A logical model of the distributed corporate network of an insurance company

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Abstract. In the context of hardware heterogeneity and the use of multi-platform software in insurance companies, it is necessary to develop specific schemes for the implementation of a distributed corporate network. This article proposes a logical model of an information and communications network built in the form of subnetworks of two types: a head office and branches of an insurance company. The proposed recommendations include the application of special adaptive traffic routing and service technologies, overload control through constructing virtual channels and introduction of packet queues optimization policies.

1. Introduction

When designing the information and communications network (ICN) of an insurance company with geographically remote branches, it is necessary to take into account a wide range of recent requirements and trends in the insurance business, among which are [1]:

- Implementation by an increasing number of companies of a reasonable growth strategy with simultaneous improvement of a multichannel sales system, development of information technologies, as well as implementation of a marketing strategy of companies taking into account the latest market trends;
- Transition to distributed data processing and active use of computer network resources, Intranet and Internet;
- Growth of hardware heterogeneity, i.e. the use of servers, workstations, laptops, routers of different classes and manufacturers in networks;
- Non-uniform nature of software used for business purposes, its multiplatformness, integration of software tools based on unified interfaces;
- Effective use of the concept of shared information space to make managerial decisions based on the resources of integrated databases and information repositories;
- Intellectualization of analytical activity in the insurance business and necessity of real-time data processing for prediction, modeling and optimization processes.

Typical systems design processes in standards are described in general terms; therefore, it is necessary to fill them with specific implementation schemes and technical recommendations at various levels of the Open Systems Interconnection Basic Reference Model (OSI), which has recently been superseded by the TCP/IP protocol stack. In this case, designers should definitely take into account the current topology of relations of structural divisions and the insurance company management system.
The issues of the formation of technical solutions of the ICN insurance company with branches for the physical and channel access levels were worked out in [2].

The purpose of this study is to summarize the experience of designing an ICN of an insurance company and building a logical model of a network level with practical recommendations for efficient packet routing and providing high quality service for ICN traffic.

2. Recommended solutions to constructing an information and communications network for an insurance company at the network level

The network level of construction of an information and communications network for an insurance company with branches resolves several important tasks for traffic organization:

- Optimal routing through forming a logical scheme of a network that includes the hierarchy of subnetworks and a harmonious node addressing system;
- Network overload control, peak load smoothing through constructing virtual channels and implementing packet queues optimization and service policies;
- Provision of high-quality service through applying special traffic service technologies (with regard to the traffic circulating in the network of an insurance company).

Let us consider typical requirements for network level organization and recommend solutions for the ICN of an insurance company with due regard to the structure of its traffic. The requirements of the well-accepted documents, such as RFC 990 and RFC 997, should be met while developing logical address schemes for a computer network of any institution. The well-known IP protocol is used to create an IP address. At the same time, the addressing of networks and that one of stand-alone devices in these networks are separated and hold on to sequential addressing to increase the effectiveness of subsequent routing processes. It is based on the separation of the addressing of networks and that one of devices in these networks. And addresses are assigned sequentially in order to make network traffic routing more effective. An IP address consists of a network number and a node number and is chosen by the administrator from preliminarily reserved address blocks 10.0.0.0/8, 172.16.0.0/12, 192.168.0.0/16. The ICN of an average insurance company may contain up to 200 connected nodes, so their addresses can be selected from the range of the second and third address blocks. If the number of nodes exceeds 5000, it is more convenient to use the address range from the first block.

The computer network of an insurance company with branches includes two types of subnetworks: the first one of a central office that forms on the basis of switches the connection of nodes located in departments, groups of an institution and the second one of nodes of branches on remote territories where connection is created through routers (figure 1).

The IP protocol at the inter-network level exchanges datagrams containing IP addresses of a signal source and a destination node and processes them at each node. A datagram destination address found in a routing table is scanned and actions intended to redirect packets are taken. IP routers are connected to several segments of an IP network between which packets should be exchanged and redirected. The routing process is carried out programmatically through an algorithm and by reading routing tables to provide connection between ICN areas [3].

Adaptive routing algorithms capture changes in the configuration of networks and are able to react quickly to topology, update routing tables automatically, take into account the lifetime of the Time ToLive route (TTL), interact with route servers according to the Next Hop Resolution Protocol (NHRP), without generating intensive additional service information traffic.

When choosing a type of routing for an insurance company, one shall take into account the configuration of a network, the number of nodes, a method of connection to the provider's network [4, 5]. Considering that both internal communication and external provider channels are involved when entering an insurance company's branches, it is advisable to use dynamic routing in the internal network of a head office and static routing outside the ICN.
Static routing is suitable for remote networks of an insurance company's branches, is manually configured by the administrator for each router and is more secure, but this network cannot scale well. It is better to combine it with dynamic routing implemented in the central office.

**Figure 1.** Structure of an insurance company with remote branches and its.

Dynamic routing protocols divide network information by exchanging data between routers, find networks and plot routes, creating and maintaining routing tables on the basis of which the router switches an incoming packet from an input interface to an output one. Rational routes are determined on the basis of metrics. If network configuration is changed, convergence time (information negotiation time in routing tables) must be minimal.

Routing tables are used to record information important for the construction of an optimal route: a network address or a destination node, or an indication that a route is a default one; a destination network bit mask that determines which part of a node IP address relates to a network address and which one relates to a node address in this network; a gateway indicating a router address in the network to which a packet should be sent (the packet being directed to a specified destination address; an interface (depending on a system, it may be a serial number, a GUID or a device's symbolic name); metrics are a numerical indicator that specifies route preference as a distance.

The second task implemented at the network level is to eliminate the possibility of overloading ICN infrastructure devices with packets [6]. Its resolution involves network load management through implementing several effective mechanisms: creation of additional virtual channels for data transfer that determine network switching node addresses without attaching transfer means, and after a load fall in the network, a virtual channel is released in response to the "disconnect" signal; creation and application of packet queues and service policies; packet lifetime management that includes the determination of optimal time for a packet to travel across the network before it is ignored by the router to avoid network congestion (too long time), or a failure to reach a destination and the necessity of retransferring the packet (too short time); choice of a routing algorithm.

The third task is to ensure the quality of ICN traffic service, which depends mainly on the structure of this traffic [7]. For an insurance company, the circulating traffic can be segmented into the following types:
• Transfer of a file stream;
• Remote transactions to the server and distributed processing;
• Multimedia processing (video, audio, images, graphics);
• E-mail message stream;
• Broadcast video stream (video conferencing with branches and units);
• Telephony;
• Access to Web objects.

Audio, video, telephony and transaction traffic is the most demanding task in terms of ICN synchronization and capacity. It is possible to achieve the high quality of service when implementing special technologies and mechanisms in the ICN of an insurance company, such as the organization of priority queues, use of overlapping capacity, differential service and application of the Resource Reservation Protocol (RSVP).

Figure 2 shows an alternate scheme of the ICN of an insurance company with remote branches. Network addresses presented in the scheme are assigned according to the CIDR classless inter-domain routing protocol.

Figure 2. Network-level logical model of the ICN of an insurance company with branches.

Each subnetwork has its own address and bit mask. The Network Address Translation (NAT) protocol is used to distinguish internal networks from provider ones. Since traffic moves from a corporate network to a provider one, a private source address in each packet is instantly translated into a public address according to the NAT protocol.

In order to eliminate any overloads in an insurance company's network, it is recommended to use switched virtual channels on routers in conjunction with the RSVP. This protocol allows network resources to be effectively redistributed when the number of priority flows is small and they require a moderate bandwidth. This is typical for the information and communications network of an insurance company. A data source, such as a server application, sends a command including a thread identifier
that ensures that the router can establish the belonging of datagrams to a particular session. This command also generates a description of an expected data stream (for example, its volume). A routing algorithm depends on the ability of routers to distribute packet flows over lines depending on their load at a given time point and is chosen automatically.

3. Conclusions

Solutions intended to organize the network-level OSI reference model of the information and communications infrastructure of an insurance company with territorially remote branches were proposed.

The logical model of a computer network consists of the subnetwork of a central office that brings together unit nodes on the basis of switches and that of branch nodes that are connected to the central office through routers using the provider's communication channels. The ICN logical address scheme was developed in accordance with the RFC 990 and RFC 997 recommendations, and addresses are assigned sequentially to improve traffic routing. It is recommended to use an adaptive routing algorithm that adjusts to the network configuration, updates routing tables automatically, takes into account the lifetime of a route and interacts with servers on-line.

The task of ICN load management can be resolved by organizing additional virtual channels, generating and applying packet queues and service policies, managing the lifetime of packets and selecting a dynamic routing algorithm.

The quality of traffic service is achieved by implementing the mechanism of priority queues in an insurance company's network, using overlapping capacity, differential service and applying the RSVP protocol.

The proposed recommendations allow us to take into account the technical design peculiarities of a logical scheme of an insurance company's distributed corporate network in connection with subsequent levels of a reference model.

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