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To present the new structure to better manage and control requests in the national information network based SDN architecture

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Abstract

National Information Network is a network of communication infrastructure and data centers which ordinary users and government officials can have access to the data network anywhere in the country and the main purpose of creating these types of networks is reducing internet dependence on abroad. The key concerns of this type of network is how to control and manage requests e as much as possible so that they can respond to requests in the country and their request structure should also be complied with international structure that can simultaneously support the requests within the network and global that in this paper, we have provided a new structure for better management and control in these networks provide that can simultaneously support internal and external requests and it uses one IP to access internal data and the Internet and defined controllers in this structure can also communicate with the Internet in a way that their structure is similar together, because in the central controller, new structure converts internal requests to the Internet structure and vice versa that with the possibility of conversion requests, other previous concerns will be resolved.

Keywords: National Information Network, SDN Architecture, Controller, Data Center

Introduction:

National Information Network is a network that has established from communication infrastructure, software and data centers which has been spread across the country and this network has the capacity to provide national information network in order to develop electronic services and more convenient high-speed access to the Internet. This network is composed of two parts: public and specific sectors that specific sector is dedicated to the exchange of information between organizations and public sector is dedicated to providing services to public users. In recent years, many countries for high security of their data thought to at least minimize their Internet connection to abroad and reduce their internet dependence on abroad. This thought led to bring these countries to the national network. Now, the national information networks is designed based on MPLS and hierarchical architecture that the survey has shown that these networks have many problems and as regards in [7] also is stated that the current internet capacity due to the rapid growth of Internet users and many requests and new services that are provided are not accountable or existing networks for computing and data storage has used improper tree structure that this structure does not meet the customers' needs on a very large scale. These problems led the related authorities thought to review the network architecture so that they introduced SDN as new architecture, and from now all governments and individuals involved in network thought to lead their networks architecture networks towards this new architecture to be able to use the new architecture to remove many existing problems in old architecture. Given that in the SDN architecture, network control is separated from traffic and can be programmed directly, we can make a lot of changes using the controller design possibility in this type of networks. Our designed structure which is the main objective of this research is in the way that first we have stored all the information in data centers in the provinces and each province has a provincial data center and a controller that each provincial controller is connected to the controller of neighboring provinces and the central controller and exchanges the information and has access to information for each of the data centers, first, the license must be issued by the province controller which information refers to the data center of that province and any access to data centers is only given to controller and controller sends response to applicant and each provincial controller supports its topology so that each node for each controller to access information and communicate with other nodes must first send its request to the its relevant controller and the controller detects an request to be answered by which data center. In this paper, first we will review the national information network architecture and SDN in section 2 and 3, introduce the new structure in section 4, compare in section 5 and also conclude in section 6.

2. National information network

National information network is one of the requirements of society in such a way that in some countries for the high security of their data and they escape the threat of global power in the terms of Interne sanction, they thought to design national information network (but the name of the network is different in various countries). For example, in Australia [1] in 2009, the National Broadband Network (NBN) has started across Australia that this is the largest project in the history of Australia and has the huge cost that it is applying to connect to high-speed broadband and enhance productivity to improve the development of education, health and development issues, connect people to local and global data, eliminating dependency on external connections and offer a high quality service. There are a lot of services that can be provided in national information network , most notably telecommunications services, switching architectures which are still presenting in many networks and services such as e-mail, the Internet, providing high speed services to consumers, allowing seekers have access to search their needs, supporting high speed video and audio services, etc. [2]. Important the national network benefits can be mentioned as follows: 1. increase speed, 2. increase reliability, 3. reduce cost of business [3]. Any system

or information network should observe security within it and observed information should also be identified security issues that national information network is also no exception that in [4] has introduced some security issues that are: (1) access control, identification and authentication, 2. awareness and education, 3. audit and accountability, 4. issuing the certificate, official license and evaluation and security and etc. One of the main benefits of a national network is high-speed data access and high-quality services which this has positive impacts on different parts of its own. [5] The impact of such networks on different parts such as: 1. information technology, 2. Communication, 3.electronic health 4. transfers logistics has discussed and as in [6] is also expressed national information network is a development in IT in each country that can be used as a common platform and access infrastructures to IT and IT internal development, especially in terms of economic sanctions plays an important role that all of these enhance the requirement to design this type of network in today's societies day by day. National information network can not only has an impact on information technology but also affects economic growth in various aspects that in [6] has been pointed out some of them as follows: 1. Develop the digital section 2. Sustainable economic growth 3. Develop the domestic IT and change communications.

3. SDN Architecture

Defined network with (SDN) software is a new network architecture that network control and traffic are planned independent of one another and individually and the management was already done by network hardware that was creating a lot of restrictions, but with the change in management idea in SDN architecture that has focused management on the controller level it will cause to enable the machine and network infrastructure to be able to offer new and better services and interact with a new range of applications and greater flexibility of networks with each other [8]. In SDN architecture, intelligent section of network has focused on the controller and all the planning is done in this controller and the controller makes it possible to maintain the overall structure of the network and network in view of application seems to be a logical switch and this architecture facilitates devices and machines work used in network architecture because it does not need to run thousands of protocols and only they receive instructions from the controller and are subject to the controller [8]. In conventional networks, network devices handle data transmission and control functions. Changes in network infrastructure such as adding the final large-scale systems in the real and virtual networks are difficult. SDN is used for functional isolation and controlling network's known devices such as routers and switches interacting via application programming interface (API) between data and control functions [9]. Introducing SDK technology is for planning and reorganization of logical topology of the network [10]. In Figure 1, we have displayed an overview of SDN architecture.

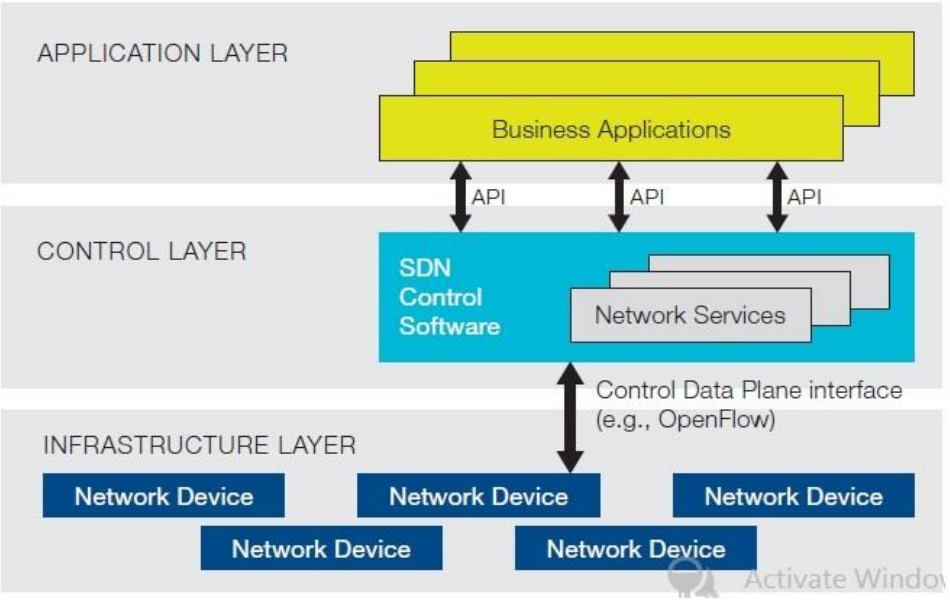


Figure 1: An overview of SDN architecture [8]

3. 1. SDN architecture features

Each architecture is presented with special features that also SDN architecture has its own feature and as in [11] is also stated that these features are:

1. Difficult working of hardware network devices (routers and switches) is much easier.
2. Better traffic engineering and high service quality. As in [12] that provides a new solution to reduce traffic on the network based SDN architecture that according to intelligent programming in the controller could greatly reduce traffic compared to the previous solutions and control network traffic much more technically that represents SDN architecture excellence than past architectures in traffic engineering.
3. It is programmable and continuously monitoring can be done on the network.

4. The new structure for better management and control of requests in the national information network based SDN architecture

Our structure is designed to be the main objective of this study is that first we store information in data centers of the provinces and each province has a data center, and a controller that each provincial controller is connected to the neighboring province controller and the central controller and exchanges information and has access to information for each of the data centers and license must be issued by the province's controller that the information refers to that province's data center and any access to data center is just given to the controller and controller sends response to applicant and each provincial controller supports its own topology such that each node of each controller to access information and communication with other nodes must first send its request to the controller and then the controller will recognize that what request level is that we have here introduced in four levels including: 1- province level, 2- neighboring provinces level, 3- non-contiguous provinces level 4- global Internet. In our new structure, we have divided works so that the applications after determining the level of services are delivered to their respective sections in controller and different parts can be defined in each controller that just do their tasks and do not know other parts duties and these parts are controlled by their own

administrators and each part receives a request that has an obligation to provide the response for request and delivers response to Reply to be sent to the applicant.

4. 1. Overview of new structure

The overall structure is that each provincial controller has its own topology and is connected to its neighboring provinces' controller, the central controller and province's data center and exchanges information. In Figure 2, we have displayed an overview of the structure.

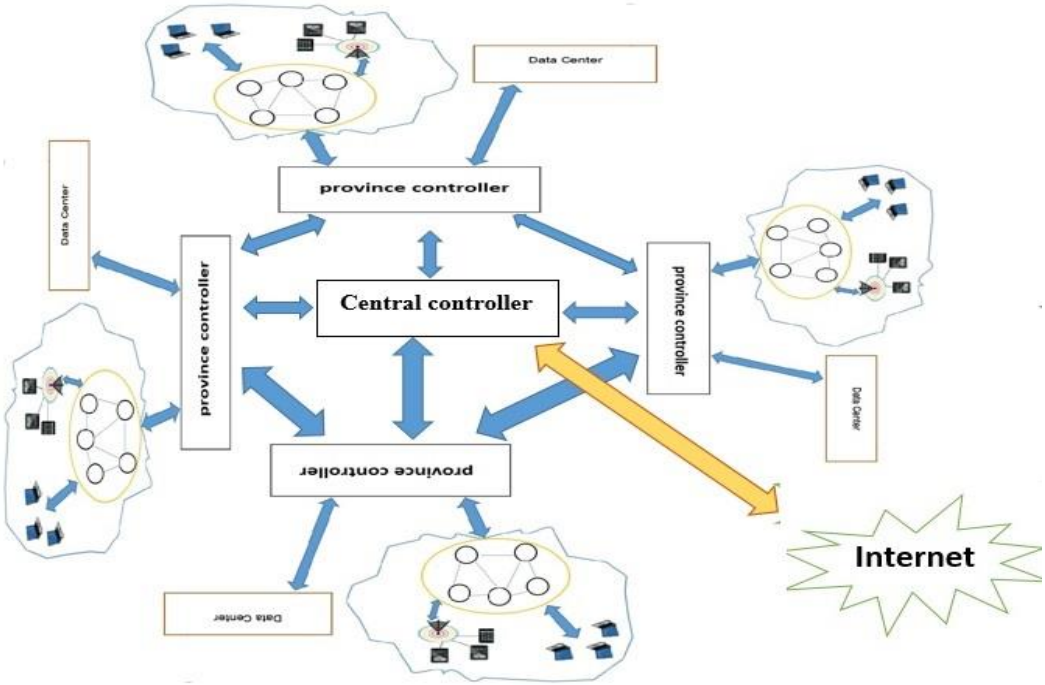


Figure 2: an overview of presented structure

4. 2. Requests structures in the new strategies

Every structure in the network is defined, before it, the structure of requests (packages) must be designed to rout out and manage requests accordingly. We have shown overall structure of requests (packages) on new strategies in Figure3.

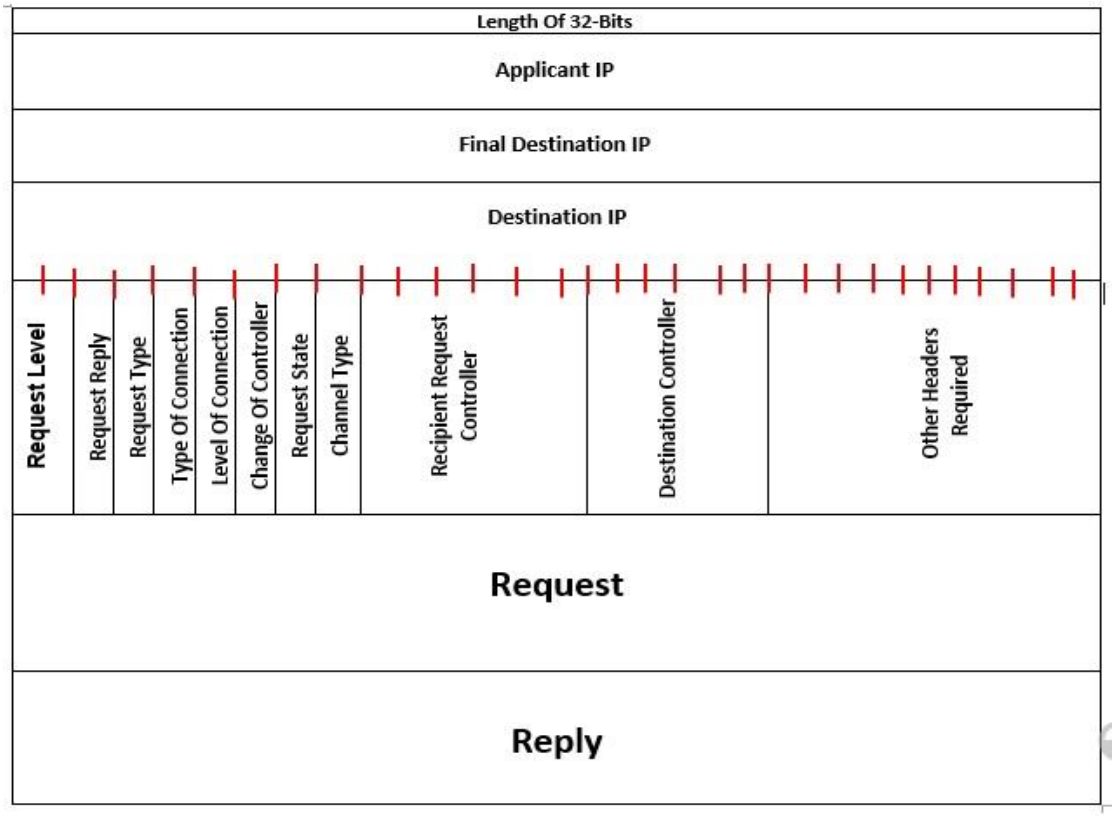


Figure 3: overall structure of requests on new strategies

We here explain every single part of the request structure of new strategy generally:

- **Applicant IP** (32 bits): This is the IP applicant that is stored by its applicant system.
- **Final Destination IP** (32 bits): This is the final destination IP services is identified and stored by controller's DNS.
- **Destination IP** (32 bits): this part is used for routing within network and it is variable. At first state, the first provincial controller address is that applicant can connect to it.
- **Request level** (2 bits): is stored in this part of request level. 0 is equal to province level, 1 for neighboring provinces level, 2 for non- neighboring provinces level and 3 for global level or web.
- **Reply** (1 bit): If 0 means the request has not been answered and if 1 means the request has been answered.
- **Request Type** (1 bit): specifies the type of request. If 0 that will communicate with the data center and if 1 means to communicate with a particular node.

- **Type of Connection** (1 bit): specifies the type of connection. 0 represents constant users and 1 represents the mobile users (mobile).
- **Level of Connection** (1 bit): determines the level of communication and will be determined to identify national and international level at the central controller. If 0 means the national level and if 1 means the global level.
- **Change of Controller** (1 bit): determines the mobile users who have first sent their request through the boundary channels to a province's controller and before they receive their request response, it has gone to boundary channels in another province and links to the prior controller has been cut and the response must be sent to the new controller. If = 0 means that does not change the controller and if it has changed controller is 1.
- **Request State** (1 bit): indicating that the request was sent by the node or communication channels. If 0 that it is sent by node and if 1 by communication channels.
- **Channel Type** (1 bit): indicates the type of communication channel. If 0 that is not a boundary channel and if 1 that it is a boundary channel.
- **Recipient Request Controller** (6 bits): It determines the first controller that has received the request.
- **Destination Controller** (6 bits): this code determines the destination controller.
- **Request**: request is stored in this field.
- **Reply**: the request response is stored in this part.

4. 3. Internal structure of the controller

Each controller has its own internal structure which we have briefly described each of them in this section and have generally explained the internal structure of each controller and have displayed them to get to learn how to manage requests on each of these controllers.

4. 3. 1. Provincial controller

This controller communicates with neighboring provinces controller, the central controller, province's data center and its topology and exchanges information. This controller has internal various parts that support each its own related requests as follows:

1. Request that refer to their respective province.
2. Requests that are related to neighboring provinces
3. Request that are related to the non-neighboring provinces.
4. Request that are related to the Internet.

We have displayed internal view of the controller in Figure 4.

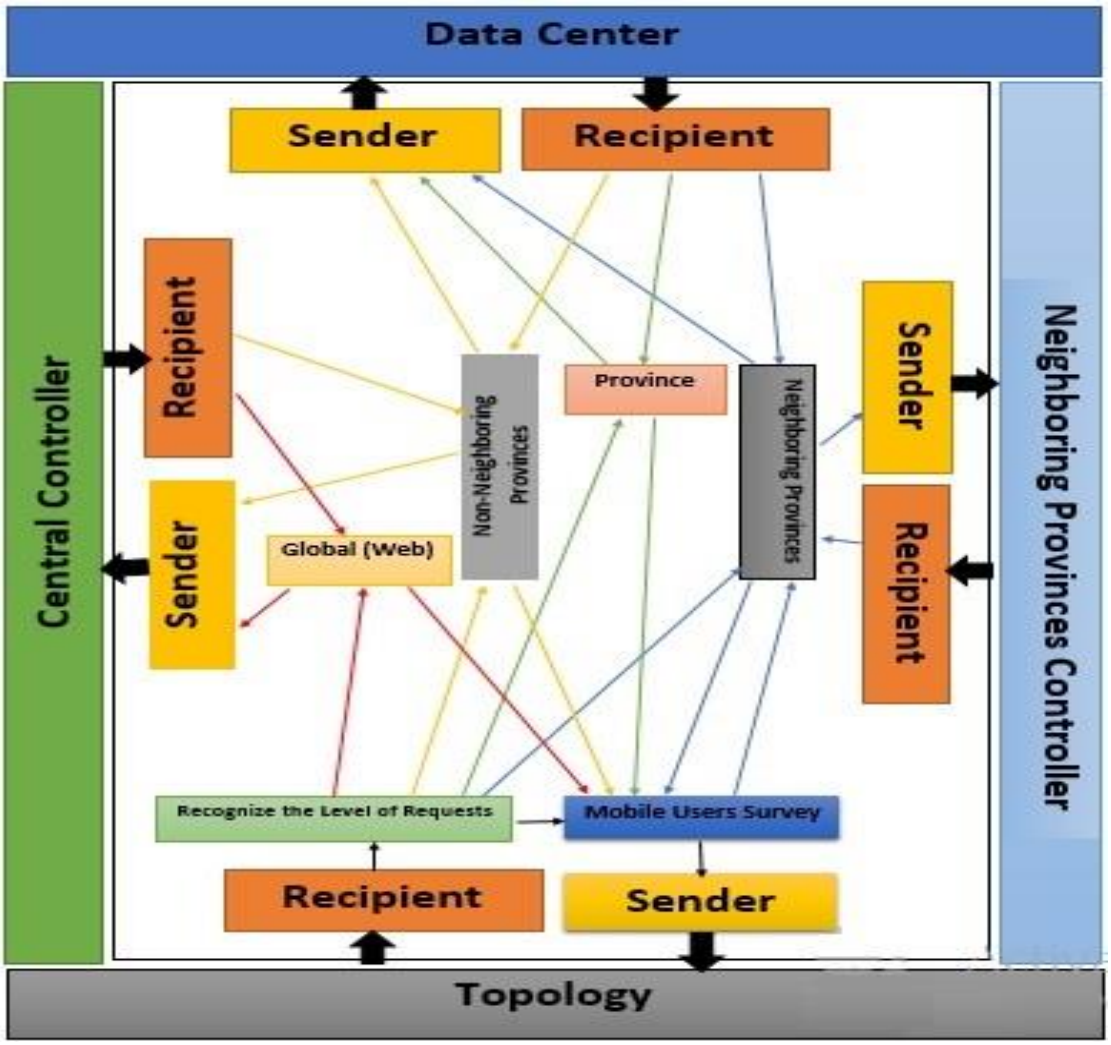


Figure 4: internal view of province's controller

- **To recognize the level of requests**

Here, requests are delivered and, according to specific mechanisms related to the network, it specifies requests level and delivers the requests to the appropriate section. In this section after receiving the request, it determines the request level, the request type, request position, the first request recipient controller and destination controller and adds to the controller to define and delivers request to the appropriate section**.**

- **Province**

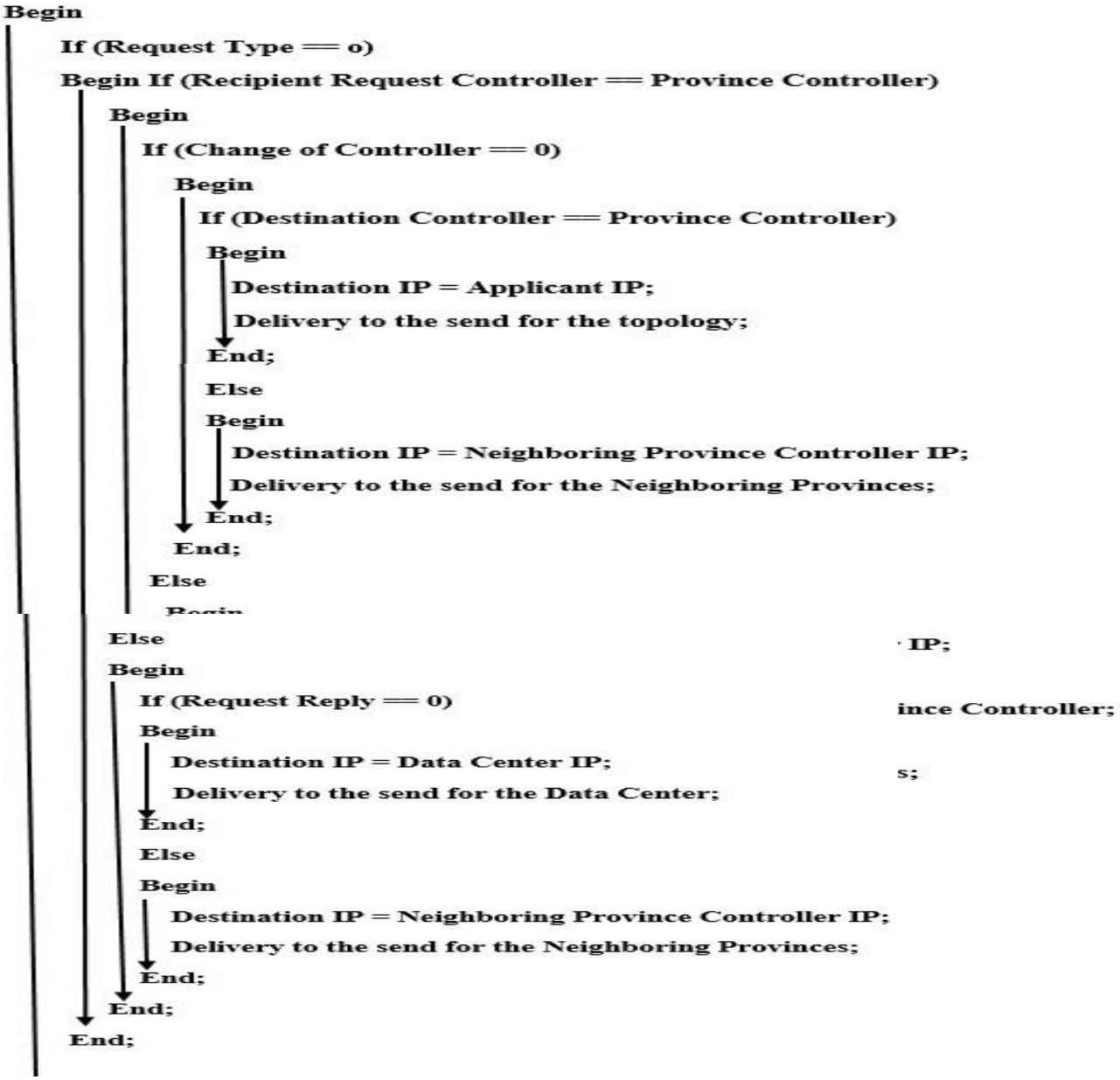
This section delivers that all of the requests are related to province (the province can answer) and after a series of investigations, it sends requests to data centers and receives transferred message from province's data center and delivers it to related sender section to transfer to applicant. We have represented the algorithm of province level in Figure 5.

```
Begin
    If (Request Type == 0)
    Begin
        If (Request Reply == 0)
        Begin
            Destination IP = Data Center IP;
            Delivery to the send for the Data Center;
        End;
        Else
        Begin
            Destination IP = Applicant IP;
            Delivery to the send for the topology;
        End;
    End;
    Else
    Begin
        Destination IP = Final Destination IP;
        Delivery to the send for the topology;
    End;
End.
```

Figure 5: algorithm of province level

➢ Neighboring provinces

At this point, the neighboring provinces controller, province's controller and data center receive the requests and send to the destination. Figure 6 shows algorithm in the neighboring provinces.


Begin
If (Request Type == o)
Begin If (Recipient Request Controller == Province Controller)
Begin
If (Change of Controller == 0)
Begin
If (Destination Controller == Province Controller)
Begin
Destination IP = Applicant IP;
Delivery to the send for the topology;
End;
Else
Begin
Destination IP = Neighboring Province Controller IP;
Delivery to the send for the Neighboring Provinces;
End;
End;
Else
Else
Begin
If (Request Reply == 0)
Begin
Destination IP = Data Center IP;
Delivery to the send for the Data Center;
End;
Else
Begin
Destination IP = Neighboring Province Controller IP;
Delivery to the send for the Neighboring Provinces;
End;
End;
End;

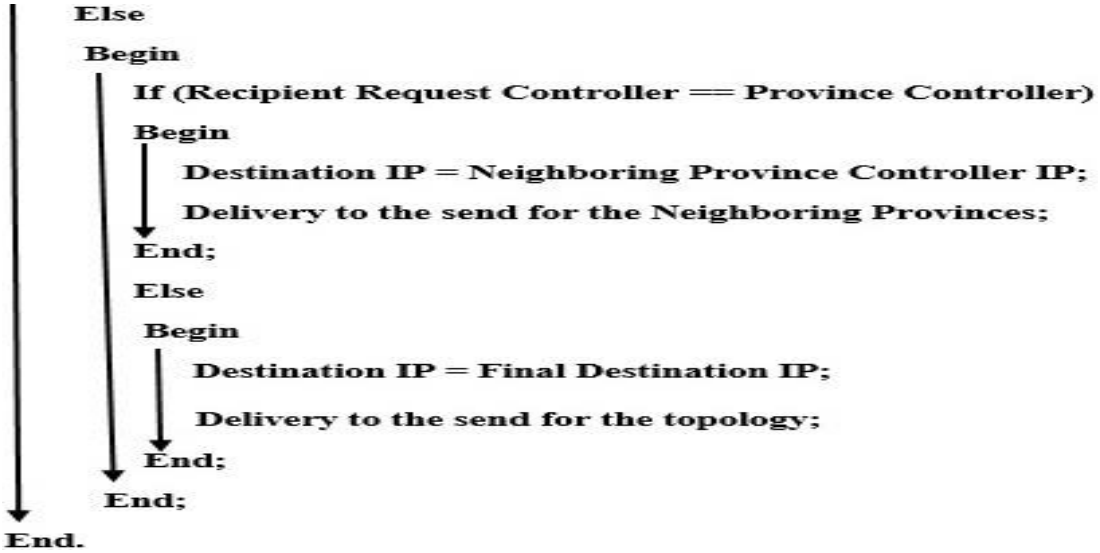


Figure 6 (B): the second part of neighboring provinces algorithm

- **Non- neighboring provinces**

In this section on the behalf of the central controller, the province's controller and data center receives the requests and sends to its destination. Figure 7 shows the algorithm of non-neighboring provinces.

```
Begin
  If (Request Type == 0)
Begin
    If (Recipient Request Controller == Province Controller)
    Begin
        If (Destination Controller! = Province Controller)
        Begin
          Destination IP = Central Controller IP;
          Delivery to the send for the Central Controller;
        End;
        Else
        Begin
          Destination IP = Applicant IP;
          Delivery to the send for the topology;
        End;
    End;
    Else
    Begin
        If (Request Reply == 0)
        Begin
          Destination IP = Data Center IP;
          Delivery to the send for the Data Center;
        End;
        Else
  Else
  Begin                                                    oller;
    If (Recipient Request Controller == Province Controller)
    Begin
      Destination IP = Central Controller IP;
      Destination controller = Non-Neighboring Province Controller;
      Delivery to the send for the Central Controller;
    End;
    Else
    Begin
       Destination IP = Final Destination IP;
       Delivery to the send for the topology;
    End;
  End;
End.
```

It receives all requests which were not on the national level and delivers directly to the central controller to be connected to the Internet by central controller and then it receives again the response from the central controller and sends it to the applicant**.**

- **Mobile Users Survey**

Some mobile applicants send their requests through cell phones to the provinces controller and before they receive the response, it has been got out of range of the province's controller and has been transferred to the range of the another provincial controller, if their request response is sent to the previous province's controller, in such cases, the boundary channels that mobile users through which have sent their requests to the province's controller and have left the confines of the channel and have entered to the range of the next channel, which is connected to the controller of other province, has stored requests in a list and has sent IP and code of new province to the province's controller as long as response reaches to the controller, there is no mistake and they transfer response to new controller. Figure 8 shows the algorithm of the study of mobile users**.**

```
Begin
  If (Type of Connection == 1)
  Begin
    If (Channel Type == 1)
    Begin
      M = the search result shows the change in the database of IP addresses change controller;
      If (M == True)
      Begin
        Change of Controller = 1;
        Request Level = 1;
        Destination Controller = Neighboring Province Controller;
        Remove the profile from the list;
        Delivery to the Neighboring Provinces;
      End;
      Else
        Delivery to the send for the topology;
    End;
    Else
      Delivery to the send for the topology;
  End;|
   Else
     Delivery to the send for the topology;
End.
```

Figure 8: algorithm of the study of mobile users

4. 3. 1. Central controller

This controller is an interface between all controllers with each other and the Internet. We have displayed the internal structure of central controller in Figure 9.

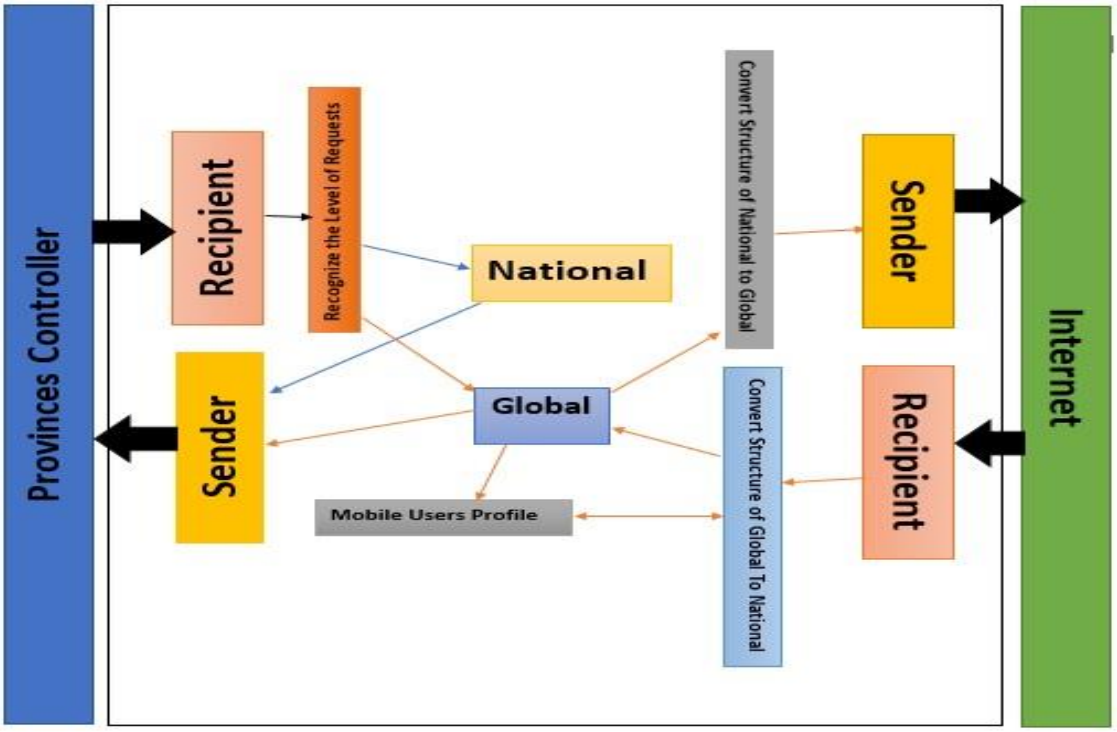


Figure 9: internal structure of central controller

There are two main parts in this controller:

1. The national requests 2. Global Requests

• The national requests

This part receives all the national requests and, according to the code of destination controller available on request, chooses destination controller address and sends to the related controller.

• Global Requests

This part receives all requests that are global and are transferred through the controllers and Internet. Central controller is the most sensitive in this part, because it should be able to change a national request to universal structure and vice versa. The part does not have any problem to become a national request; but to the contrary, it has a fundamental problem, mobile users create a major problem to convert global structures to national structure that we've also taken a choice here in the way that first it considers requests delivered to the global part and if the request is owned by mobile users, it stores applicant IP, controller code of the first recipient of the requests, channel type in a list and then changes the request to the global structure until request to be also accepted on the Internet and it checks on the list to return first, and if the destination IP is on mobile users list, all information stored in the list has been added to the structure to not to be confused with routing within the controller.

5. Compare the new structure with the old structure

We have paid attention to compare the new structure with the old structure (in Iran). In the previous structure of the national network's information, given that in [13] and [14] is also expressed that implementation architecture based on IP / MPLS implementation is hierarchical and we have applied some of the difficulties and limitations which have also stated in [15] as our comparison criteria. Figure 10 compares the old structure with the new structure.

Comparison criteria / Structures	**Old structure**	**New structure**
Security	average	good
Development at any time and place	difficult	easy
Simultaneous support from global and national request	No	Yes
Control availabilities	average	excellent
Network management and configuration	difficult	easy
Traffic engineering	difficult	easy
Monitor the whole network	difficult	easy
Authentication	average	good
The number of IP addresses used to connect to the national network and the Internet	2	1
Reliability	average	excellent
Connectivity to global search engines	No	Yes
Internet connection	Yes	Yes
Suspicions users consistency	difficult	easy
To bypass network using international virtual private networks	easy	difficult
To control request before sending to data center	No	Yes

Figure 10: to compare new structure to old structure

6. Conclusion

National network is one of the biggest and most important projects in the field of information technology in countries that should be implemented properly and can provide considerably complete security for the information. When security is established that the entire network has been put under consideration and can control and manage requests that will be sent the network. The main aim of creating a national information network is to reduce dependence on abroad and be greatly able to respond the requests in the country than abroad and if we can also apply this decline at the provincial level, we can more greatly increase the speed of this kind of network. In this paper, a new approach to control and manage requests have been provided and the solution is in a way that we store data in the provinces data center and each province has a controller and data center that controller issues access permission to data center and this controller communicates with controllers in other provinces and exchanges information and these

controllers have established the severe division of labor in the country and controller delivers any request to their respective part and only receives response from their relevant part, since all requests pass from the controller, these controllers, as far as possible, respond to requests using the nearest data center and prevent to exit a lot of traffic to the outside of the province and country, and by doing so, we can control and manage traffic in the national information network more than the previous solutions and also take advantage of broadband Internet because unnecessary requests will not be sent abroad and only requests are sent abroad that the national network is unable to answer them, and those who are sent abroad are limited and these limitations cause the number of transferred requests abroad, encounter with little traffic and quickly receive their response that it is one of the most important tasks in national network which realizes.

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