US009756001B2

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Singh et al.

(10) **Patent No.: US 9,756,001 B2**
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(54) **SCHEMA-BASED DYNAMIC PARSE/BUILD ENGINE FOR PARSING MULTI-FORMAT MESSAGES**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 12 days.

This patent is subject to a terminal disclaimer.

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US 2016/0065510 A1 Mar. 3, 2016

Related U.S. Application Data

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G06F 15/16 (2006.01)
G06F 15/173 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04L 51/066*** (2013.01); ***G06Q 20/40*** (2013.01); ***G06Q 30/06*** (2013.01); ***H04L 51/046*** (2013.01); ***H04L 69/22*** (2013.01); *H04L 69/03* (2013.01)

(58) **Field of Classification Search**
CPC H04L 67/02; H04L 51/066; H04L 51/00; H04L 69/22; H04L 63/102; H04L 63/12; G06F 9/546; G06F 9/547; G06F 9/541
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,341,477 A 8/1994 Pitkin et al.
5,459,837 A 10/1995 Caccavale
(Continued)

FOREIGN PATENT DOCUMENTS

JP 09-311800 12/1997
JP 2003323443 11/2003
(Continued)

OTHER PUBLICATIONS

Rahm et al., Matching large XML schemas, Dec. 2004, 6 pages.*
(Continued)

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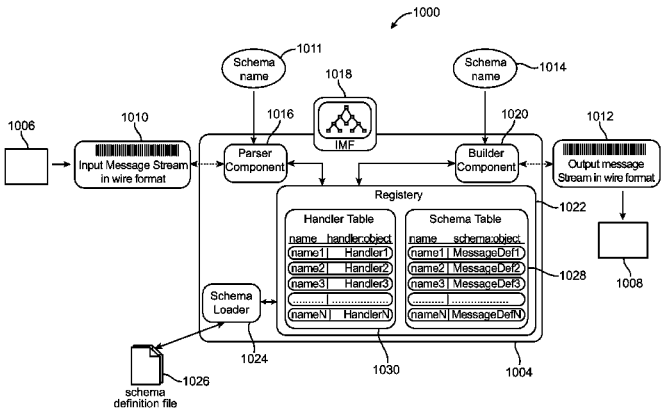
(74) *Attorney, Agent, or Firm* — Kilpatrick Townsend & Stockton LLP

(57) **ABSTRACT**

A parse/build engine that can handle multi-format financial messages. The engine converts the different format messages into a common format, and the common format message is then processed by the business service application. A parser examines the message and determines an appropriate schema for the particular format of message received. The schema is a data structure in a schema registry that includes a grammar structure for the received format as well as pointers to handlers for converting the different fields of the message into the internal message format using the grammar structure (the "grammar" can include field sequence, field type, length, character encoding, optional and required fields, etc.). The handlers are individually compiled. As formats change, new formats or changes to old
(Continued)



formats can be dynamically added to the parse/build engine by loading new schema and handlers.

20 Claims, 18 Drawing Sheets

Related U.S. Application Data

continuation of application No. 12/707,634, filed on Feb. 17, 2010, now Pat. No. 8,555,262, which is a continuation of application No. 11/172,397, filed on Jun. 29, 2005, now Pat. No. 7,694,287.

(51) **Int. Cl.**

H04L 12/58	(2006.01)
H04L 29/06	(2006.01)
G06Q 20/40	(2012.01)
G06Q 30/06	(2012.01)

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,521,910	A	5/1996	Matthews	
5,754,543	A	5/1998	Seid	
5,805,798	A	9/1998	Kearn et al.	
5,974,460	A	10/1999	Maddalozzo, Jr. et al.	
6,006,264	A	12/1999	Colby et al.	
6,016,307	A	1/2000	Kaplan et al.	
6,039,245	A	3/2000	Symonds et al.	
6,091,724	A	7/2000	Chandra et al.	
6,134,598	A	10/2000	Raman	
6,144,641	A	11/2000	Kaplan et al.	
6,302,326	B1	10/2001	Symonds et al.	
6,317,438	B1	11/2001	Trebes, Jr.	
6,389,479	B1	5/2002	Boucher et al.	
6,430,184	B1	8/2002	Robins et al.	
6,456,594	B1	9/2002	Kaplan et al.	
6,460,120	B1	10/2002	Bass et al.	
6,473,404	B1	10/2002	Kaplan et al.	
6,487,286	B1	11/2002	Reaves et al.	
6,535,488	B1	3/2003	Mahe	
6,732,175	B1	5/2004	Abjanic	
6,754,188	B1	6/2004	Garahi et al.	
6,788,688	B2	9/2004	Trebes, Jr.	
6,802,067	B1	10/2004	Camp et al.	
6,839,700	B2	1/2005	Doyle et al.	
6,886,166	B2	4/2005	Harrison et al.	
7,047,285	B2	5/2006	Burgess	
7,058,691	B1	6/2006	Yu et al.	
7,131,116	B1 *	10/2006	Krishna	H04L 12/5835 709/203
7,188,336	B2	3/2007	Humphries	
7,356,616	B2 *	4/2008	Kaler	H04L 63/0272 709/206
7,412,667	B2	8/2008	Chrysanthakopoulos	
7,467,149	B2	12/2008	Gaurav	
7,493,594	B2	2/2009	Shenfield et al.	
7,551,567	B2 *	6/2009	Anthias	H04L 69/22 370/252
7,631,314	B2	12/2009	Joseph	
7,673,282	B2	3/2010	Amaru et al.	
7,694,287	B2	4/2010	Singh et al.	
7,739,696	B2	6/2010	Wolfe	
7,746,773	B2 *	6/2010	Gerdes	G06F 9/546 370/230
7,804,945	B2 *	9/2010	Ottavi	G06F 9/546 379/114.03
7,805,713	B2	9/2010	Patel	
8,112,103	B2 *	2/2012	Yeh	H04L 12/5835 455/412.1
8,301,800	B1 *	10/2012	Champion	G06F 9/546 709/203
8,549,171	B2 *	10/2013	Ramarao	G06F 9/546 709/224
8,661,452	B2	2/2014	Gandini	
2002/0083210	A1	6/2002	Harrison et al.	
2002/0091844	A1	7/2002	Craft et al.	
2002/0116530	A1	8/2002	Burgess	
2002/0141449	A1	10/2002	Johnson	
2003/0055768	A1	3/2003	Anaya et al.	
2003/0093479	A1	5/2003	Mellen-Garnett et al.	
2003/0153338	A1	8/2003	Herz et al.	
2003/0158951	A1	8/2003	Primak et al.	
2003/0163585	A1	8/2003	Elderon et al.	
2003/0169749	A1	9/2003	Huang et al.	
2003/0187996	A1	10/2003	Cardina et al.	
2003/0210694	A1	11/2003	Jayaraman et al.	
2003/0221000	A1	11/2003	Cherkasova et al.	
2003/0223408	A1	12/2003	Chen et al.	
2004/0039693	A1	2/2004	Nauman et al.	
2004/0088425	A1 *	5/2004	Rubinstein	H04L 63/20 709/230
2004/0153511	A1	8/2004	Maynard et al.	
2004/0172254	A1	9/2004	Sharma et al.	
2004/0254922	A1	12/2004	Vincent, III	
2004/0268296	A1	12/2004	Kayam et al.	
2005/0050203	A1	3/2005	Chattopadhyay et al.	
2005/0050549	A1	3/2005	Joseph et al.	
2005/0080850	A1	4/2005	Salesky et al.	
2005/0138002	A1	6/2005	Giacobbe et al.	
2005/0138632	A1	6/2005	Groetzner et al.	
2005/0193078	A1	9/2005	Jordan, Jr.	
2005/0273772	A1	12/2005	Matsakis et al.	
2005/0278270	A1	12/2005	Carr et al.	
2006/0013367	A1	1/2006	Sawyer et al.	
2006/0080120	A1	4/2006	Tcherevik	
2006/0090155	A1 *	4/2006	Gurevich	G06F 8/315 717/136
2006/0117307	A1	6/2006	Averbuch et al.	
2006/0155722	A1	7/2006	Sengupta	
2006/0167818	A1	7/2006	Wentker et al.	
2006/0206864	A1	9/2006	Shenfield et al.	
2006/0242085	A1	10/2006	Jones et al.	
2006/0259912	A1	11/2006	Weinrich	
2007/0067760	A1	3/2007	Andrew et al.	
2007/0276765	A1	11/2007	Hazel et al.	
2008/0147565	A1	6/2008	Huang et al.	

FOREIGN PATENT DOCUMENTS

JP	2004303205	10/2004
RU	2222046	1/2004
RU	2249848	4/2005
WO	2004/036855	4/2004
WO	2005/043413	5/2005

OTHER PUBLICATIONS

Velegrakis et al., Preserving mapping consistency under schema changes, Sep. 2004, 20 pages.*

Korhonen et al., Visualization of EDI messages: facing the problems in the use of XML, Sep. 2003, 8 pages.

P. Resnick, Internet Message Format, Apr. 2001, 45 pages.

"Design and implementation of the parallel multimedia file system based on message distribution", Park et al., Oct. 2000, pp. 422-425. Online retrieved at <http://delivery.acm.org/10.1145/380000/376325/p422-park.pdf>.

"Performance analysis framework for large software-intensive systems with a message passing paradigm", C. D. Rosso, Mar. 2005, pp. 885-889. Online retrieved at <http://delivery.acm.org/10.1145/1070000/1066878/p885-del.sub.--rosso.--pdf>.

"Virtual machines for message based, real-time and interactive simulation", Kim et al., Dec. 2000, pp. 1529-1532. Online retrieved at <http://delivery.acm.org/10.1145/520000/510603/p1529-kim.pdf>.

Search/Examination Report dated Mar. 3, 2011 from Russian Patent Application No. 2008103282, 11 pages.

Supplementary European Search Report of EP Patent Application No. 06774431.8, mailed Dec. 16, 2011, 5 pages total.

(56) **References Cited**

OTHER PUBLICATIONS

Non-final rejection dated Jul. 27, 2012 from Korean Patent Application No. 10-2008-7002321 together with English language translation, 10 pages.
English Translation of Office Action mailed Sep. 26, 2012 in Japanese Patent Application No. 2008-519670, 3 pages.
Caballero et al., Polyglot: automatic extraction of protocol message format using dynamic binary analysis, Oct. 2007, 13 pages.

* cited by examiner

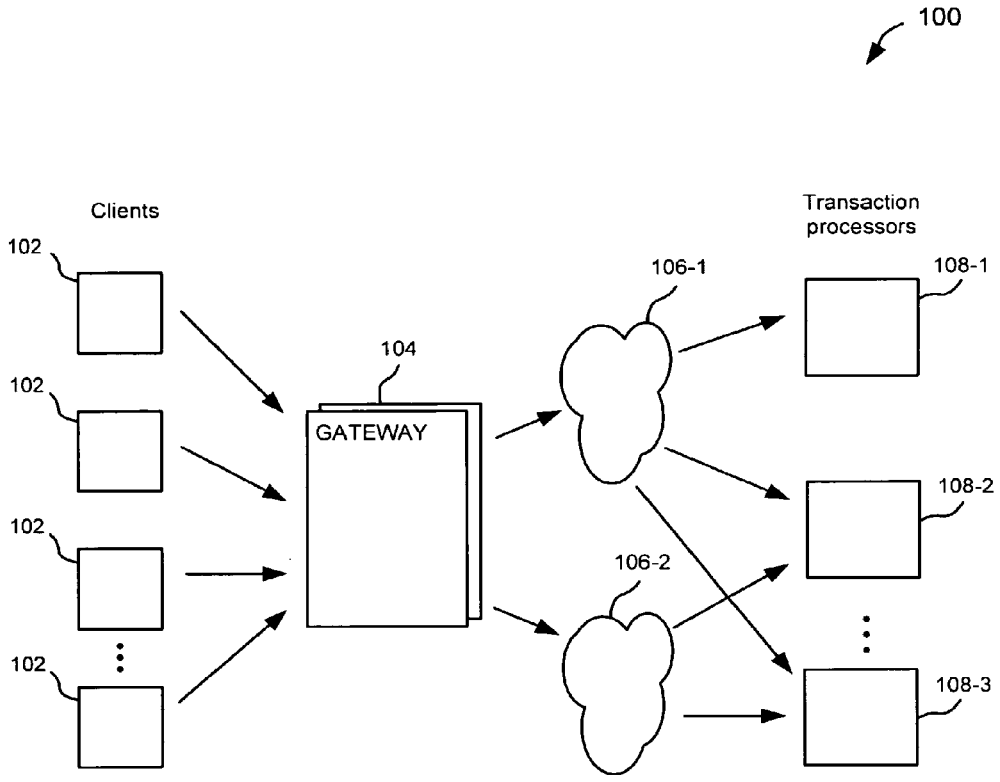

100
Clients
102
102
102
102
104
GATEWAY
106-1
106-2
Transaction processors
108-1
108-2
108-3

Fig. 1

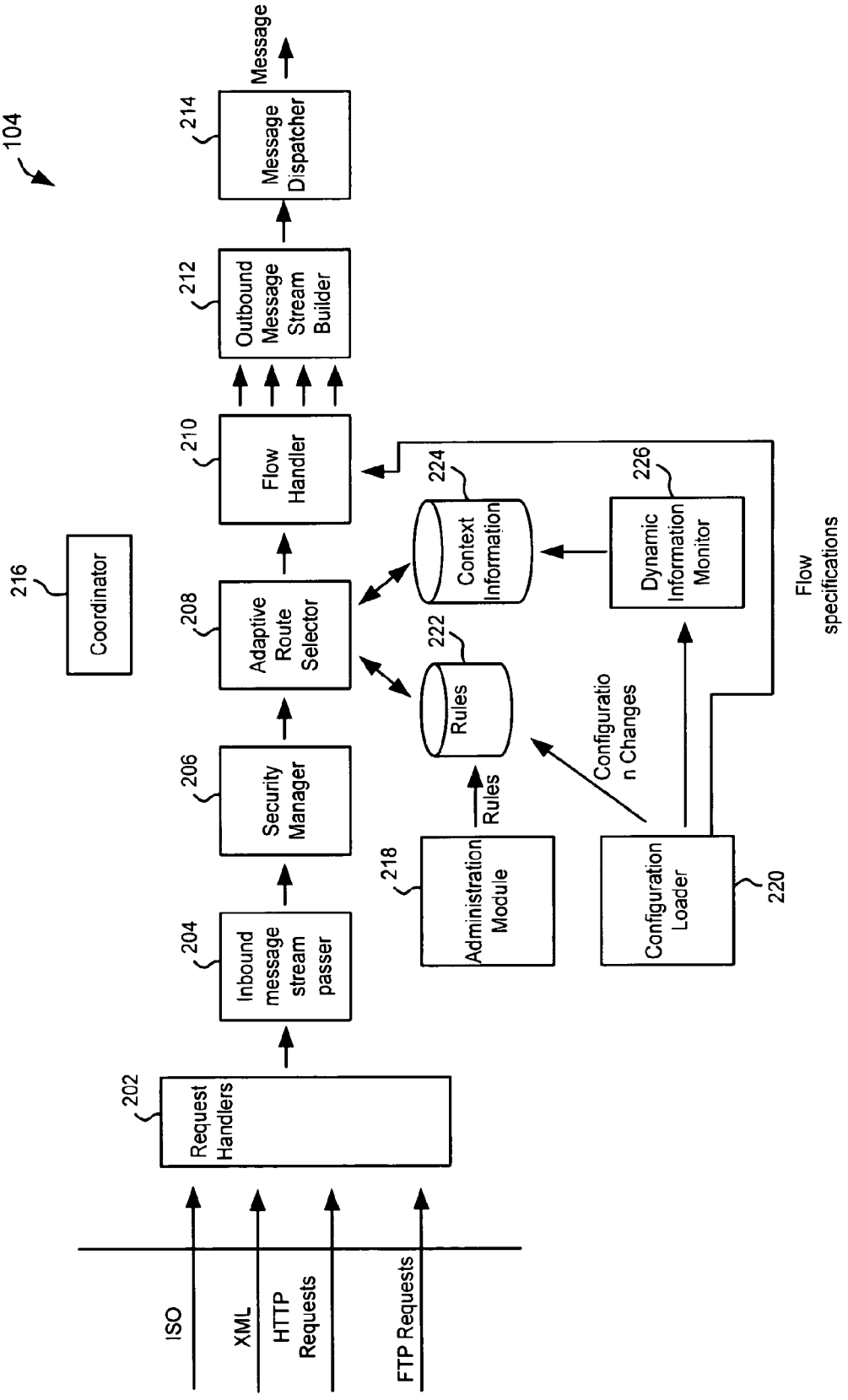

104
Message
214
Message Dispatcher
212
Outbound Message Stream Builder
210
Flow Handler
224
Context Information
226
Dynamic Information Monitor
Flow specifications
216
Coordinator
208
Adaptive Route Selector
222
Rules
Configuration Changes
206
Security Manager
218
Administration Module
Rules
204
Inbound message stream passer
Configuration Loader
220
202
Request Handlers
ISO
XML
HTTP Requests
FTP Requests

Fig. 2

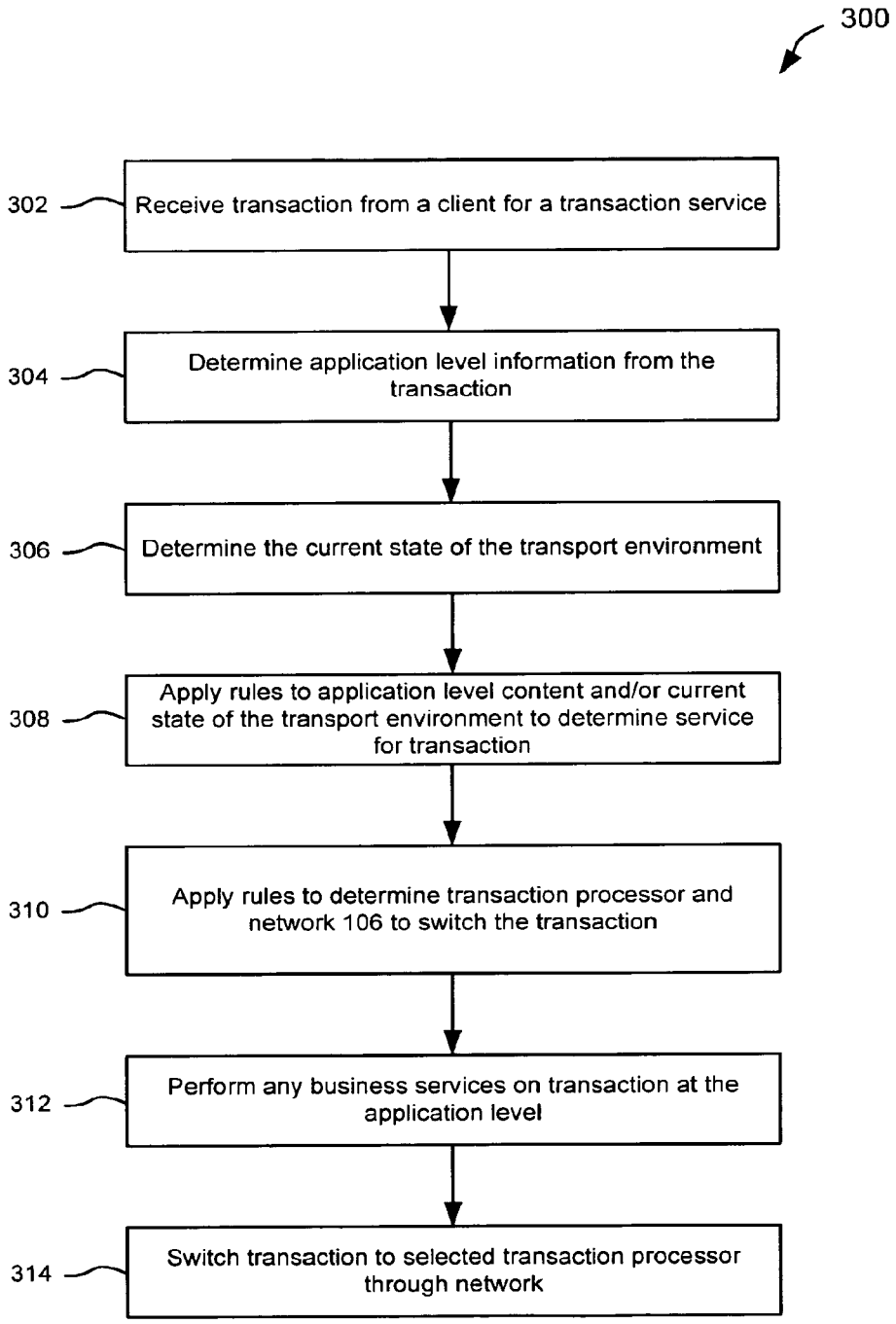

300
302
Receive transaction from a client for a transaction service
304
Determine application level information from the transaction
306
Determine the current state of the transport environment
308
Apply rules to application level content and/or current state of the transport environment to determine service for transaction
310
Apply rules to determine transaction processor and network 106 to switch the transaction
312
Perform any business services on transaction at the application level
314
Switch transaction to selected transaction processor through network

Fig. 3

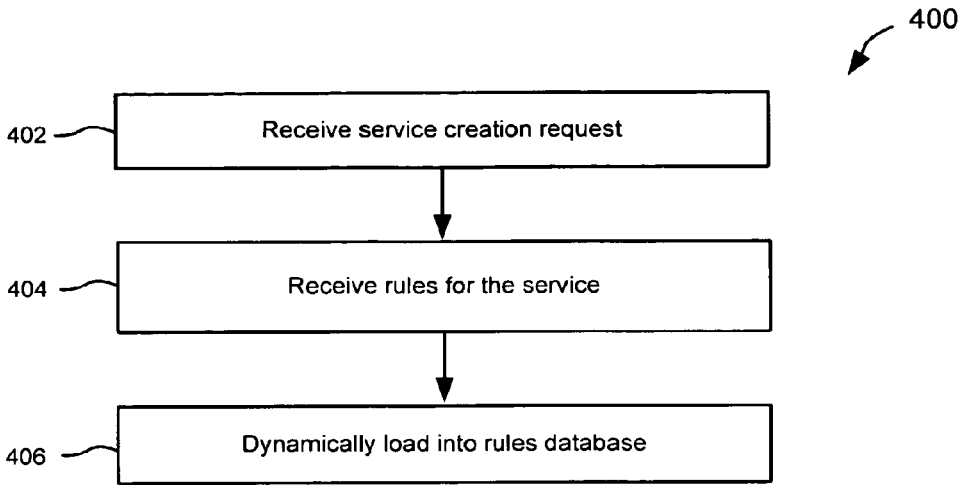

400
402
Receive service creation request
404
Receive rules for the service
406
Dynamically load into rules database

Fig. 4

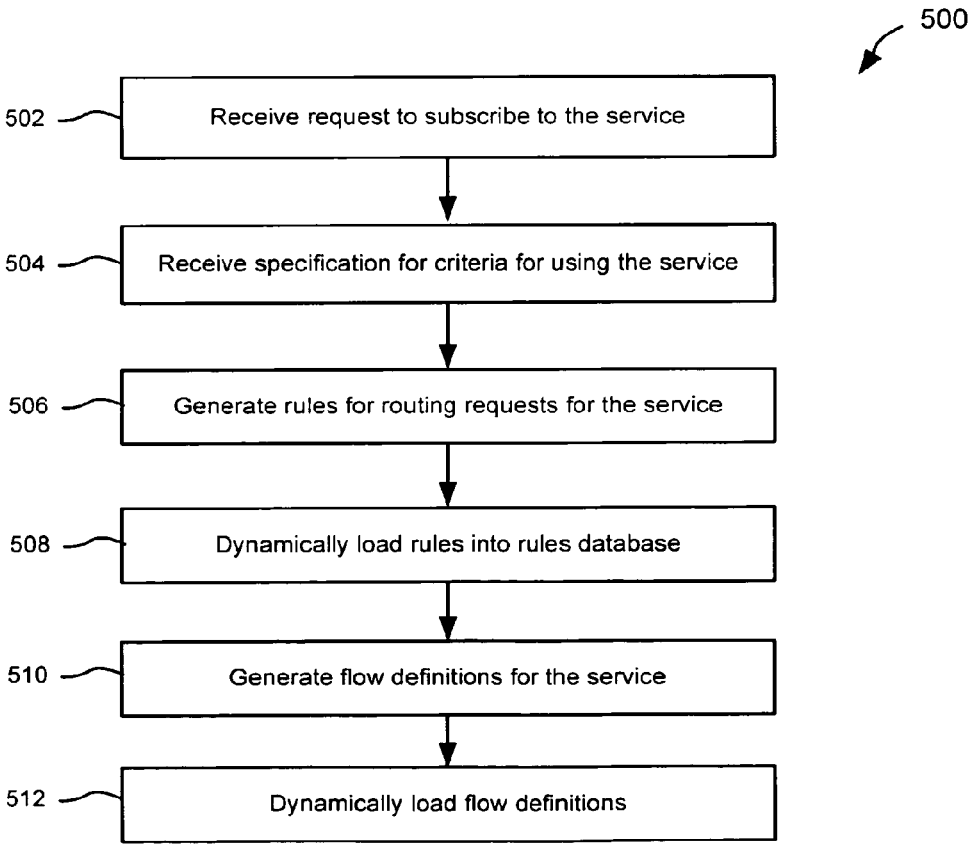

500
502
Receive request to subscribe to the service
504
Receive specification for criteria for using the service
506
Generate rules for routing requests for the service
508
Dynamically load rules into rules database
510
Generate flow definitions for the service
512
Dynamically load flow definitions

Fig. 5

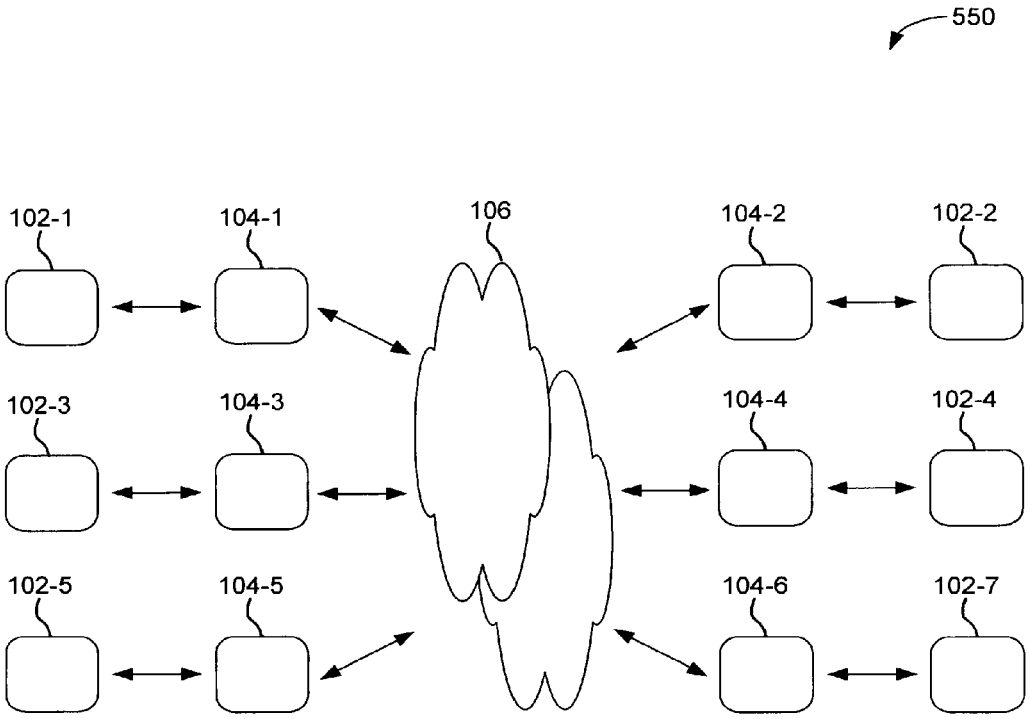

550
102-1
104-1
106
104-2
102-2
102-3
104-3
104-4
102-4
102-5
104-5
104-6
102-7

Fig. 6

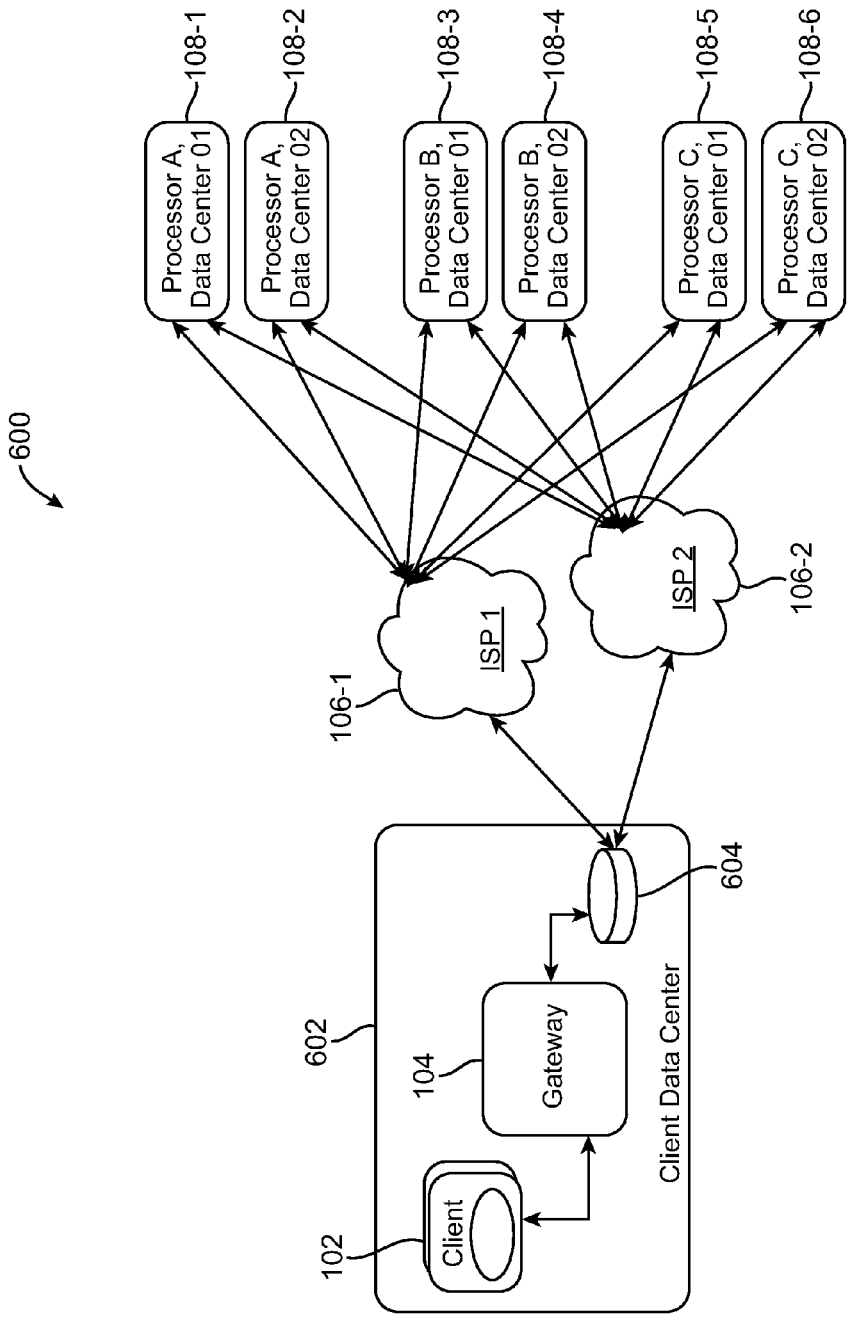

600
Processor A, Data Center 01
108-1
Processor A, Data Center 02
108-2
Processor B, Data Center 01
108-3
Processor B, Data Center 02
108-4
Processor C, Data Center 01
108-5
Processor C, Data Center 02
108-6
ISP 1
106-1
ISP 2
106-2
604
602
Client Data Center
104
Gateway
102
Client

FIG. 7

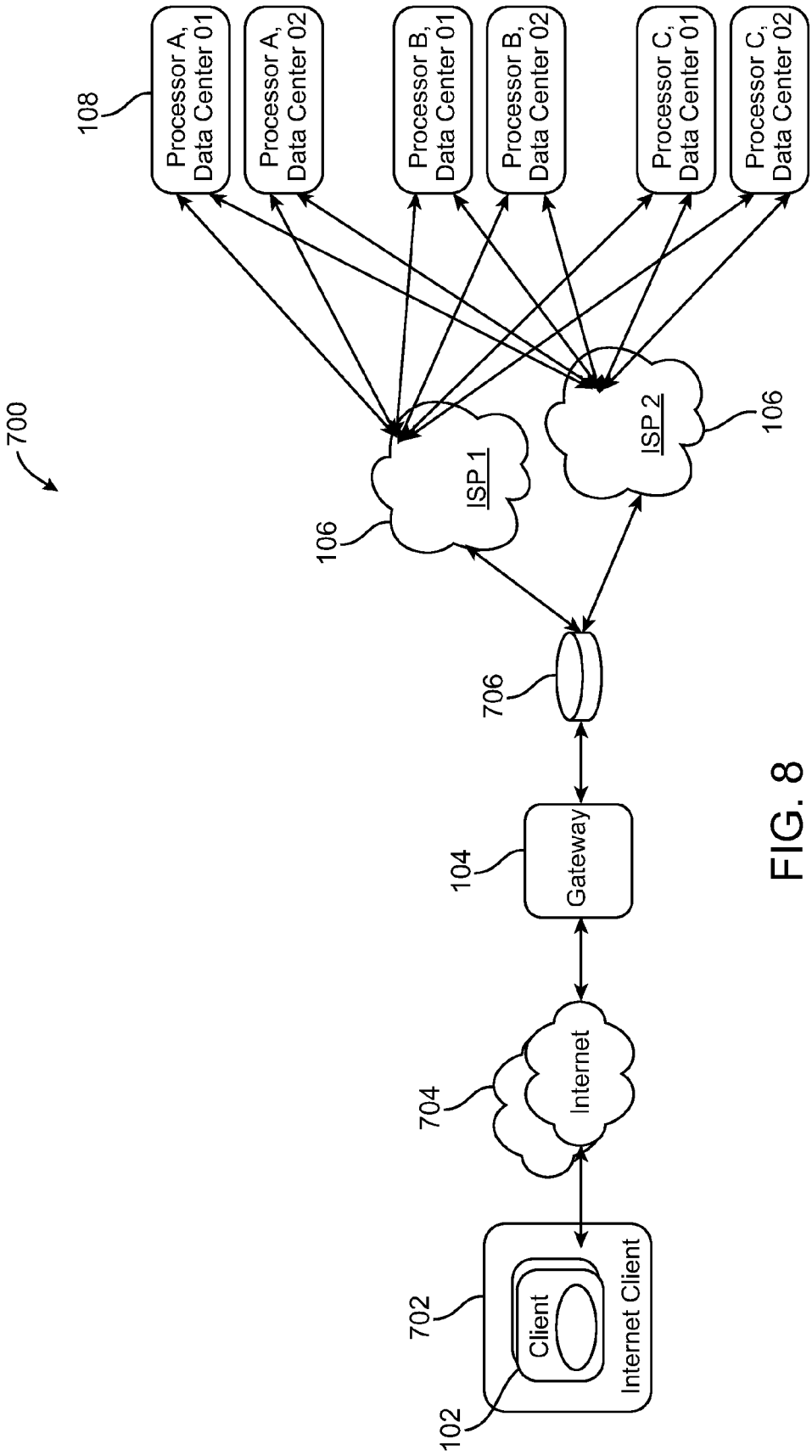

700
108
Processor A, Data Center 01
Processor A, Data Center 02
Processor B, Data Center 01
Processor B, Data Center 02
Processor C, Data Center 01
Processor C, Data Center 02
106
ISP 1
ISP 2
106
706
104
Gateway
704
Internet
702
Client
Internet Client
102

FIG. 8

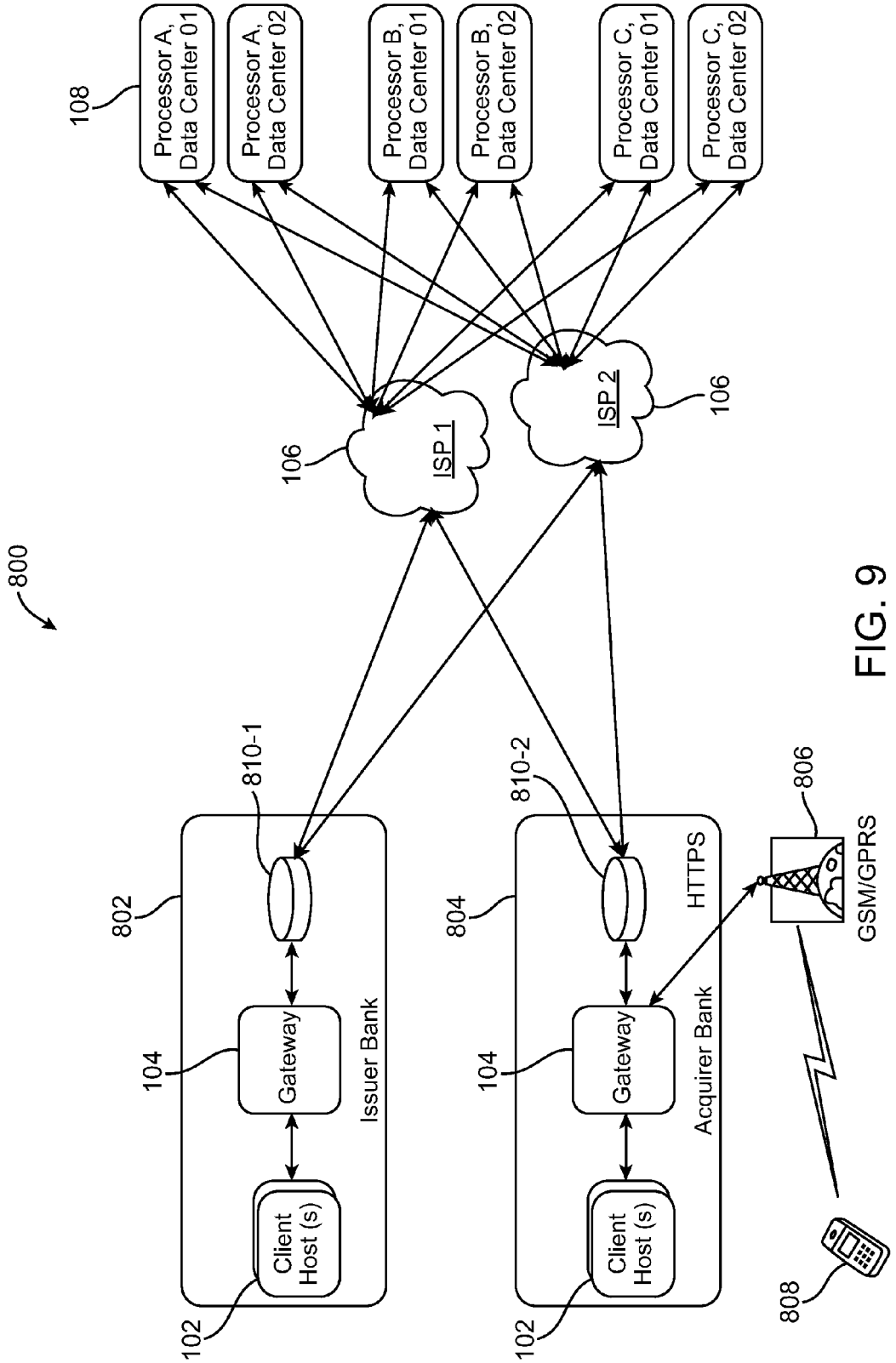

800
108
Processor A, Data Center 01
Processor A, Data Center 02
Processor B, Data Center 01
Processor B, Data Center 02
Processor C, Data Center 01
Processor C, Data Center 02
106
ISP 1
ISP 2
106
810-1
810-2
806
802
804
HTTPS
GSM/GPRS
104
Gateway
Gateway
Issuer Bank
Acquirer Bank
Client Host (s)
Client Host (s)
102
102
808

FIG. 9

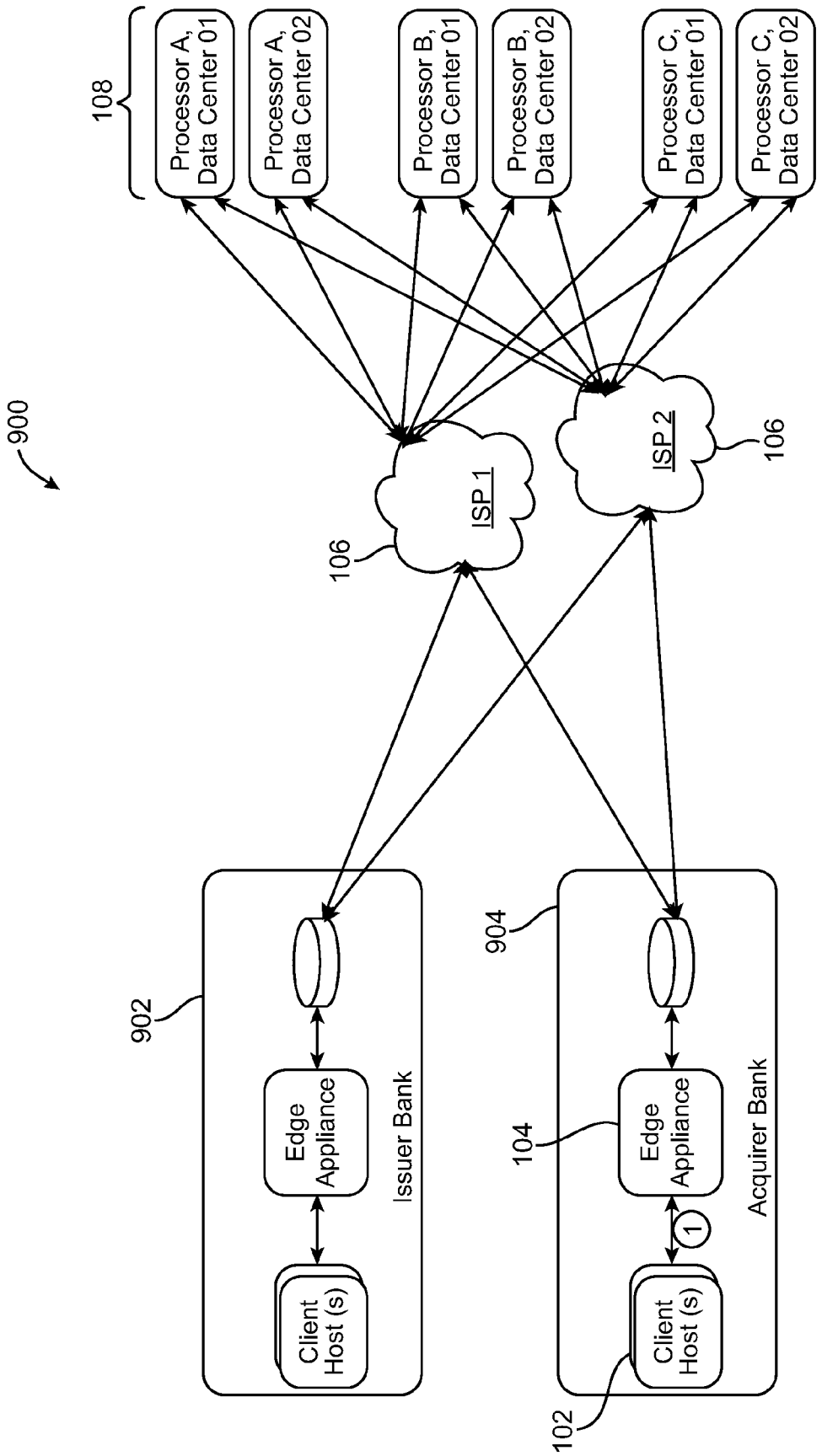

900
108
Processor A, Data Center 01
Processor A, Data Center 02
Processor B, Data Center 01
Processor B, Data Center 02
Processor C, Data Center 01
Processor C, Data Center 02
106
ISP 1
106
ISP 2
902
Edge Appliance
Client Host (s)
Issuer Bank
904
104
Edge Appliance
1
Client Host (s)
Acquirer Bank
102

FIG. 10

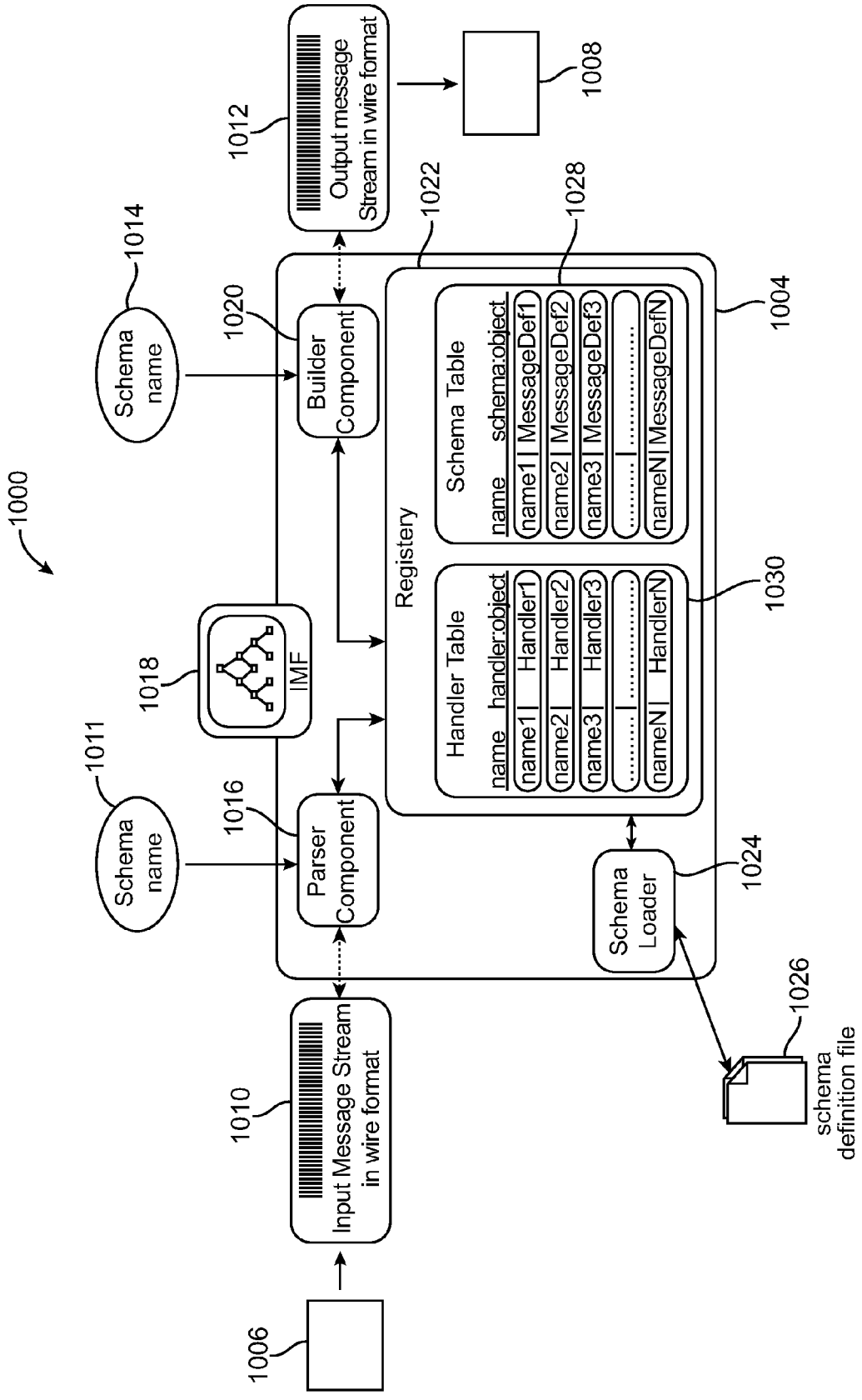

1000
1004
1006
1008
1010
1011
1012
1014
1016
1018
1020
1022
1024
1026
1028
1030
Input Message Stream in wire format
Output message Stream in wire format
Schema name
Schema name
Parser Component
Builder Component
IMF
Registery
Handler Table
name handler:object
name1 Handler1
name2 Handler2
name3 Handler3
nameN HandlerN
Schema Table
name schema:object
name1 MessageDef1
name2 MessageDef2
name3 MessageDef3
nameN MessageDefN
Schema Loader
schema definition file

FIG. 11

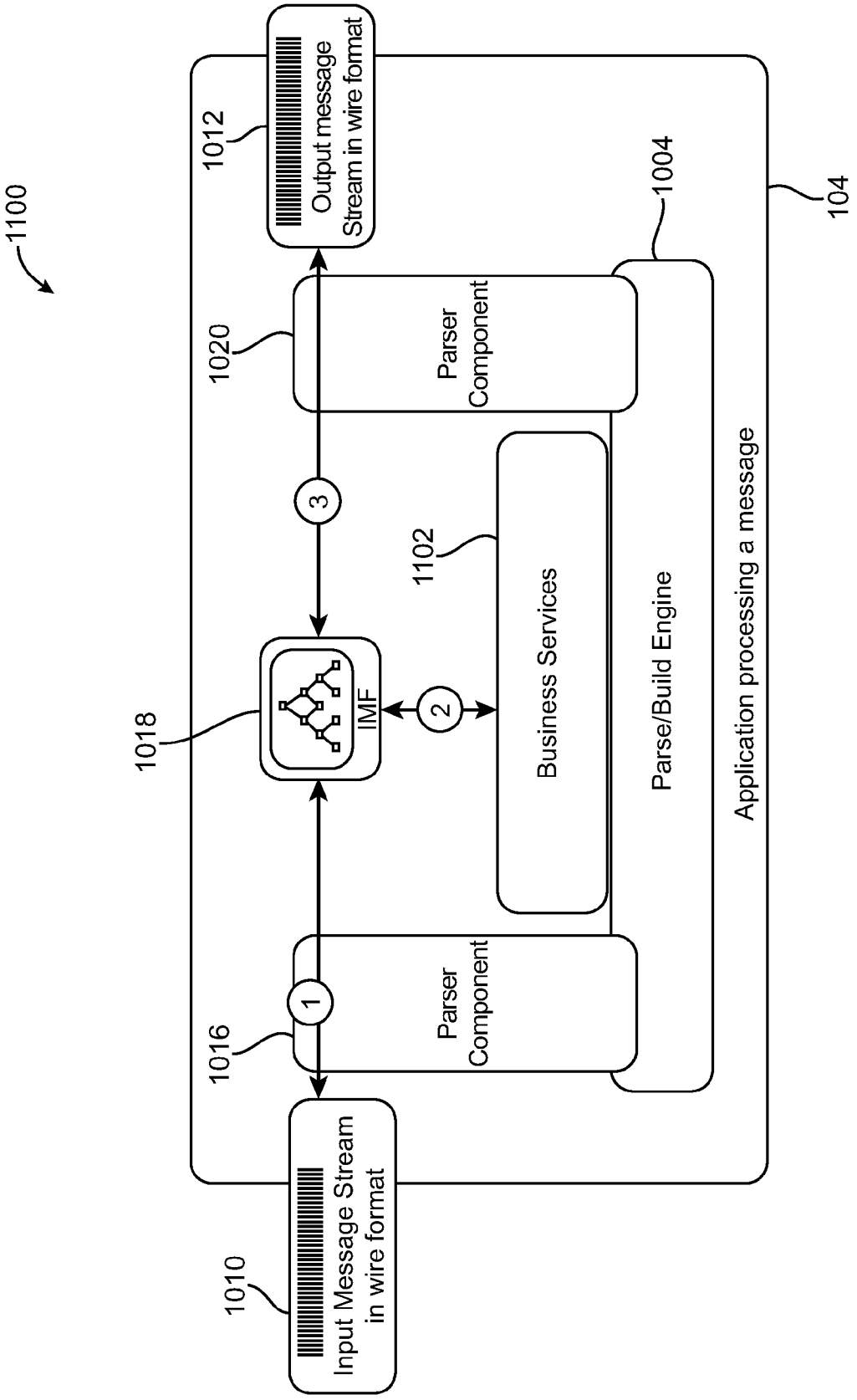

1100
1012
Output message
Stream in wire format
1004
104
1020
Parser
Component
3
1102
Business Services
1018
IMF
2
Parse/Build Engine
Application processing a message
1016
1
Parser
Component
1010
Input Message Stream
in wire format

FIG. 12

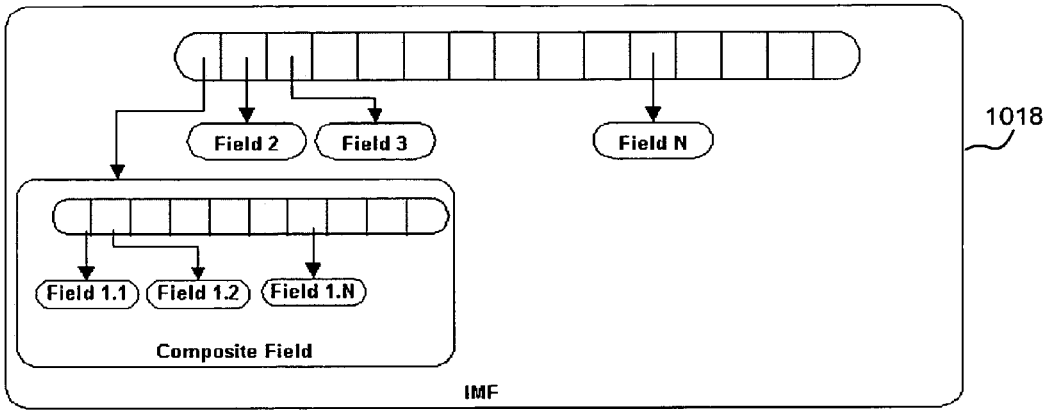


Fig. 13A

Schema

```
MessageDef{ 1000, ISO, 154 }
    FieldDef {1.0.0, HDR ,                REQUIRED ,  FIXED:BINARY(22) ,  RAW,        CUSTOM ,      ISOHEADER ,  14}
    FieldDef {1.1.0,  HDR_LEN,            REQUIRED ,  FIXED:BINARY(1),    N,          NOTCUSTOM ,   NULL,          0}
    FieldDef {1.2.0,  HDR_FORMAT,         REQUIRED ,  FIXED:BINARY(1) ,   BITSTRING , NOTCUSTOM ,   NULL ,         0}
    FieldDef {1.3.0,  HDR_TEXT,           REQUIRED ,  FIXED:BINARY(1),    N,          NOTCUSTOM ,   NULL ,         0}
    FieldDef {1.4.0,  HDR_MSG_LEN,        REQUIRED ,  FIXED:BINARY(2),    N,          NOTCUSTOM ,   NULL ,         0}
    ........
    .......
    FieldDef {1.13.0, HDR_BMA,            OPTIONAL ,  FIXED:BINARY(2),    BITSTRING,  NOTCUSTOM,    NULL,          0}
    FieldDef {1.14.0, HDR_REJECT_GROUP,   OPTIONAL ,  FIXED:PACK_BCD(2) , N,          NOTCUSTOM,    NULL,          0}
    ......
    ......   1202     1204          1206        1208          1210        1212        1214       1216
}
```

Fig. 13B

Message 1010

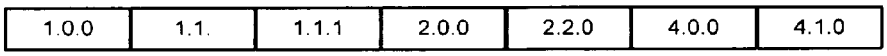


Fig. 14A

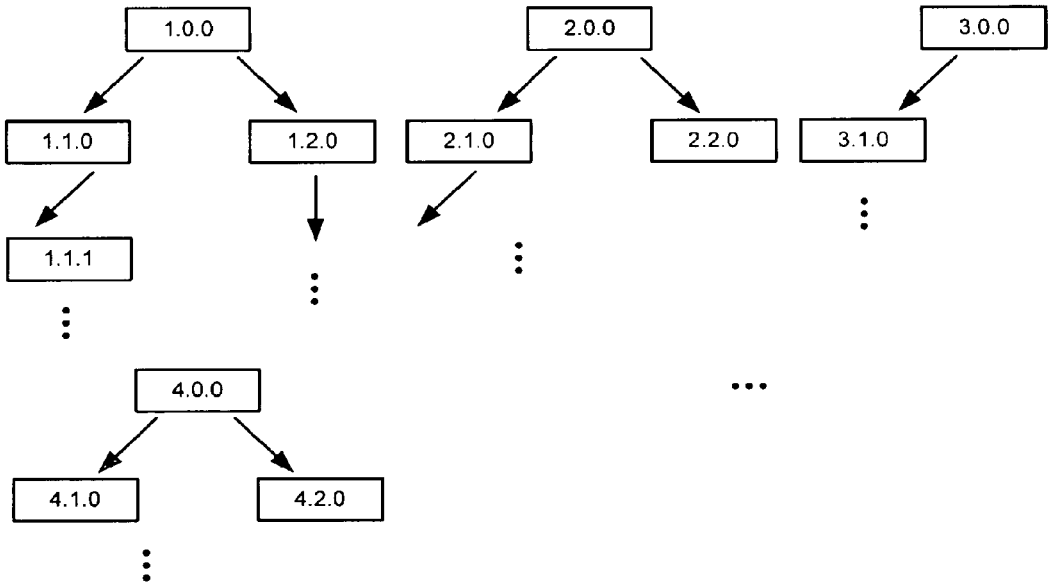


Fig. 14B

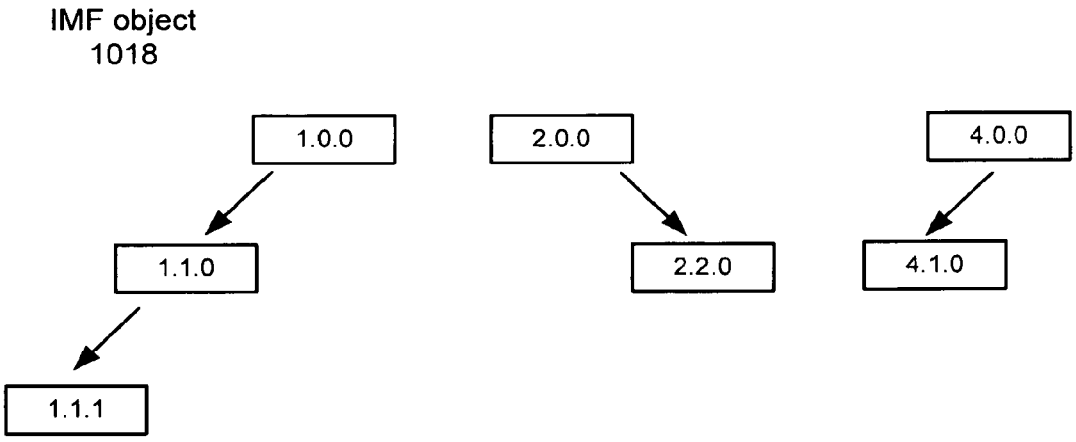


Fig. 14C

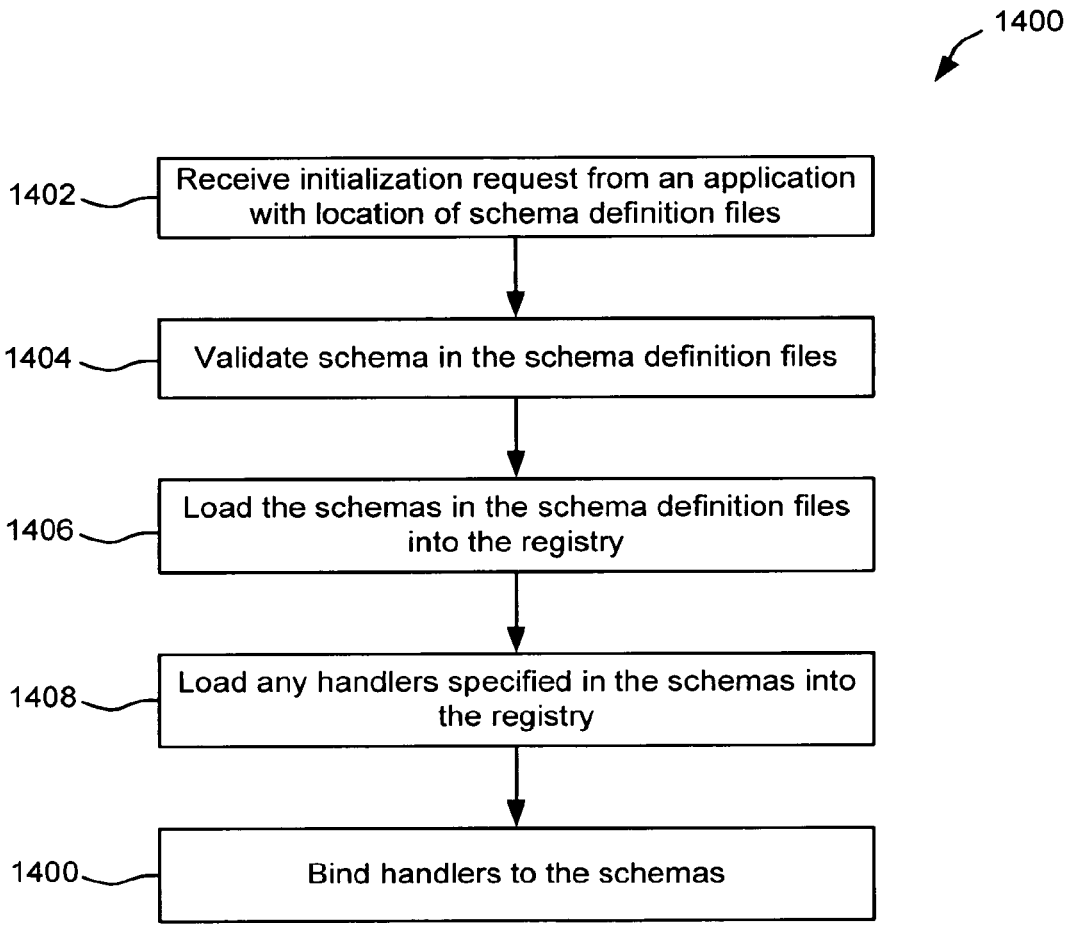

1400
1402
Receive initialization request from an application with location of schema definition files
1404
Validate schema in the schema definition files
1406
Load the schemas in the schema definition files into the registry
1408
Load any handlers specified in the schemas into the registry
1400
Bind handlers to the schemas

Fig. 15

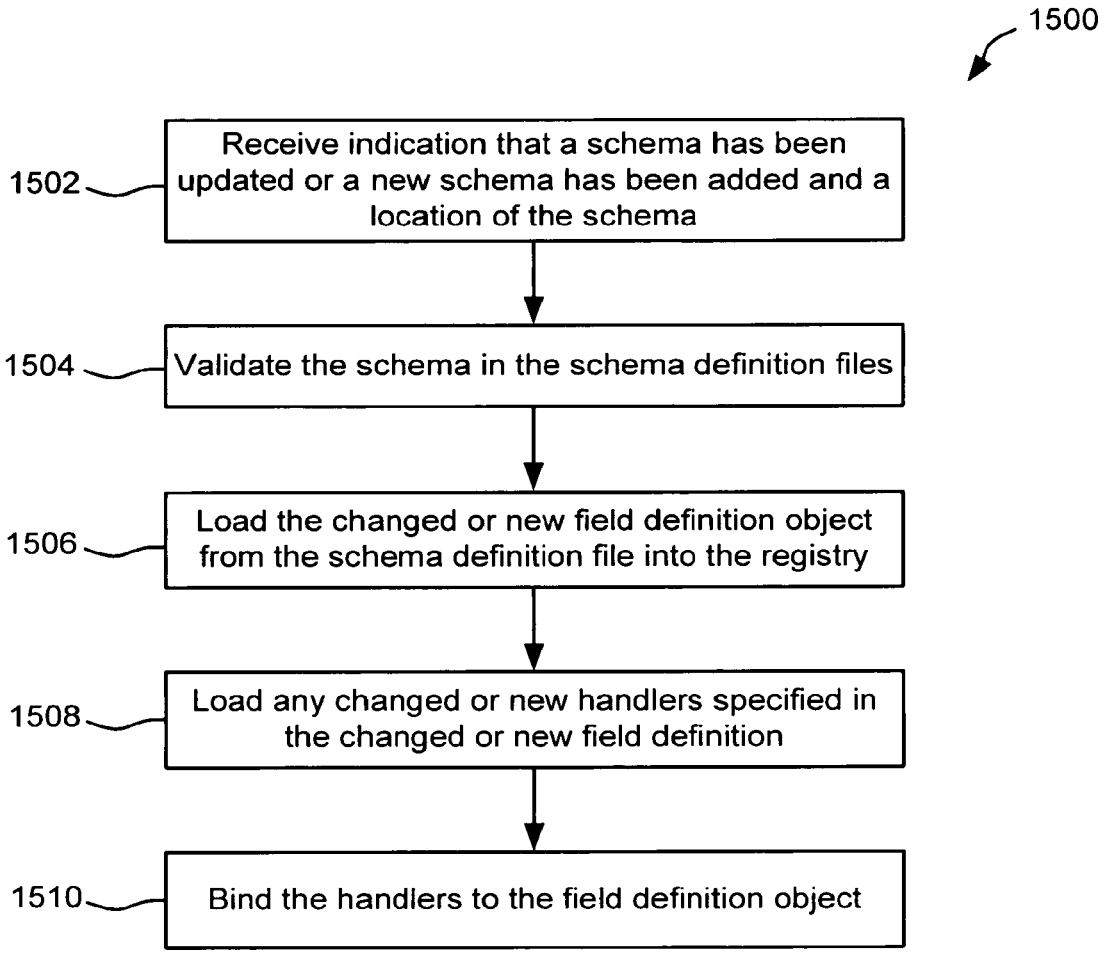

1500
1502
Receive indication that a schema has been updated or a new schema has been added and a location of the schema
1504
Validate the schema in the schema definition files
1506
Load the changed or new field definition object from the schema definition file into the registry
1508
Load any changed or new handlers specified in the changed or new field definition
1510
Bind the handlers to the field definition object

Fig. 16

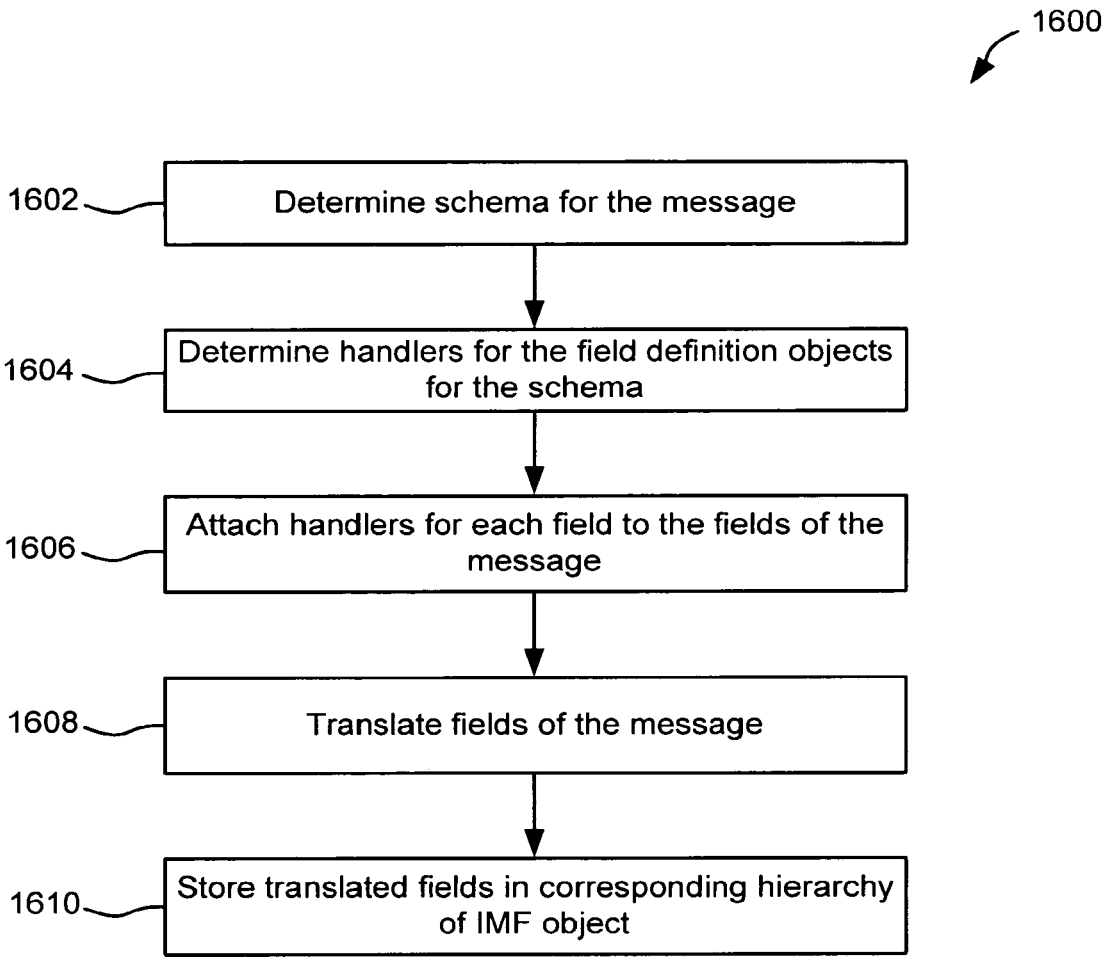

1600
1602
Determine schema for the message
1604
Determine handlers for the field definition objects for the schema
1606
Attach handlers for each field to the fields of the message
1608
Translate fields of the message
1610
Store translated fields in corresponding hierarchy of IMF object

Fig. 17

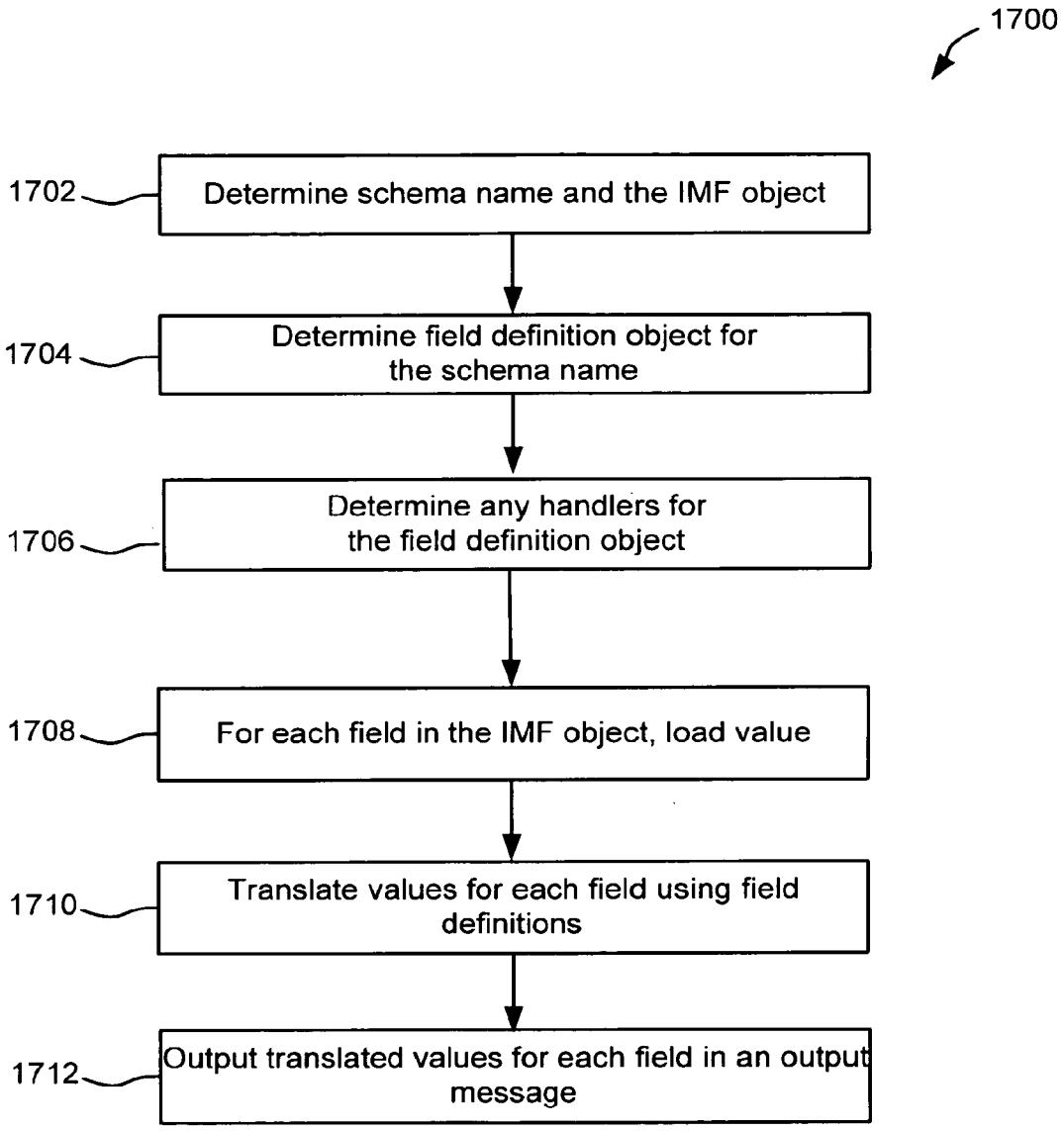

1700
1702
Determine schema name and the IMF object
1704
Determine field definition object for the schema name
1706
Determine any handlers for the field definition object
1708
For each field in the IMF object, load value
1710
Translate values for each field using field definitions
1712
Output translated values for each field in an output message

Fig. 18

SCHEMA-BASED DYNAMIC PARSE/BUILD ENGINE FOR PARSING MULTI-FORMAT MESSAGES

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a divisional of U.S. application Ser. No. 14/017,214, now U.S. Pat. No. 9,215,196 filed on Sep. 3, 2013, which is a continuation of U.S. application Ser. No. 12/707,634, now U.S. Pat. No. 8,555,262, filed on Feb. 17, 2010, which is a continuation of U.S. application Ser. No. 11/172,397, now U.S. Pat. No. 7,694,287, filed on Jun. 29, 2005, all of which are herein incorporated by reference in their entirety for all purposes. This application is related to U.S. patent application Ser. No. 11/171,516, now U.S. Pat. No. 7,774,402, filed on June 29, 2005, entitled "ADAPTIVE FRONT END GATEWAY FOR SWITCHING TRANSACTIONS AND DATA ON UNRELIABLE NETWORKS USING CONTEXT-BASED RULES," which is herein incorporated by reference in its entirety for all purposes.

BACKGROUND OF THE INVENTION

The present invention generally relates to parse/build engines and more specifically to a high performance and yet very flexible parse/build engine capable of translating multi-format message streams into an internal message format for processing and translating the internal message format back to the multi-format message streams where formats that can be translated may be dynamically added to the parse/build engine.

Applications need to communicate with other heterogeneous systems when performing tasks. These heterogeneous systems may use data in a format that is different from the internal format of the host application. In order to be able to process information received in the different data format, the host-application may have to parse the external data format to its own internal data format. The host application can then process the parsed information in the internal data format. After processing, the processed information is then built into the external data format. Accordingly, the software application can then effectively communicate with external heterogeneous systems that process data in a different data format than the internal data format used by the software application.

Conventionally, parse/build engines are used for the parse and build steps described above. The engines are generally one of two types, interpreter-based parse/build engines and compiled parse/build engines.

Interpreter-based parse/build engines can handle multiple data formats. The interpreter-based parse/build engines include a large grammar dictionary that is used to interpret a certain set of messages. Accordingly, multiple data formats can be handled, but at the cost of performance because using the grammar dictionary is often very complex and translating messages using it degrades performance. Another drawback with the interpreter-based parse/build engines is they can only interpret the certain set of messages included in the grammar dictionary. If additional definitions in the grammar dictionary need to be added, the engine typically has to be recompiled in order to use the new definitions for the grammar dictionary.

Compiled parse/build engines are customized for high performance for a fixed set of data formats. But compiled parse/build engines cannot support new data formats dynamically. They require code changes to incorporate the new data formats that may be necessary to support new business requirements. The code changes must then be recompiled. Thus, compiled parse/build engines are not a good fit for systems that need to handle new message types dynamically and cannot be brought down for re-compiling.

BRIEF SUMMARY OF THE INVENTION

The present invention provides a parse/build engine that can handle multi-format messages. The engine converts the messages in different formats into a common format, and the common format message is then processed by a business service application. The common format is a canonical message format that is referred to as an internal message format herein. A parser examines the message and determines an appropriate schema for the particular format of message received. The schema is a data structure in a schema registry that includes a grammar structure for the received format as well as pointers to handlers for converting the different fields of the message into the internal message format using the grammar structure (the "grammar" can include field sequence, field type, length, character encoding, optional and required fields, etc.). The handlers are individually compiled. Thus, rather than compiling the overall system, the handlers are separately compiled, giving the speed of compiled software while retaining a modular system that can be easily upgraded without disturbing other elements of the engine. As formats change, new formats or changes to old formats can be dynamically added to the parse/build engine by loading new schema and handlers.

In one embodiment, the parser can load a root schema corresponding to the format of message detected, such as an ISO 8583 financial message. The root schema would point to a handler which determines what type of message has been received (e.g., authorization message, reconciliation message, etc.). The parser then loads the schema for the message type identified, which in turn provides the particular grammar and points to the handlers for that message type. Thus, the entire grammar and handlers for all types of financial messages need not be loaded, only the subset actually needed, thus limiting the memory needed and improving performance. In addition, for each message type, schema and handlers are loaded and called only for the fields actually present. This is made possible by the modular structure and iterative approach of the invention.

In one embodiment, in addition to only loading the schema, grammar and handlers that are actually needed, the parse/build engine uses a fast indexing system for the internal message format. This indexing system uses encoded object IDs in the schema, which, for each field used in the received format, index into (point to) the corresponding field of the internal message format. Fields of the internal message format that aren't used are not pointed to and thus don't need to be accessed. The indices can point to fields that are several layers down in a hierarchical structure. By using the indices, instead of sequentially processing all the fields, a speed advantage is provided.

In one embodiment, a business service application processes the message in the internal message format. As a result of the processing, the business service application may update or add fields (e.g., a time stamp, preprocessing tasks such as calculating a risk score, etc.). The modified message then undergoes the reverse of the parsing operation, a build operation. The build operation similarly uses schema and handlers to build the message into a desired external format for return to the originator, or forwarding onto another destination for processing. The business service

application is separate from the parse build engine, thus changes to the parse build engine need not affect the business services application.

A further understanding of the nature and the advantages of the inventions disclosed herein may be realized by reference of the remaining portions of the specification and the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** depicts a system for processing transactions according to one embodiment of the present invention.

FIG. **2** depicts a more detailed embodiment of a gateway according to one embodiment of the present invention.

FIG. **3** depicts a simplified flowchart of a method for processing a transaction according to one embodiment of the present invention.

FIG. **4** depicts a simplified flowchart for generating configuration information for a service offered by a transaction processor according to one embodiment of the present invention.

FIG. **5** depicts a simplified flowchart of a method for subscribing to a service according to one embodiment of the present invention.

FIG. **6** depicts a decentralized system of a plurality of gateways according to one embodiment of the present invention.

FIG. **7** depicts a system that shows the gateway as a front-end gateway according to one embodiment of the present invention.

FIG. **8** depicts a system where the gateway is an Internet gateway according to one embodiment of the present invention.

FIG. **9** depicts a system where the gateway is used as a wireless gateway according to one embodiment of the present invention.

FIG. **10** depicts a system for processing ISO 8583 transactions according to one embodiment of the present invention.

FIG. **11** depicts a system for parsing messages according to one embodiment of the present invention.

FIG. **12** discloses an embodiment of a gateway according to embodiments of the present invention.

FIG. **13**A depicts a structure for an IMF object according to one embodiment of the present invention.

FIG. **13**B depicts attributes for a message definition according to one embodiment of the present invention.

FIGS. **14**A, **14**B, and **14**C depict a possible message, a hierarchical format with object ID codes, and an IMF object for the message according to one embodiment of the present invention.

FIG. **15** depicts a simplified flowchart of a method for initializing the parse/build engine to process a message stream according to one embodiment of the present invention.

FIG. **16** depicts a simplified flowchart of a method for dynamically adding or updating a schema in the parse/build engine according to one embodiment of the present invention.

FIG. **17** depicts a simplified flowchart of a method for parsing an input message according to one embodiment of the present invention.

FIG. **18** depicts a simplified flowchart of a method for building an output message from an IMF object according to one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Embodiments of the present invention relate to the parse/build of messages. A gateway that may incorporate a parse/build engine according to an embodiment of the present invention is described first. The parse/build engine is then described in more detail.

The Gateway

Processing Overview

In one embodiment, intelligent switching of transactions is provided. A transaction may be a credit card authorization, debit card transaction or an electronic check transaction. Other examples of transactions include awarding of points or other rewards in an awards program, checking a password for a Verified by Visa authentication, doing a money transfer, deducting a payment from a prepaid card, such as a Visa Buxx card or a salary card, handling a proximity payment from a cell phone, pager, PDA, etc., determining coverage under health, auto, or other insurance, etc. A client sends a transaction to a gateway, which is then configured to intelligently switch the transaction to a transaction processor of a service provider. The client could be a POS, a merchant computer networked to POS devices or ECRs (electronic cash registers), a kiosk (such as for coupons or money transfer), an Internet web site server, etc.

The gateway is configured to make switching decisions at the application level based on the application level content of the transaction, a current state of a transport environment, and/or dynamic rules. The application level content may be information that is processed or used by a transaction processor in processing the transaction. In one embodiment, the information may be OSI layer 7 information. This layer directly serves the transaction processor or end user. It includes applications such as credit card authorization, debit card transaction applications, etc. Example application layer protocols are FTP (File Transfer Protocol), NFS (Network File System), CIFS (Common Internet File System), HTTP (Hyper Text Transfer Protocol), database query, SQL (Standard Query Language), and XML (Extensible Markup Language). For example, in a credit card authorization, application level content may include the credit card number, personal account number (PAN), a customer account number, a total amount for the transaction, etc. The transaction processor may use this information in order to process the transaction.

The current state of the transport environment includes real-time information associated with networks that can transport the transaction and transaction processors that may process the transaction. The real-time information may include the health of a network or transaction processor, the availability of a network or transaction processor, the application processing speed of a transaction processor, etc.

The dynamic rules may be information that is used to decide how to intelligently switch the transaction. The rules are used to switch the transaction according to the application level content and the current state of the transport environment. For example, the rules may specify that, depending on certain application level content and the current state of the transport environment, a certain service offered by a service provider should be selected. Further, the rules may be used to select a transaction processor for the service provider to process the transaction. For example, certain countries may require local processing for domestic transactions, thus requiring routing to a regional processing center. These rules may also factor in static information,

such as network costs, service costs, etc. in order to make a selection. The rules may be dynamically changed without taking down a gateway.

The gateway may also perform services on the transaction according to the rules. The services may include processing the application level content. For example, transaction processors may be configured to process a transaction in different formats. A selected transaction processor may be configured to process application level content in a different format from the application level content currently in the transaction. Thus, the gateway may change the application level content to the new format so the selected transaction processor can process it. Accordingly, the gateway may change information in a transaction at the application level. This is different from reviewing information at the packet level. Conventionally, a transaction may be broken up into packets. A router may look at information in the packet and route the packet accordingly. Looking at information at the packet level, however, does not allow the router to perform services using the application level content for the transaction. For example, by looking at the application level content for the full transaction, the transaction may be intelligently routed with appropriate services applied to the transaction. If individual packets carrying information for the transaction are processed individually, the application level content of the transaction as a whole is not processed.

Accordingly, a gateway is provided that intelligently switches a transaction at the application level based on the application level content, current state of a transport environment, and/or dynamic rules. The gateway may also provide services that are applied based on the switching decision.

System Overview

FIG. **1** depicts a system **100** for processing transactions according to one embodiment of the present invention. As shown, system **100** includes one or more clients **102**, one or more gateways **104**, one or more networks **106**, and one or more transaction processors **108**. The following description will be described with respect to a single gateway **104**, but it will be understood that multiple gateways **104** may be provided to perform any functions described below. Also, although the gateways are shown adjacent the clients, gateways may also be deployed adjacent the transaction processors, between the transaction processors and the networks **106**.

Clients **102** include any system configured to send a transaction. For example, clients **102** may include a system of computing devices that perform transactions with users. In one example, clients **102** may include a point of sale (POS) device that receives user information, such as credit card information, a pin number, name, etc., for a credit card authorization, check card transaction, etc. A client could also be a kiosk in a store for checking points or coupon information, or a kiosk for money transfer, or a node for receiving wireless user input from a cell phone or other device, or a web site server, etc. The client could also be a merchant server through which POS devices are networked.

The client (e.g., POS device) may then send a transaction that requests a transaction service from a transaction processor **108**. A transaction service may be any actions that may be performed by a transaction processor **108**. In one embodiment, these transaction services add value for transactions being performed by clients **102**. Examples of transaction services include facilitating credit card authorizations, debit card transactions, electronic check transactions, etc. A transaction service may also include processing a transaction or exchanging data.

Gateway **104** includes a system configured to receive transactions from clients **102** and to route the transactions to transaction processors **108** through networks **106**. In one embodiment, gateway **104** is situated on the edge of a network **106**. For example, gateway **104** may be at the point of access for client **102** or be on the premises of client **102**. The edge of network **106** may be a point where transactions may be configured for routing through network **106**. For example, gateway **104** may select a transaction processor **108** and send the request to a router of network **106**. The transaction may be broken up into a number of packets. The router would then route the packets for the transaction through network **106** to transaction processor **106**.

Networks **106** may be any network configured to transfer data. For example, networks **106** may include any packet-based networks, public switched telephone networks (PSTNs), wireless networks, the Internet, private financial networks, etc.

In one embodiment, networks **106** may be disparate and/or unreliable networks. The networks are disparate in that they may be controlled by different entities, may route data using different protocols and formats, may route data using different transport methods, etc. For example, networks **106** may be controlled by different entities. In one example, a first Internet Service Provider (ISP) may maintain a network **106-1** and a second Internet Service Provider may maintain a network **106-2**. Transactions may be routed through either network **106-1** or network **106-2** in one embodiment.

Also, networks **106** may be of different types. For example, a network **106-1** may be an asynchronous transfer mode (ATM) network that routes packets of data. Another network **106-2** may be a wireless network that transmits data wirelessly. Further, another network **106** may be a private network for an entity, such as the VisaNet network. Although only two networks **106** are shown, it will be understood that many more networks **106** may be provided. Also, it will be understood that transactions may be routed through multiple networks **106**. For example, transactions may be routed through network **106-1**, then network **106-2**, and then to a transaction processor **108**.

Networks **106** may also be unreliable. Because of the nature of networks, they may fail at any time. Thus, failover processing is needed to avoid disruptions in transaction processing.

Service providers may register and publish services that can be offered to clients **102**. Clients **102** may register for the services and have transactions switched to the service providers. Service providers may have any number of transaction processors **108** that are configured to provide the services to clients **102**. In one embodiment, transaction processors **108** process financial transactions. For example, transaction processors **108** may be associated with issuers, acquirers, merchants, or any other service provider. In one example, transaction processors **108** facilitate the authorization of credit card transactions.

A service may be provided by more than one transaction processor **108**. For example, a service provider may have many data centers that can provide a service to a client **102**. Thus, a transaction for the service may be switched to any of the transaction processors **108** that can provide the service. The transaction processor **108** may be selected by gateway **104** based on application level content, context information for a transport environment, and/or dynamic rules, all of which may be dynamically changing.

The application level services may be dynamically changed. Services available may be modified, moved to another processor, be unavailable due to maintenance or failure, etc.

The context information for the transport environment may also be dynamically changing. Gateway **104** thus determines the context information for the transport environment when determining how to switch a transaction. For example, a current state of the health of a network **106**, the availability of a network **106**, the availability of a transaction processor **108**, the speed that data is being transferred through a network **106**, the cost of transferring a transaction through a network **106**, the cost of processing a transaction, how long an application is taking to process a transaction at the application level, etc. may be determined.

In addition to the dynamic information for the context information for the transport environment, certain relatively static information may be determined. For example, static information may be the cost of a transaction, the format needed in order for a transaction processor **108** to process a transaction, etc. Gateway **106** may use the dynamic and static information in determining how to route a transaction.

The dynamic rules may be information that is used to decide how to intelligently switch the transaction. The rules may be dynamically loaded. For example, a service provider may register rules for a service, which be dynamically loaded onto gateway **104**. Also, a client may subscribe to the service and provider rules for switching its transactions to the service provider. These rules may also be dynamically loaded onto gateway **104**.

Accordingly, gateway **104** can dynamically select a transaction processor **108** for a service that can process a transaction. Business services particular to a selected transaction processor may also be performed on the transaction, such as the transaction may be formatted such that the selected transaction processor **108** can process it. The transaction can then be sent through a selected network **106** to the selected transaction processor **108**. By dynamically selecting transaction processors **108** and/or networks **106**, gateway **104** insulates clients **102** from any failures of transaction processors **108** and/or networks **106**. Accordingly, this provides extremely high service availability. Gateway **104** insulates a client **102** from any changes that need to be made that may cause downtime for a transaction processor **108**.

Overview of Gateway **104**

FIG. **2** depicts a more detailed description of gateway **104** according to one embodiment of the present invention. As shown, gateway **104** includes one or more request handlers **202**, an inbound message stream parser **204**, a security manager **206**, an adaptive route selector **208**, a flow handler **210**, an outbound message stream builder **212**, a message dispatcher **214**, a coordinator **216**, an administration module **218**, a configuration loader **220**, a rules database **222**, a context information database **224**, and a dynamic information monitor **226**.

Request handlers **202** are configured to receive transactions from clients **102**. Clients **102** may send transactions in different protocols and formats, such as hypertext transfer protocol (HTTP), file transfer protocol (FTP), extensive markup language (XML), ISO 8583 standards, etc. Request handlers **202** provide an interface for transactions sent in various protocols and formats, and provide the transactions to inbound message stream parser **204**. For example, an ISO message handler is configured to receive ISO 8583 requests from clients **102** and pass them to inbound message stream parser **204**. Also, an XML message handler, an HTTP request handler, and an FTP request handler can handle XML, HTTP, and FTP messages and/or requests. Accordingly, request handlers **202** allow gateway **104** to receive messages in different protocols and formats. Although the above formats and protocols are described, it will be understood that a person skilled in the art will appreciate other formats and protocols that request handlers **202** may process.

Inbound message stream parser **204** is configured to receive a transaction from request handlers **202** and convert the request into a canonical form. Inbound message stream parser **204** can receive messages in different formats and process those requests into a canonical format that can then be processed by other components of gateway **104**. Accordingly, transaction requests in many different formats may be processed by gateway **104**. Inbound message stream parser **204** also provides an extensible architecture in that new formats that may be processed by gateway **104** may be enabled. If a new format is added, the translation from the new format to the canonical format is added to inbound message stream processor **104**. Thus, because the canonical format is used, changes to all components in gateway **104** are not needed when new formats are added. Rather, inbound message stream parser **204** is configured to parse a request into a canonical format that can be processed by other components of gateway **104**. Further details of inbound message stream parser **204** can be found in below.

Security manager **206** is configured to provide security features for the transactions. For example, security features such as pluggable authentication and authorization, role-based access control (RBAC), encryption, file integrity, etc. may be provided. The pluggable authentication and authorization feature provides a standard interface for authentication and authorization and hence allows newer methods of authentication and access control to be added without impacting existing methods. A person skilled in the art will appreciate other security features that may be added to transactions.

An adaptive route selector **208** is configured to switch a transaction to a transaction processor **108** through a network **106**. Adaptive route selector **208** switches the transaction based on application level content, the current state of a transport environment, and/or dynamic rules.

Adaptive route selector **208** uses rules found in rules database **222** and dynamic context information found in context information database **224** to route a transaction. As mentioned above, context information may be stored in context information database **224**. In one embodiment, the context information may be dynamic. A dynamic information monitor **226** may monitor and determine context information. The dynamic information is then stored in context information database **224**. Examples of context information include the availability of networks **106**, the health of transaction processors **108**, a cost per transaction, time taken for an application to process previous transaction at the application level, etc. In one embodiment, dynamic information monitor **226** may determine dynamic context information at run-time when a transaction is received. In another embodiment, dynamic information monitor **226** may determine dynamic context information at certain intervals.

Each different service performed by transactions processors **108** may specify probes that can be performed by dynamic information monitor **226**. The probes are sent and allow information to be collected based on the status of a transaction processor **108** and/or network **106**. For example, dynamic information monitor **226** may ping a network in order to determine if the network is available. If the transaction processor **108** or network **106** cannot be reached, it

may be considered unavailable and status information is reflected in context information database **224**. If all transaction processors **108** for a service cannot be reached, then the service may be considered unavailable. Gateway **104** may determine another service provider that provides the service in this case. Also, the time it takes an application on a transaction processor **108** to process a transaction may be measured. For example, how long the application takes to authorize a credit card authorization is measured. This measurement provides application level context that can be used to switch a transaction.

Rules database **222** includes rules for determining a service for a transaction in addition to a network **106** and processor **108** to process the transaction. The rules may also express criteria for a client. For example, in order for a service to be selected, certain context information and application level content should be satisfied for the rules. Clients may provide client-specific rules that may be used to select a service for the transaction. In one example, when a transaction is received for a client **102**, adaptive route selector **208** may determine a client's specified selection rules and determine a service that can handle the transaction. In order to switch the transaction to a service provider that provides the service, application level content is determined from the transaction and/or dynamic context information is determined from context information database **224**. The application level content and/or context information is applied to the rules to determine a service provider that can process the transaction according to the rules. For example, based on certain factors, such as costs, clients **102** may specify that the cheapest service should be selected first, but if not available, a second more expensive service should be selected. Also, based on application level content, such as account numbers, transactions may be switched to a certain credit card service. For example, certain account numbers may indicate a credit vs. debit card, or that a particular points or awards system applies. Other account numbers or fields could indicate a need for other services, such as money transfer or password verification (e.g., Verified by Visa). Also, the application level content may include the location of the client and any regional or country-specific regulations that dictate if the transaction needs to be processed locally or sent to a processor **108** in a different country.

The services may also include a service specification that specifies rules for the service. For example, the rules may specify the message format required for transactions, the network addresses of transaction processors **108** that provide the service, preferences for switching transactions to transaction processors **108**, the range of account numbers that qualify for the service, etc. These rules are provided by a service provider upon registration, as discussed in more detail below. The service provider may directly load the rules on gateway **104**, which would then publish the rules to other interested gateways.

The rules may specify flows that can process the transaction. The flows handle processing of the transaction for sending to a transaction processor **108**. The message is then sent to a selected flow handler **210**. After the transaction processor **108** and network **106** are selected, flow handler **210** may perform business services on the transaction. For example, different transaction processors **108** may process transactions in different formats. Flow handler **210** may determine the appropriate format for the selected transaction processor **108** and format the transaction in that format. Other business services may include currency-conversions, encrypting sensitive fields, client side stand-in processing for transaction values below a certain threshold, etc.

Flow handler **210** may include a plurality of flows. Each flow may handle a set of business services that process a class of messages. Each flow includes a flow handler that coordinates all the business services in the flow. A sequence of services within a flow is specified by a flow specification, which can be loaded at run time using configuration loader **220**. The flow specification is the sequence of services that determines how the incoming message is handled. Each service is a software application code that performs a specific function. New services and flow specifications can be loaded dynamically to gateway **104**.

After flow handler **210** processes the transaction in a flow, the message is sent to an outbound message stream builder **212**. Builder **212** is configured to build an outbound message from a canonical format based on a message form expected by the determined transaction processor **108**. Builder **212** is thus configured to generate a message in any message format based on the canonical message format. Outbound message stream builder **212** is described in more detail below.

Message dispatcher **212** is configured to send a transaction to a transaction processor **108**. Dispatcher **214** may ensure that a transaction reaches the selected transaction processor **108**. It may manage connections to various transaction processors **108**, attempt to reconnect to failed transaction processors **108**, and also provide the status of transaction processors **108** and networks **106** to dynamic information monitor **226**. In one embodiment, the transaction may be packetized, i.e., broken up into a series of packets and sent to a router. The router may route the packets through network **106** to the transaction processor **108**.

A coordinator **216** is provided to coordinate the processes of gateway **104** and to ensure transactions are properly processed. Also, coordinator **216** provides services for application management, software distribution, system monitoring and failover capabilities to gateway **104**. Application management supports starting and stopping of applications and services locally and remotely. It also allows new applications and services to be added to gateway **104**. Software distribution enables software updates to be installed on gateway **104**, and includes support for rolling back updates if necessary. System monitoring service monitors key parameters of system components such as memory, CPU, network interfaces, and processes, and generates alerts if the configured parameters deviate from threshold values. It also restarts a process if it detects a process failure. Coordinator **216** also monitors the health of a peer gateway **104** using a heart-beat mechanism (in case of a multi-gateway cluster deployment), and takes over the processing load of the peer gateway **104** if the peer gateway **104** fails.

Dynamic Loading of Rules

After initial registration of a service (described below), the rules and business services performed by gateway **104** may be dynamically changed. Administration module **218** and configuration loader **220** are configured to dynamically load changes to rules database **222** and flow handler **210**.

Configuration loader **220** is configured to load a configuration changes, routing rules, new flow specifications, etc. into rules database **222** at run time. Accordingly, configuration loader **220** allows the dynamic reconfiguration of routing rules in rules database **222**. The rule-base maintains multiple versions of the rule-objects and has a synchronized reference to the current version of the rule-base. Before configuration loader **220** loads updates to the rule-base, it creates a shadow copy of the active rule-base and versions it. Then, for every object that is updated, it creates a new instance of the object and updates the reference in the new

version of the rule-base. When all the updates are completed, it changes the reference to point to the new version of the rule-base.

Administration module **218** is configured to allow for administrative actions to be performed. Administration module **218** may be used by a user agent to administer one or more gateways **104**. For example, administration module **218** may be used to define new rules into rule database **222** or change routing rules dynamically. Also, administration module **218** may also be used to load and unload new flow specifications for flow handler **210**, start and stop business services, and load and unload configurations. Configuration loader **220** is then configured to perform the changes.

The dynamic changes of embodiments of the invention are made possible by the combination of modularization of services and the run-time invocation of services for processing messages through a flow (e.g., see description of flows above). When a new transaction is received by adaptive route selector **208**, it reads the current version of the rule-base and applies the rules to select the appropriate flow. Since the flow handler **210** uses a specific version of a flow for the entire life of the transaction, and each flow specification refers to a specific versions of services, flows and rules. Thus, they can be updated without interfering with an existing transaction at that time because the updates are effected in a different version than the version being currently used by existing transactions.

Processing of a Transaction

FIG. **3** depicts a simplified flowchart **300** of a method for processing a transaction according to one embodiment of the present invention. In step **302**, a transaction is received from a client **102**. The transaction may be any type of transaction such as credit card authorization, check card transaction, etc.

In step **304**, application level content is determined for the transaction. As mentioned above, the application level content is used to process the transaction. For example, the application level content may be credit card number, PIN, the name of a member bank (enquirer or issuer), etc. The application level content may be considered as a whole. For example, if the transaction was packetized into a number of packets, the application level content may be found in a payload of multiple packets. This information may be reassembled into the application level content for the transaction.

In step **306**, the current state of the transport environment is determined. For example, the health of a transaction processor that can provide the services determined. Further, the network health for networks **106** that can route the transaction may also be determined. This information may be determined in real-time to provide the current state of the transport environment.

In step **308**, rules are applied to the application level information and/or current state of the transport environment to determine a service. For example, certain clients **102** may be associated with certain services. A processor host such as Visa may desire that its transactions be switched to transaction processors **108** that are owned by Visa. Further, other processor hosts may desire that their transactions be switched to a secondary transaction processor, such as Vital.

In step **310**, rules are applied to determine a transaction processor and/or network **106** in which to switch the transaction for the service. This decision may be determined based on the application level content and/or the current state on the transport environment as applied to the rules. For example, a service to process the transaction is determined. Then, an applicable transaction processor **108** is determined based on network availability.

Also, a service may also be associated with various transaction processors **108** and networks **106**. For example, credit card authorizations may be configured to be sent to certain transaction processors **108**. Further, check card transactions may be configured to be sent to a second set of transaction processors **108**. These rules are determined for the client and/or transaction service.

In step **312**, any business services may be performed at the application level on the transaction as required. For example, a transaction may be formatted into a format expected by the selected transaction processor **108**, any information at the application level may be added to the transaction, or any other business services may be performed.

In step **314**, the transaction may be switched to the selected transaction processor **108** through network **106**.

Alternatively, in another embodiment, gateway **104** is configured to process the transaction without switching the transaction to a service provider. A service provider may specify rules that state gateway **104** can process transactions if certain criteria are met. For example, if the transaction is lower than a certain amount. In one example, credit card transactions less than a threshold amount could be approved, not only without having to go to the bank for approval, but also without having to go over network **106** to a credit card company. This offers many advantages as transactions can be processed at the edge of the network. This eliminates network bottlenecks and provides a decentralized processing system.

Service Creation and Subscription

As mentioned above, rules may be dynamically loaded into rules database **222**. FIG. **4** depicts a simplified flowchart **400** for loading rules in gateway **104** for a service offered by transaction processor **108** according to one embodiment of the present invention. In step **402**, a service creation request is received. For example, a service provider may try to register a service by sending a service creation request that specifies a service that is being offered by the service provider. Alternately, a gateway **104** associated with a transaction processor or other service provider may dynamically advertise new services, and a gateway associated with a client can determine whether to initiate a registration for those new services. A new service might be a money transfer service, a new points program, etc.

In step **404**, rules for the service are received. For example, the rules may specify addresses for transaction processors **108** that can process the service. The network addresses may be IP addresses or any other identifiers that can be used to route transactions to transaction processors **108**. Additionally, information for networks **106** that can be used to route the request to the transaction processors **108** may also be received. The rules may also specify criteria for using the service. For example, criteria specifying the format messages are expected to be received in, the costs of using the service (both fixed and per-transaction costs), and any other criteria for using the service may be received. The rules could specify which types of cards, or types of accounts or account number ranges qualify or are registered for the service.

In step **406**, rules for the service are dynamically loaded into rules database **222** by administration module **218** using configuration loader **220**. Further, any flow specifications that are needed to process transactions for the service may be loaded into flow handler **202**.

Accordingly, when the service has been created and published, clients **108** may subscribe to the services. FIG. **5** depicts a simplified flowchart **500** of a method for subscrib-

ing to a service according to one embodiment of the present invention. In step **502**, a request is received from a client **108** to subscribe to a created service. The request may be received through a web portal or by any other methods. Clients **102** may contact and access gateway **104** directly.

In step **504**, a specification for rules or criteria for using a service is received from client **108**. This specification may indicate criteria that are needed to select the service for a transaction received from client **108**. The criteria may be client-specific or may be uniform across many clients **108** (e.g., for all POS devices for an entity). Also, the specification may be in the form of a priority for each service subscribed to by the client **108**. For example, a client may specify that, for a transaction, a first service is selected, but, if that service is not working, then a second service should be selected, etc. The criteria may also be more complicated and include more complex rules that factor in the network costs, service costs, etc.

In step **506**, rules for routing the requests for the service are generated. These rules may specify criteria that need to be satisfied based on application level content and/or the current state of the network transport environment in order for the service to be selected.

In step **508**, these rules may be dynamically loaded into rules database **222**. Accordingly, a service may be immediately available to a client **108** that subscribes to the service.

In step **510**, flow definitions for the service are generated. Flow definitions may be configured to support the service. In one embodiment, flow definitions for the service may have already existed and may not need to be generated. However, if the specialized business services need to be performed for client **108**, new flow definitions may be generated.

In step **512**, the flow definitions generated in step **510** may be dynamically loaded by configuration loader **220**.

In one embodiment, the rules may be received from a client **102** before a transaction is sent. For example, client **102** may subscribe to a service and provide rules for using the service. In another embodiment, the rules may be sent immediately before or after a transaction is sent. For example, client **102** may specify rules to use in a message sent before or after the transaction. The rules are then dynamically loaded onto gateway **104**. This allows a client **102** to dynamically configure gateway **104** at run-time.

Decentralization of Rules for Services

A plurality of gateways **104** may be deployed in a system. Each gateway **104** can provide its own services to clients **102** it is coupled to. Gateway **104** may be positioned at the edge of network **106**, at a point of client access, and possibly on the physical premise of a client **102**. In one embodiment, gateways **104** only store information for services offered by the gateway **104**. Different gateways **104** may have information for a different set of services. Accordingly, the information for providing various services registered by service providers or subscribed to by clients **102** may be distributed across gateways **104** or is decentralized. Because of the decentralization of information, gateways **104** are configured to contact other gateways **104** to either query for information for a service or to provide information for a service.

FIG. **6** depicts a system **550** showing the decentralized system of gateways **104** according to one embodiment of the present invention. As shown a plurality of clients **102** and gateways **104** are shown. Gateways **104** are located on the edge of one or more networks **106**.

Each gateway **104** may be coupled to one or more clients **102**. For discussion purposes, a single client **102** is shown coupled to a gateway **104** but it will be understood that many clients **102** may be coupled to a gateway **104**. Also, it will be understood that gateways **104** may be coupled to transaction processors **108** instead of clients **102**.

Gateway **104** is configured to process transactions for the clients **102** it is coupled to at the edge of network **106**. For example, gateway **104-1** is configured to process transactions for client **102-1** and gateway **104-2** is configured to process transactions for client **104-2**. Gateway **104-1** stores information for services offered to client **102-1** and also information regarding preferences for client **102-1**. The same is true for other gateways **104** and clients **102**.

Gateways **104** maintain contact information for other gateways **104** to facilitate distribution of information for services. For example, when a first gateway **104** needs information for a service not currently offered by the first gateway **104**, it can contact a second gateway **104** that offers the service to have information, such as the rules for the service, sent to it. In another embodiment, the first gateway **104** may send a transaction for the service to the second gateway **104** where the second gateway **104** can process the transaction. In this case, the second gateway **104** can switch the transaction to a transaction processor **108**, receive a response, and then send the response back to the first gateway **104**.

The contact information may also be used to distribute information for services to other gateways **104**. For example, a service provider may upload a new service on a first gateway **104**. The rules for the service may then be distributed to other gateways **104**. For example, gateways that are coupled to clients **102** at the edge are sent the rules if the clients **102** are interested in the service. Clients **102** can also upload their own rules.

Each client may load only the rules for services it desires, reducing the memory and updating needed, and improving the speed of the gateway processing. For example, a hotel client may want a points or rewards service, but not a money transfer service. By only loading desired services, the hotel could get more information on its gateway without impacting performance. For example, the account numbers, or ranges of account numbers, that are in a points program can be stored on the gateway, so the processing to determine if a user qualifies for points can be done locally. A web site client, on the other hand, might be more interested in the Verified by Visa service. Similarly, information and rules particular to Verified by Visa could be stored locally, such as whether a card member subscribed and has a password, allowing prompting for the password without going out over the network to determine if the user is a subscriber. Certain merchants that do a lot of business with certain corporations may be more interested in the Visa business card, and want local listings of purchase card account numbers that are approved for purchases at that particular merchant.

In this way, clients **102** and service providers may interact directly with gateways **104** to load or request services. This may be advantageous for clients **102** because gateways may be tailored to that client's needs. Further, because a gateway **104** may be maintained at a client's site, the gateway **104** may be accessed easily and without delay.

Accordingly, a decentralized set of services is provided by system **550**. Instead of having a central processor, the processing is distributed to the edge of the network. This eliminates bottlenecks and provides failover protection. For example, conventionally, if a central processor is used and it goes down, then transaction processing for the whole system may be affected. However, if a gateway **104** goes down, processing for the whole system **550** is not affected and transactions may be rerouted to other gateways **104**.

Deployment Scenarios

Gateway **104** may be deployed in many different scenarios. For example, gateway **104** may be deployed as a front-end gateway on a private network, as an Internet gateway, and/or as a wireless gateway. FIG. **7** depicts a system **600** that shows gateway **104** as a front-end gateway according to one embodiment of the present invention. System **600** connects one or more clients **102** to one or more transaction processors **108** across disparate networks **106**. Transaction processors **108** may be any system that can process a transaction from client **102**. For example, Visa, MasterCard, etc. may own transaction processors for credit card and debit card transactions, and a member bank (acquirer/issuer) may be a client **102**.

A client data center **602** may receive transactions from client **102**. The transactions may be credit card authorizations or debit card transactions. The data center may be a central computer connected via a client's private network to multiple POS devices, for example. Gateway **104** processes the transactions and intelligently switches the transactions to a transaction processor data center **108**. For example, if the transaction is a Visa transaction, transaction processor data centers A and B may be associated with Visa. If the transaction is a MasterCard transaction, processor data centers C may be selected because they are associated with MasterCard.

Gateway **104** determines an appropriate transaction processor **108** and network **106** in which to route the transaction. The transaction is then sent to a router **604** which can then route the transaction. In one embodiment, router **604** may route packets to the selected transaction processor **108** through a network **106**.

FIG. **8** depicts a system **700** where gateway **104** is an Internet gateway according to one embodiment of the present invention. An Internet client **702** includes a client **102**. Client **102** may send transactions to gateway **104** through the Internet **704**. Gateway **104** may be configured for particular services needed for on-line shopping, such as normal credit card authorization, password authentication (Verified by Visa), rewards or points processing, etc.

Gateway **104** provides connectivity to different transaction processors **108** for client **102**. Gateway **104** may accept HTTP(s) and other XML-based requests. Based on application level content and the current state of a transport environment, a service and transaction processor **108** may be selected. Because the transaction may have been sent in HTTP or any other XML-based request, gateway **104** may translate the message to a format expected by transaction processor **108** before switching the transaction. For example, transaction processor **108** may require that a message be processed in an ISO 8583 format. Typically, when a POS device processes a transaction, the transaction may be sent in the ISO 8583 format. However, when a transaction is processed by an Internet gateway, an Internet client **702** may not be configured to send an ISO 8583 message. Thus, gateway **104** is configured to format the message into the ISO 8583 format required by transaction processor **108**.

In one example, gateway **104** may process Internet transactions from an Internet client **702**. Internet client **702** sends an HTTP(s) request to gateway **104**. Gateway **104** translates the HTTP(s) request into a canonical internal message format. Any business services may then be performed on the transaction. In one example, application level data may be changed in order to conform to a format required by transaction processor **108**. For example, an XML transaction may be converted into an ISO 8583 format. Gateway **104** then intelligently switches the transaction to a transaction processor **108**.

Transaction processor **108** processes the transaction and sends a response back to gateway **104**. This response may be in a transaction processor-specific format. Gateway **104** then builds an HTTP(s) response and sends it to Internet client **702**. Accordingly, a transaction through the Internet can be processed using gateway **104**.

FIG. **9** depicts a system **800** where gateway **104** is used as a wireless gateway according to one embodiment of the present invention. The gateway may receive wireless messages from a user's mobile phone, PDA, pager, etc. Gateway **104** may be configured to support different wireless formats, such as wireless application protocol (WAP), mobile information device protocol (MIDP), JQME, etc. A MIDlet sends XML format requests over networks such as the global system for mobile communication (GSM) or general packet radio services (GPRS). Gateway **104** may convert inbound request payloads into a canonical internal message format. The internal message format (IMF) may then be processed by business services. The outbound message stream builder **212** converts the IMF to a response payload for sending to a transaction processor **108**. Accordingly, wireless transactions may be processed by gateway **104**.

A wireless transaction will now be described. In one embodiment, a wireless client **808** initiates a wireless payment transaction by sending an XML request over HTTP (s)/GSM/GPRS. Gateway **104** receives the XML request and converts it into a canonical internal message format before processing the request. Application level content in the transaction is used in addition to a current state of the transport environment to switch a transaction to a transaction processor **108**. Depending on the transaction processor **108** selected, flow handler **210** may perform business services on the transaction. The transaction is then sent to a transaction processor **108**.

Transaction processor **108** determines a client bank (or issuer) **802** and routes a message to the issuer **802**. Issuer **802** processes the request and sends a response back to transaction processor **108**. Transaction processor **108** then sends a response (in a transaction processor-specific format) back to acquirer **804**. Gateway **104** receives the response, translates it into an XML format, and sends it to wireless client **808**. Accordingly, gateway **104** is configured to route wireless transaction payments.

FIG. **10** depicts a system **900** for processing ISO 8583 transactions according to one embodiment of the present invention. As shown, an issuer bank **902** and an acquirer bank **904** participate in the transaction. A client computer **102** at an acquirer bank **904** sends an ISO 8583 request to gateway **104**. Gateway **104** uses application level content and the current state of the transport environment in order to select a transaction processor **108** to handle the request. The message is then sent to the selected transaction processor **108** after any business services are performed on the request.

Transaction processor **108** processes the transaction and switches it to the appropriate issuer **902** for authorization. The issuer sends an ISO 8583 back to transaction processor **108**. Transaction processor **108** then sends a response to gateway **104**, which then is sent to client **102** of acquirer bank **102**.

In one example, a transaction processor **108** may not be available. In this case, for example, Processor A, data center **01** may not be available. This may be the preferred processor for a client **102** for the service. Gateway **104** then sends the transaction to a second processor, Processor A, data center

02. Gateway **104** may keep checking for the availability of the primary data center and, once it becomes available, may start routing messages to the primary data center. The re-routing of transactions is done in a manner that is transparent to client **102**. Accordingly, down time for any transaction processors **108** is avoided using the intelligent switching of gateway **104**.

In another embodiment, the data centers for Processor A may be down and other data centers for other processors, such as Processors B and C, may need to be used. Processors B and C may process transactions in a different format than that of Processor A. In this case, gateway **104** may convert the format of the transaction to a format that corresponds to a format for processor B or processor C. The formatted transaction is then sent to processor B or processor C. Accordingly, different processors can be used in a way that is transparent to clients **102**. Even if processors use different formats, gateway **104** is configured to still route the transaction in that format.

Parse/Build of Messages

Overview of Parse Build Engine

FIG. **11** depicts a system **1000** for parsing messages according to one embodiment of the present invention. System **1000** is configured to parse multi-format message streams, such as ISO 8583 messages into a canonical message format referred to as an internal message format (IMF) and build multi-format message streams, such as ISO 8583 message streams, from the IMF. Although financial message streams are described, it will be understood that any multi-format message streams may be parsed and built using system **1000**.

Parse/build engine **1004** corresponds to inbound message stream parser **204** and outbound message stream builder **212** of FIG. **2** Although all the components as shown in FIG. **2** are not shown in FIG. **11**, it will be understood that those components may also be included in system **1000**. Additionally, parse/build engine **1004** may be included in gateway **104**, but may also be included in other components. For example, parse/build engine **1004** may be compatible with any software applications that processes data in a data format different from other heterogeneous systems.

Parse/build engine **1004** is configured to receive an input message stream **1010** from a system **1006** and parse the message into an internal message format. The internal message format (IMF) may then be processed by other components, such as a business services application shown in gateway **104**. After components in gateway **104** process the message in the IMF, parse/build engine **1004** builds an output message stream **1012** from the processed IMF. The output message stream **1012** may then be sent to a system **1008**, or returned to originating system **1006**.

Systems **1006** and **1008** may be any system that is configured to send messages **1010** and/or receive messages **1012** from parse/build engine **1004** (or gateway **104**). In one embodiment, systems **1006** and **1008** may be point of sale devices, smart card devices, transaction processors **108**, any system configured to process transactions, such as an acquirer, issuer, a service provider, a transaction authenticator, etc. Systems **1006** and **1008** may send/receive messages in many different formats such as ISO 8583 messages, extensible mark-up language (XML), HTML, etc. The input message stream may also be in any of multiple encoding schemes, such as ASCII, EBCDIC, BCD, etc., and have different data types, such as numeric, string, byte-array etc.

The parse/build engine of FIG. **11** uses a schema table **1028**. Each schema is a data structure that provides metadata, including a grammar structure for the received format as well as pointers to handlers in handler table **1030**. The handlers correspond to particular fields in the message and convert the different fields of the message into the internal message format using the grammar structure. The handlers are code that is individually compiled. Thus, rather than compiling the overall system, the handlers are separately compiled, giving the speed of compiled software while retaining a modular system that can be easily upgraded without disturbing other elements of the engine.

Parse/build engine **1004** loads the identified schema and invokes the functionality of handlers associated with the schema. The handlers then parse the fields of a message into an IMF object

The schemas and any associated handlers not already loaded, may be loaded from schema definition file **1026** into schema table **1028** and handler table **1030** using the schema loader **1024**. Schema table **1026** includes various schemas, labeled schema name **1**, name **2**, . . . , name N. For each message format that may be parsed and built by parse/build engine **1004**, a corresponding schema may be provided. Each schema name is associated with a schema object that defines the "grammar," the composition of a message stream in the external format. The composition may include a field sequence, field type, length, character encoding, and other fields that are optional or required. The new schema and compiled handlers may be loaded and used by parse/build engine **1004** without recompiling parse/build engine **1004**.

Parse/Build Flow

An example flow will now be described. As shown in FIG. **11**, when a message is received, a business services program calls the parse/build engine **1004**. The message **1010** (a message stream in wire format) is sent to the parse/build engine, where it is first received by parser component **1016**. The business services application also provides the schema name **1011** to parser component **1016**. The parser component creates an internal message format (IMF) object in which to store the values from the message fields once they are translated into the IMF. In one embodiment, parser component **1016** recognizes the origin of message **1010** and determines which schema is needed for messages **1010** sent from the origin. In another embodiment, information in message **1010** may be parsed to determine the data format and thus a corresponding schema that should be used. Further, message **1010** may indicate which schema corresponds to the data format.

In one example, the parser component **1016** first looks up a root schema corresponding to the format of message detected, such as an ISO 8583 financial message. Such an ISO message may have a bitmap at the beginning which identifies which fields are present. The root schema would point to a handler, which is called and parses a type field to determine what type of message has been received (e.g., authorization message, reconciliation message, etc.). The parser component then looks up the schema for the message type identified, which in turn provides the particular grammar and points to handlers for that message type. Schema and handlers are looked up and called only for the fields actually present in the message. As new fields are identified or pointed to, new schema can be looked up and the corresponding handlers can be called. A particular field could be a composite field with one or more conditions, and the translating or parsing of the conditions can point to additional schema and associated handlers needed, depending on the outcome of the condition.

The IMF object **1018** (described in more detail below) is populated by the called handlers. The only fields populated are the fields corresponding to the fields included in the incoming message.

IMF object **1018** may then be processed by the business software application of gateway **104**. After being processed, IMF object **1018** is sent to build component **1020** along with a schema name for the outbound message stream. Because processing of the processed IMF object **1018** may be performed in a different data format, builder component **1020** is configured to build an output message stream **1012** from the processed IMF object **1018**. The process described above is repeated in reverse, with builder component **1020** looking up a root schema, calling the handler pointed to in order to build the type information in a process that can be reiterated many times. The called handlers build values found in IMF object **1018** into the fields that should be included in output message stream **1012**. Output message stream **1012** may then be sent to system **1008**, which can process the output message stream **1012**.

FIG. **12** illustrates a business services application **1102** that uses the IMF object **1018** to perform any services provided by gateway **104**. Business services application **1102** operates on IMF object **1018**. The operations could include application layer routing, such as determining an issuer bank or processing center to send the message to. Additionally, services may be performed on a message, such as application level formatting of the message stream, logging, time-stamping, creating new fields needed for a reply or further processing, etc. The business services application could do pre-processing for an issuer or financial network, or it could perform local processing that has been offloaded. For example, authorization messages for purchases less than $50 may be approved, and a reply message sent without needing to forward the message to a financial institution for approval. Business services application **1102** is configured to process data in internal message format and not the external formats. Accordingly, business services application **1102** is insulated from any external formats that are used by other systems by parsing the message into the IMF.

IMF Structure

FIG. **13**A depicts a structure for the IMF **1018** according to one embodiment of the present invention. As shown, N fields are provided in IMF **1018**. The fields may be an array of fields where each field can also include any number of child fields, which in turn can include grandchild fields, etc. in a hierarchical structure. For example, Field **1** includes child Fields **1.1**, **1.2**, . . . **1**.N. Fields **1.2**, . . . **1**.N may also include any number of child fields (not shown). When a message if received, only the fields actually used are populated with data.

FIG. **14**B shows the hierarchical format with object ID codes, indices to the field definitions for the fields shown in FIG. **13**A. The OID allows the indexing for various fields in an IMF object **1018**. Field definitions are accessed for fields in IMF object **1018** using the OID. In one embodiment, the OID is an eight-byte number that is represented by the dotted decimal representation shown. The OID for the first field is encoded as **1.0.0**. Any subfields are encoded as **1.1.0**, **1.2.0**, and so on. The second field is encoded as **2.0.0**, with any subfields encoded as **2.1.0**, **2.2.0**, and so on.

Schema Structure

FIG. **13**B shows an example schema. The address of the schema is the first line, the message definition (MessageDef). The schema includes grammar and pointers to handlers for each of the fields in the message. In the example shown, the first field of the message is identified by a Field Definition Object (FieldDef) **1202** with index **1.0.0**. This is also referred to as an OID attribute **1202**. Following the index for this field is the identification of the handler **1204** to be called (HDR). The rest of the elements on that line are the definitions of the grammar for that particular field. These field definitions describe the properties of the field, such as field sequence, field type, length, character encoding, the names of the hander needed, etc. The field definitions may be used to parse/build fields encoded in different encodings like ASCII, EBCDIC, BCD etc., and different data types like numeric, string, byte-array etc. Thus, multi-format message streams may be processed using the message definition. In one embodiment, the schema is metadata in the form of an XML schema.

The field definitions may include a number of attributes. It will be recognized that the attributes depicted in FIG. **13**B are not exhaustive and a person skilled in the art may appreciate that other attributes may be used.

A handler attribute **1204** is the name of the field. A required/optional attribute **1206** indicates whether the field is required or optional in a message. A first data format attribute **1208** is the data format for the value of the field as found in the external format (also referred to as the wire-format). A second data format attribute **1210** is the internal format in which the field is stored in the IMF and processed by the business services.

A custom/not custom attribute **1212** indicates whether the field uses a custom handler or a generic handler to the parsing and building of the field.

A seventh attribute **1214** indicates the handler name that is needed to process the value in the field of the message. The handler takes the value in the identified field in the received message and either parses it into the IMF (for a parser schema) or builds the value from the IMF to an external format (for a builder schema).

An eighth attribute **1216** indicates the number of subfields within the field.

Example Message Fields Used in IMF (Internal Message Format)

FIG. **14**A depicts an example of the fields used for a particular message object **1010** which includes a number of object IDs (Ms) for different fields, OIDs **1.0.0**, **1.1.0**, **1.1.1**, **2.0.0**, **2.2.0**, **4.0.0**, and **4.1.0**. These are the fields pointed to by the schema of FIG. **13**B. Thus, for this example message, only the fields identified in FIG. **14**C would be populated in the message object, which is shown in FIG. **13**A. FIG. **14**B shows a portion of the total hierarchical object IDs for the complete set of fields in the internal message format. As can be seen, message **1010** only includes the portion of these fields that it needs. For example, object IDs **1.2.0**, **3.0.0** and **4.2.0** are not used. Note that these fields may have any number of child fields.

The object IDs provide a fast indexing system into the hierarchical internal message format of the message object shown in FIG. **13**A. This indexing system uses the encoded object IDs (**1.0.0**, etc.), which, for each field used in the received format, index into (point to) the corresponding field of the internal message format. The indices can point directly to fields that are several layers down in a hierarchical structure.

When components of gateway **104** process IMF object **1018**, processing of the unnecessary fields is not performed. Thus, processing speed is increased.

Required fields may also be added to IMF object **1018**. Some fields may be required by business services module **1102** or transaction processors **108**. If it is determined that a field that is necessary to be used is not included in a

received message **1010**, the field may be populated by the business services module for inclusion in the message to be built for retransmission. Thus, the "required" fields in the schema of FIG. **13**B may be added to an IMF object **1018** if not included in message **1010**.

Initializing Parse/Build Engine

FIG. **15** depicts a simplified flowchart **1400** of a method for initializing parse/build engine **1004** upon the start-up of the business services application. In step **1402**, an initialization request is received from the application. The request includes the location of one or more schema definition files **1026**.

In step **1404**, the schemas found in schema definition files **1026** are validated. The schemas are validated by a number of procedures, such as verifying that the correct type of data is referred to, that the handlers identified by the schema actually exist, etc.

In step **1406**, the schemas in schema definition files **1026** are loaded into registry **1022** from disk or other storage repository into DRAM memory using schema loader **1024**.

In step **1408**, any handlers specified in the schema are loaded into registry **1022**. For example, handlers specified by the field definitions in the message definition object are loaded into handler table **1030**. In one embodiment, handlers are stored as objects keyed by the handler name.

In step **1410**, the handlers are bound to the respective message definition objects. For example, all handlers that are specified by field definitions in a message definition object are bound to that message definition object.

Parse/build engine **1004** has now been initialized for the schema. In one embodiment, compiling of parse/build engine **1004** is not necessary. This is because of the use of compiled handlers that are used to parse/build field values.

During run-time, schemas may be dynamically updated and added to parse/build engine **1004**. The schemas may be updated by changing message definition objects or may be added by adding new message definition objects. If new handlers are needed, they may also be dynamically added to parse/build engine **1004** as compiled objects.

The schemas may be added without recompiling parse/build engine **1004** and without bringing it down. Thus, parse/build engine **1004** may continue to parse/build messages even as schemas are updated.

Adding or Updating Schema

FIG. **16** depicts a simplified flowchart **1500** of a method for dynamically adding or updating a schema in parse/build engine **1004** according to one embodiment of the present invention. In step **1502**, a request to dynamically add or update a schema is received from an application. The request includes the location of one or more schema definition files **1026** that include the new or updated schema.

In step **1504**, the schemas found in schema definition files **1026** are validated.

In step **1506**, the schemas in schema definition files **1026** are loaded into registry **1022**. If an updated schema is provided with a set of new field definitions or changed field definitions, only the new or changed field definitions may be loaded into registry **1022**. While adding or updating the schema, the appropriate data structures are write-locked to ensure that in-flight messages being processed are not corrupted as a result of schema change. The in-flight messages continue to use the previous version of the schema while the Schema Loader **1024** loads the updated version of the schema.

In step **1508**, any handlers specified in the message definition object are loaded into registry **1022**. Parse/build engine **1004** may check to determine if any handlers are already present in registry **1022** and may not reload those handlers into registry **1022**. However, if any handlers were changed, the changed handlers are loaded.

In step **1510**, the handlers are bound to the respective message definition objects. In one embodiment, only the new or changed handlers are bound to a message definition object that has been updated. Parse/build engine **1004** has now been dynamically updated.

Flowchart of Parse Process

FIG. **17** depicts a simplified flowchart **1600** of a method for parsing an input message stream **1010** according to one embodiment of the present invention. In step **1602**, a schema for the message is determined. The schema corresponds to a data format that the input message stream **1010** is composed in.

In step **1604**, any handlers for the message definition object are determined from the pointers in the schema.

In step **1606**, the handlers for each field are attached to the field.

In step **1608**, the handler translates the fields of the message. A handler for each field is invoked. The handlers use the field definitions in the schema to translate values of the fields into the IMF. The OID for the field points to both the field definitions in the schema for that field and also points to the corresponding field in the IMF object **1018**.

In one embodiment, parser component **1016** maintains an offset for the fields read in message **1010**. For example, the number of bytes read is stored as an offset. The parser component decrements this offset as each handler is called. When the handlers reach the end of message **1010** (e.g., when the offset equals a certain length), or the last field definition in the message definition object, the parser component knows the translation is complete.

In step **1610**, the translated fields are stored in the corresponding hierarchy of IMF object **1018**. An OID for the field may be used to store the translated values into corresponding positions in a hierarchy in IMF object **1018**.

If the translation above fails at any point, an error may be returned to gateway **104**. The parsing may continue and an IMF object **1018** may be returned. Error flags, however, may be noted in IMF object **1018**.

Flowchart of Build Process

The build process will now be described with respect to FIG. **18**. FIG. **18** depicts a simplified flowchart **1700** of a method for building an output message stream **1012** from an IMF object **1018** according to one embodiment of the present invention. In step **1702**, a schema name and IMF object **1018** are determined. In one embodiment, IMF object **1018** is first determined. The schema name may be determined based on information in IMF object **1018**. For example, the schema name may be stored in information in IMF object **1018**. Also, the schema name may be determined by the channel or destination system in which information in the IMF object **1018** will be sent to.

In step **1704**, a message definition object is used to address the schema in registry **1022**. In step **1706**, any handlers needed for the schema are also determined.

In step **1708**, for each field found in IMF object **1018**, the value from a corresponding field in the hierarchy in the IMF object **1018** is loaded. OIDs for the field are used to access the field definitions.

In step **1710**, the value is translated from the field in IMF object **1018** according to the attributes of the field definition for the field. Accordingly, a value found in the IMF format is translated into a format compatible with another system.

In step **1712**, the built values are composed in corresponding fields of a generated output message stream **1012**.

If a value for a field in an IMF object **1018** is not found for a field required for the external forma, the value for that field in the external message may be set to null or the message generated may simply not have this field in the message. Further, if it is determined that IMF object **1018** should have had this field, then an error may be returned indicating that a field was not found in IMF object **1018**.

Alternatives

The present invention can be implemented in the form of control logic in software or hardware or a combination of both. The control logic may be stored in an information storage medium as a plurality of instructions adapted to direct an information-processing device to perform a set of steps disclosed in embodiment of the present invention. Based on the disclosure and teachings provided herein, a person of ordinary skill in the art will appreciate other ways and/or methods to implement the present invention.

The above description is illustrative but not restrictive. Many variations of the invention will become apparent to those skilled in the art upon review of the disclosure. The scope of the invention should, therefore, be determined not with reference to the above description, but instead should be determined with reference to the pending claims along with their full scope or equivalents.

What is claimed is:

1. A computer-implemented method comprising:

receiving, by a server computer, an input message comprising a plurality of fields;

determining, by the server computer, a schema for the input message;

retrieving, by the server computer, a plurality of handlers based on the schema, wherein each handler is code for building at least one field of a common internal message format object from at least one field of the input message, and wherein each of the plurality of handlers is separately compiled; and

translating, by the server computer, the input message into the common internal message format object using the plurality of handlers.

2. The method of claim **1**, wherein the schema is one of a plurality of schemas, and wherein the method further comprises:

dynamically loading the one of the plurality of schemas without recompiling any other schema in the plurality of schemas.

3. The method of claim **1**, further comprising:

processing the common internal message format object using a business services application; and

modifying a value in a field of the common internal message format object.

4. The method of claim **1**, wherein the schema includes at least one field identified by an object ID, and wherein the object ID is an index that points to a field in the common internal message format object.

5. The method of claim **1**, wherein the input message corresponds to an electronic payment transaction.

6. A computer-implemented method comprising:

transmitting an input message to a server computer, wherein the input message comprises a plurality of fields, and wherein the server computer:

determines a schema for the input message;

retrieves a plurality of handlers based on the schema, wherein each handler is code for building at least one field of a common internal message format object from at least one field of the input message, and wherein each of the plurality of handlers is separately compiled; and

translates the input message into the common internal message format object using the plurality of handlers.

7. The method of claim **6**, wherein the schema is one of a plurality of schemas, and wherein the server computer dynamically loads the one of the plurality of schemas without recompiling any other schema in the plurality of schemas.

8. The method of claim **6**, wherein the server computer processes the common internal message format object using a business services application, and modifies a value in a field of the common internal message format object.

9. The method of claim **6**, wherein the schema includes at least one field identified by an object ID, and wherein the object ID is an index that points to a field in the common internal message format object.

10. The method of claim **6**, wherein the input message corresponds to an electronic payment transaction.

11. A computing device comprising:

a processor; and

a computer readable medium coupled to the processor, wherein the computer readable medium includes code executable by the processor for implementing a method comprising:

receiving an input message comprising a plurality of fields;

determining a schema for the input message;

retrieving a plurality of handlers based on the schema, wherein each handler is code for building at least one field of a common internal message format object from at least one field of the input message, and wherein each of the plurality of handlers is separately compiled; and

translating the input message into the common internal message format object using the plurality of handlers.

12. The computing device of claim **11**, wherein the schema is one of a plurality of schemas, and wherein the method further comprises:

dynamically loading the one of the plurality of schemas without recompiling any other schema in the plurality of schemas.

13. The computing device of claim **11**, wherein the method further comprises:

processing the common internal message format object using a business services application; and

modifying a value in a field of the common internal message format object.

14. The computing device of claim **11**, wherein the schema includes at least one field identified by an object ID, and wherein the object ID is an index that points to a field in the common internal message format object.

15. The computing device of claim **11**, wherein the input message corresponds to an electronic payment transaction.

16. A computing device comprising:

a processor; and

a computer readable medium coupled to the processor, wherein the computer readable medium includes code executable by the processor for implementing a method comprising:

transmitting an input message to a server computer, wherein the input message comprises a plurality of fields, and wherein the server computer:

determines a schema for the input message;

retrieves a plurality of handlers based on the schema, wherein each handler is code for building at least one field of a common internal message format

object from at least one field of the input message, and wherein each of the plurality of handlers is separately compiled; and

translates the input message into the common internal message format object using the plurality of handlers.

17. The computing device of claim **16**, wherein the schema is one of a plurality of schemas, and wherein the server computer dynamically loads the one of the plurality of schemas without recompiling any other schema in the plurality of schemas.

18. The computing device of claim **16**, wherein the server computer processes the common internal message format object using a business services application, and modifies a value in a field of the common internal message format object.

19. The computing device of claim **16**, wherein the schema includes at least one field identified by an object ID, and wherein the object ID is an index that points to a field in the common internal message format object.

20. The computing device of claim **16**, wherein the input message corresponds to an electronic payment transaction.

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