative numbers are to be given a sign. The encoding of the value is terminated by "##" characters.

ASN.1 definition	Encoding (several examples)
Int ::= INTEGER	INTEGER=123##
	INTEGER=-123##

BIT STRING
A bit string is encoded using the text "BIT STRING". The value is encoded by means of a binary list enclosed in "{}" characters and designated by a preceding "B" for binary and the number of encoded elements. Hexadecimal encoding instead of binary encoding is designated with an "H". If the number of bits is not an integral multiple of four, the undefined low-order bits (rightmost) are to be encoded with the binary value "0". For both binary and hexadecimal encoding, it is possible in conformance with the ASN.1 definition to do without the encoding of elements at the end if they are encoded with the value "0".

In extended encoding, the designators of the elements are listed whose binary value is "1". The beginning of the list is designated by the "{" character, and the end by the "}" character. A "/" character is used as the separator in this list.

ASN.1 definition	Encoding (multiple variants)
BitStr ::= BIT STRING {	BIT STRING=B5{01100}
ele(0),	BIT STRING=B3{011}
ele(1),	BIT STRING=H2{70}
ele(2),	BIT STRING=H1{7}
ele(3),	
ele(4) }	Extended encoding:
	BIT STRING={ele(1)/ele(2)}
	BIT STRING=B5{00000}
	BIT STRING=B1{0}
	BIT STRING=H1{0}
	Extended encoding:
	BIT STRING={}

OCTET STRING
An octet string is encoded with the text "OCTET STRING". The value is encoded through a binary list enclosed in "{}" characters and preceded by a "B" for binary and the number of encoded elements. Hexadecimal encoding can also be used; it is designated by a "H". A "/" character is used as the separator between the individual octet values.

ASN.1 definition	Encoding
OctStr ::= OCTET STRING	OCTET STRING=B2{11100001/ 11111111}
	OCTET STRING=H2{E1/FF}

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NULL
Encoding of the ASN.1 data type null is performed using the text "NULL=NULL##".

ASN.1 definition	Encoding
Null=NULL	NULL=NULL##

OBJECT IDENTIFIER
The ASN.1 data type object identifier is encoded using the text "OBJECT IDENTIFIER". The value is encoded by listing the ordinal numbers of the nodes in the registration tree, from the root element to the registered element, and preceding the listing with the encoding of the text "NUMERIC". The number values of this list are separated by periods. The encoding of the value is terminated by "##" characters.

In extended encoding, designated by the text "Symbolic", a unique mnemonic designator is used in place of the less telling numeric sequences. That of course requires that a clear, one-to-one and onto tabular relationship be created between designators and object identifiers. A combination of mnemonic designators and numeric sequences is not permissible. The encoding of the value is terminated by "##" characters.

ASN.1 definition	Encoding
Obj ::= OBJECT IDENTIFIER	OBJECT IDENTIFIER=Numeric, 1.2.2.1.4##
	Extended encoding OBJECT IDENTIFIER=Symbolic, systemId##

EXTERNAL
The tag of the data type external is encoded using the text "EXTERNAL". The encoding of values of this data type is derived from the encoding rules for the following SEQUENCE:

```
SEQUENCE
{
    direct-reference OBJECT IDENTIFIER OPTIONAL,
    indirect-reference      INTEGER OPTIONAL,
    data-value-descriptor   ObjectDescriptor OPTIONAL,
    encoding                CHOICE
    {
      single-ASN1-type      [0] IMPLICIT ANY,
      octet-aligned         [1] IMPLICIT OCTET STRING,
      arbitrary             [2] IMPLICIT BIT STRING
    }
}
```

REAL
Real numbers are encoded in scientific notation. The encoding of the value is terminated by "##" characters.

ASN.1 definition	Encoding
Real ::= REAL	REAL=1.23E45##

ENUMERATED
The tag of an enumerated type is encoded using the text "ENUMERATED". Values are encoded by specifying the integer associated with the element. The encoding of the value is terminated by "##" characters. In extended encoding, the element is encoded identically to its definition text.

ASN.1 definition	Encoding
Enum ::= ENUMERATED {	ENUMERATED=1##
a(0),	
b(1),	extended encoding:
c(2) }	ENUMERATED=b(1)##

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SEQUENCE

The tag of a sequence is encoded using the text "SEQUENCE". The encoding of the value of a sequence begins with the number of encoded elements, followed by a "{" character, and terminates with a "}" character. In further specifying the value encoding, we must distinguish between two types of sequences:

With a simple sequence, the ASN.1 types contained in the sequence are encoded in the order in which they appear in the definition. The position numbers are placed in front, each separated by a comma. A "/" character is inserted as a separator between these types. Unused optional elements of the sequence are simply left out when encoding, so that in such cases, the "/" separator character is also not encoded.

ASN.1 definition	Encoding (several examples)
Seq ::= SEQUENCE {	SEQUENCE=2{1,INTEGER=123##/
	3,INTEGER=456##}
a INTEGER,	SEQUENCE=3{1,INTEGER=1##/2,
	BOOLEAN=FALSE##/3,
	INTEGER=3##}
b BOOLEAN OPTIONAL,	
c INTEGER }	

The value of a sequence is defined by encoding the enclosed data type the appropriate number of times, with preceding position number, and each separated by a "/" character.

ASN.1 definition	Encoding (several examples)
Seq ::= SEQUENCE OF INTEGER	SEQUENCE OF=3{1,INTEGER=1##/2,
	INTEGER=2##/3,INTEGER=3##}
	SEQUENCE=0{}

SET

The tag of the set type is encoded using the text "SET". The encoding of the value begins with the number of encoded elements, followed by a "{" character, and terminates with a "}" character. In further specifying the value encoding, we must distinguish between two kinds of set data types:

With a simple set, the ASN.1 types contained in the definition are encoded in the order in which they appear in the definition. The position numbers are placed in front, each separated by a comma. A "/" character is inserted as a separator between these types. Unused optional elements of the set are simply left out when encoding, so that in such cases, the "/" separator character is also not encoded.

ASN.1 definition	Encoding (several examples)
Set ::= SET {	SET=2{1,INTEGER=123##/2,BOOLEAN=TRUE##}
a INTEGER,	
b BOOLEAN,	
c OBJECT IDENTIFIER optional }	

The value of a set of type is defined by encoding the enclosed data type the appropriate number of times, with preceding position number, and each separated by a "/" character.

ASN.1 definition	Encoding (several examples)
Set ::= SET OF INTEGER	SET=3{1,INTEGER=1##/2,INTEGER=2##/
	3,INTEGER=3##}
	SET={}

Character Strings

Encoding is identical for the various string types and the subtypes derived from them. The type is encoded using the text "NumericString", "PrintableString", "TeletexString", "VideotexString", "VisibleString ", "IA5String", "GraphicString", "GeneralString", "ObjectDescriptor", "UTCTime" or "GeneralizedTime", depending on which type is involved.

If no special characters are contained, and no characters which cannot be encoded, simple value encoding can be used. It is introduced by the text "simple" and, separated by a "," character, followed

by the number of characters included. The text itself then follows uncoded enclosed in curly braces. If encoding is not possible with simple value encoding, extended encoding is used, which is introduced by the text "complex". Separated by a "," character, the encoding of the number of characters included follows, and then a "{" character. Then the codes of the individual characters are encoded in hexadecimal form, separated by "/" characters from each other. The encoding is terminated by a "}" character.

ASN.1 definition	Encoding (several examples)
Str ::= GeneralString	GraphicString=simple,3{xyz}
	GeneralString=complex,3{78/79/7A}

CHOICE

The choice type is encoded using the text "CHOICE". The encoding of the value of a choice is similar to that of a sequence and begins with the number "1" for the number of elements encoded in the choice. The encoding of the element contained begins with a "{" character and terminates with a "}" character. Before the encoding of the type, its position is encoded, separated by a comma.

ASN.1 definition	Encoding (several examples)
Bsp ::= CHOICE {	CHOICE=1{2,GraphicString= simple.3{A}}
typ1 INTEGER,	CHOICE=1{1,INTEGER=123##}
typ2 GraphicString }	

ANY DEFINED BY

The type ANY DEFINED BY is defined by the string "ANY". The value of an ANY type is encoded as a type of its own, unlike BER encoding. Since this type is only permitted within a sequence or a set, the example shows the corresponding definition inside a sequence definition. For the encoding, first the text "1{" is encoded, and then the type intended for the ANY type. The definition is terminated by a "}" character.

ASN.1 definition	Encoding
Seq ::= SEQUENCE {	SEQUENCE=2{1,INTEGER=1##/2,
	ANY={INTEGER=5##}}
i INTEGER;	
a ANY DEFINED BY i }	

Referencing an information model

Unlike plain-text encoding, which can be decoded without knowing anything of the information model, a BER encoding requires a reference to the information model, stored in metadata format. To enable encoding by referencing metadata from within plain-text encoding as well, it is possible to precede any type encoding with the metadata to be used. This metadata is then valid only for that type and any types contained in it.

ASN.1 definition	Encoding
Bsp ::= INTEGER	SetMetaData=Dateiname, INTEGER=123##

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CLAIMS:

1. Method for the transmission of information, the structure of said information being defined by the formal language for the definition of data structures known as Abstract Syntax Notation One (ASN.1), characterized in that transmission takes place in a form coded as text.

2. Method according to claim 1, characterized in that coding is in plain text.

3. Method according to claim 2, characterized in that, for each item of information to be transmitted, the description of the data type, defined in each case according to ASN.1, is transmitted.

4. Method according to claim 3, characterized in that the description is included as a prefix and is separated from the information by a predetermined separator.

5. Method according to claim 4, characterized in that the predetermined separator is an equals sign.

6. Method according to any one of claims 1 to 5, characterized in that the form of the information coded as text can be represented by means of a standardly available output means.

7. Method according to any one of claims 1 to 6, characterized in that the items of information to be transmitted by means of CMIP relate to the management of public telecommunications networks.

8. Method according to any one of claims 1 to 7, characterized in that the items of information are transmitted between a subscriber and a public telecommunications network and relate to a management of the

telecommunications network to be performed by the subscriber.

9. Method according to any one of claims 1 to 8, characterized in that an email interface is formed for the text-coded items of information.

10. Method according to any one of claims 1 to 9, characterized in that the coding is flexibly adaptable to the character set of the transmission system through the use of coding tables.

11. Method according to any one of claims 1 to 10, characterized in that the coding and sending of management information as well as the receiving and decoding thereof take place automatically.

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PATENT AGENTS

1/1

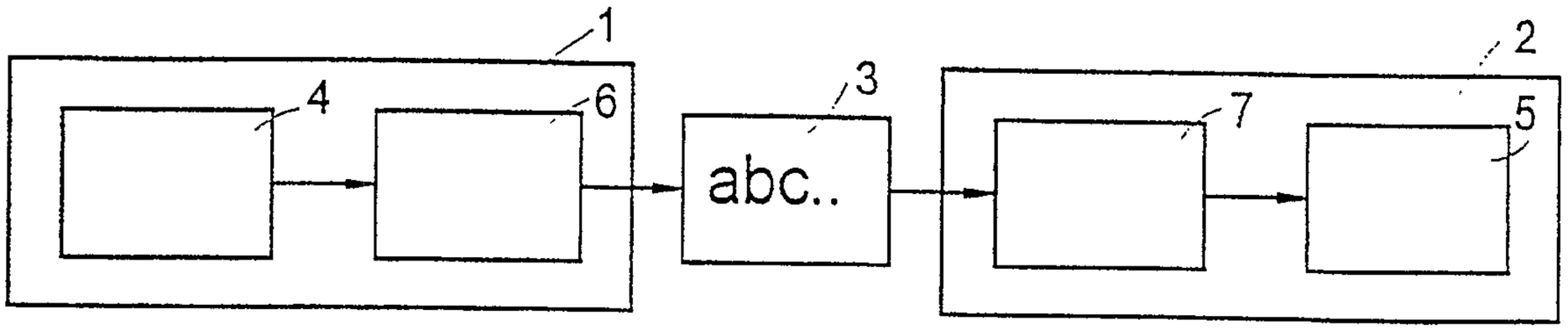


Fig.1

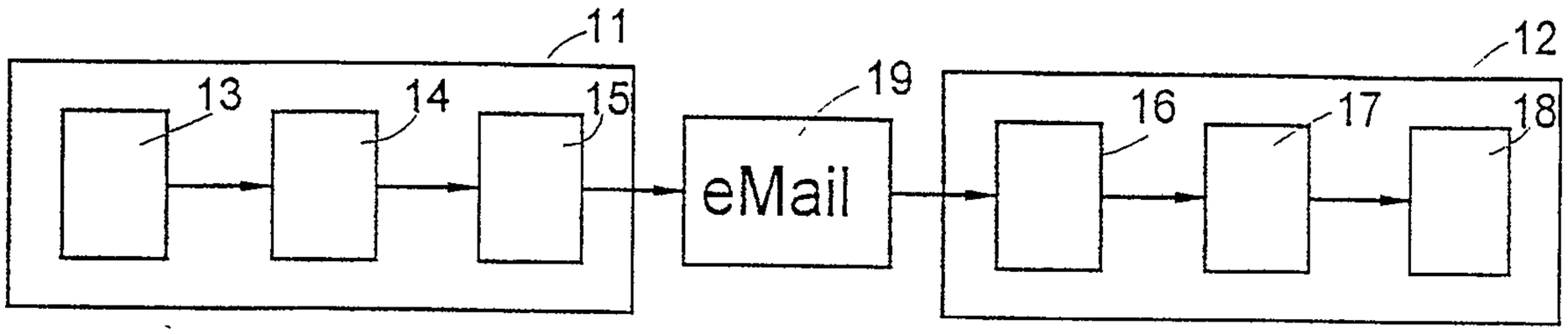


Fig.2

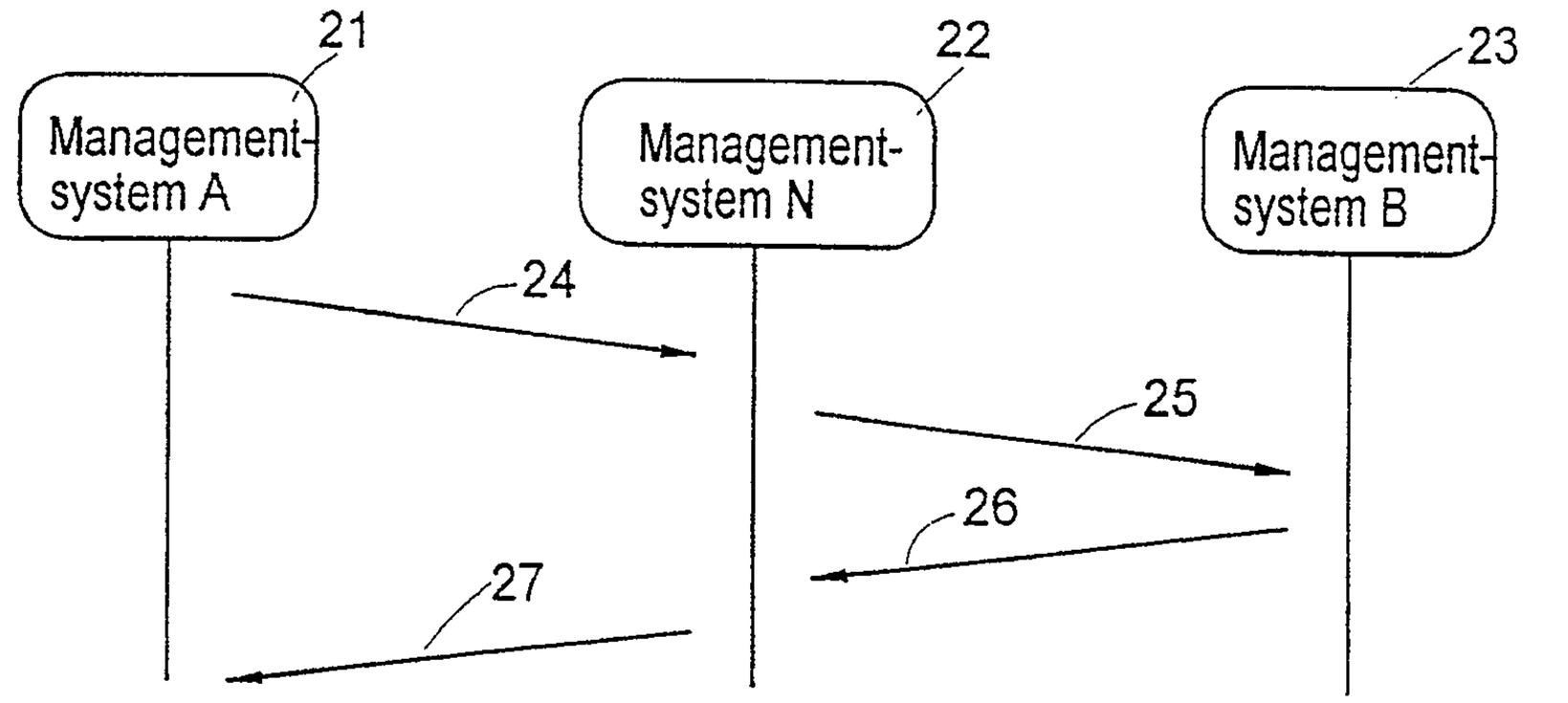


Fig.3

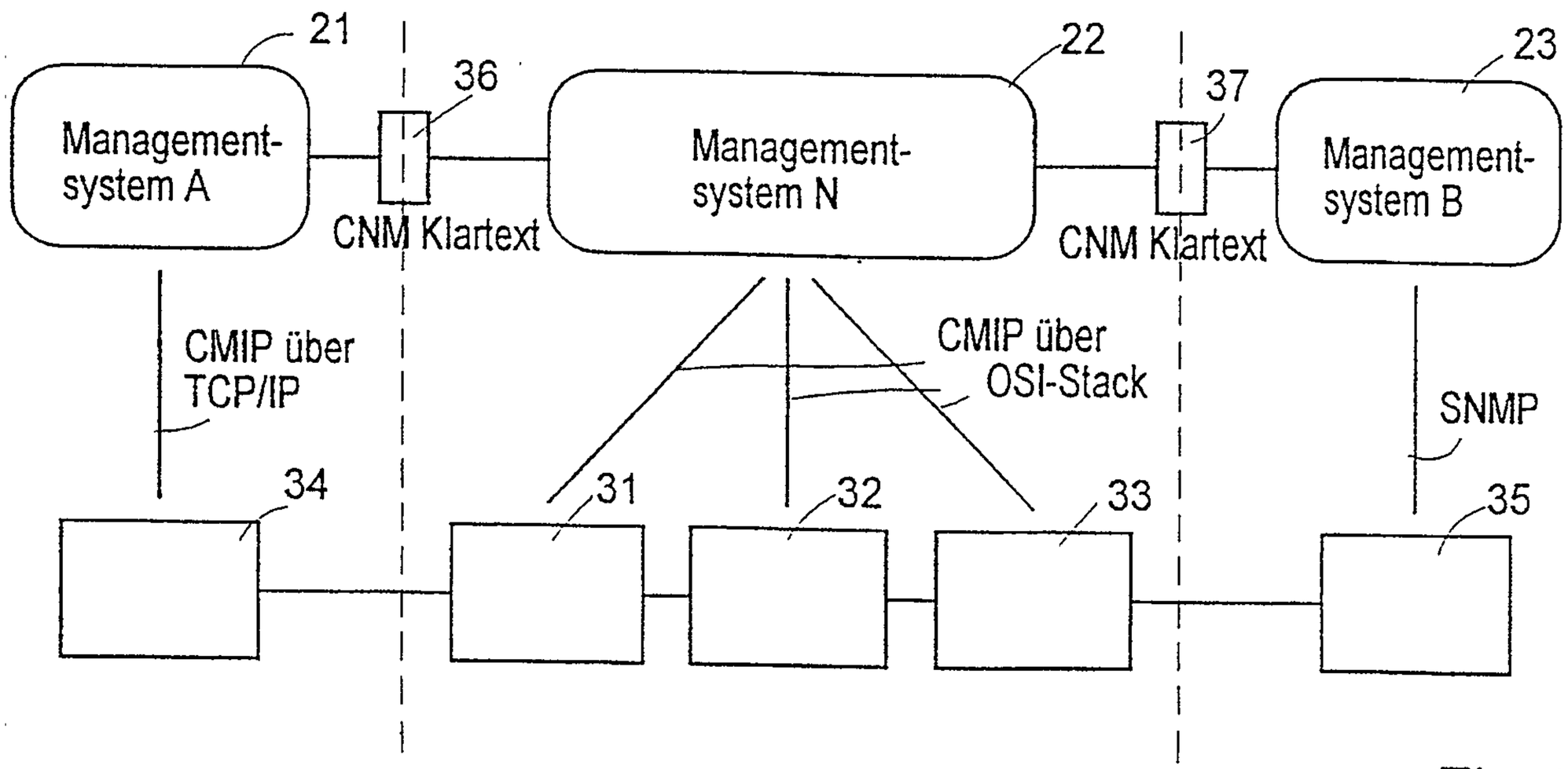
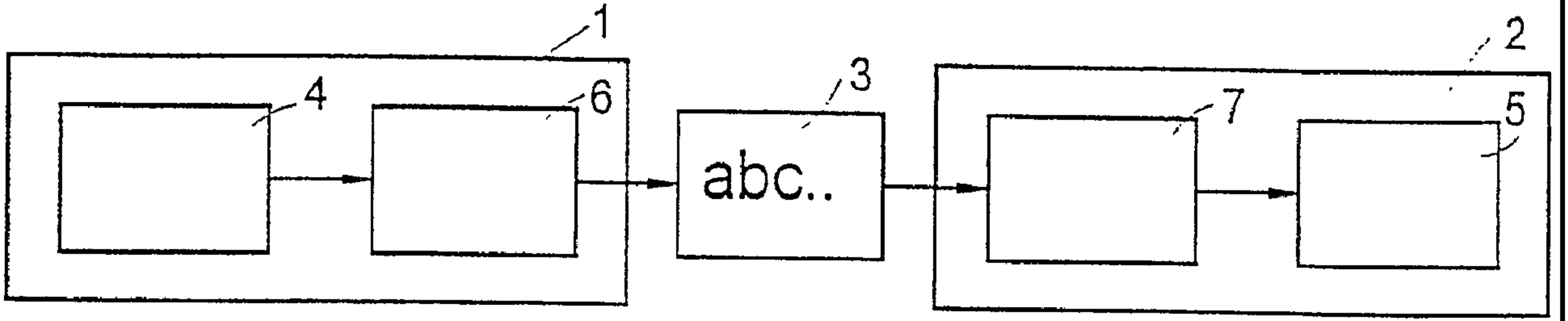


Fig.4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