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A Novel Structure of the Data Objects in Data Aware Networking

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Abstract: - **Innovative progressions in technologies, in particular, the proliferating smart livelihood systems provoking a gigantic data hardship on the networks these days. The proclamation of brand new technologies every day might significantly demand a thumping data to be disseminated around, which causes the existing networks awkward to handle it copiously. In order to address such impediments and to instigate diverse services to be flourished in the prospective networks, the ITU-T recommended a state-of-the-art network paradigm, known to be as the Data Aware Networking (DAN). This recent approach structures its data in the form of data objects that lets the users have a quick name-based identification and retrieval of the desired data nevertheless of its location, which significantly curtails the burden on the networks and also greatly reduce the blockades in today's host centric networks. In this paper, we classified the data objects into various categories and proposed a novel structure for the data objects that empowers the DANs intermediary elements to identify a requested data object, process it accordingly in order to disseminate the same to its requester possibly from a nearest DAN element. This novel approach makes the DAN an imperative architecture to realize the future networks.**

Index Terms—**Data Aware Networking, DAN, Data Objects, DO_ID, Country_ID, Agent_ID, Author_ID, Scope_ID, Nature_ID, Life_ID, Regional Agents, National Agents, Local Agents**

I. INTRODUCTION

The extents of data transmission over the networks are in lightning acceleration today. According to Cisco VNI forecast, the yearly IP traffic may surpass 3 zettabytes by 2021 and likewise the rush-hour demand will have a remarkable expansion of 4.6 fold [1]. Emerging trends in technology including IOT, personal digital systems, cloud computing platforms, augmented reality and artificial intelligence systems are ceaselessly spawning and communicating large volumes of data, which entails a seamless connectivity of the networks. Such a stimulation in users affinity in information necessitate massive amounts of data dissemination and demands the allocation of substantial network resources, which makes it awkward for today's host-centric networks. In this perception, the ITU-T in its wide recommendation Y.3001, identified and highlighted Data Awareness as one of the prime design goals of the future networks. It entails the significance of architecting and incorporating a proficient paradigm for accessing and disseminating such large volumes of data irrespective of their location. This approach can be realized under the name of Data Aware Networking. Data Aware Networking (DAN) is a futuristic networking framework that empowers its users attain a brand-new tailor-made service experience in quick accessing the desired data simply and securely irrespective of its location [2]. DAN can systematize its data in the form of data objects. A Data Object (DO) is a uniquely identifiable named data chunk, distributed over DAN and can be manageable using its name. Such a name based communication is the reigning idea behind DAN and can prompt a streamlined mobility management. More importantly, the intermediary nodes of DAN are aware of user requests, capable of recognizing the data objects, process them and refine the corresponding responses in an optimized manner [3]. Hence the data awareness feature of DAN clearly distinguishes them from the existing networks. However, the DAN elements can also able to restrict the network traffic towards the hosts by serving the possible requests with a locally cached copy of a data object. This provision from DAN not only substantially lightens the burden on the actual data hosts but can also effectively address the busy-hour internet traffic as well Data Objects play a major role in the orchestration of DAN at full extent. An efficient Systematization of data objects facilitates the required DOs easy to locate, retrieve and distribute from their corresponding DAN components and also revamps their performance and utilization. This can be realized by classifying and methodizing the data objects accordingly into various categories of their relevance. The rest of the paper is structured as follows. Section-II illustrates the classification of the data objects into various categories. We defined the structure of a data object along with a detailed explanation of its attributes

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in section-III. Finally section-IV provides the conclusion and future work of the proposed data objects structure.

II. CATEGORIZATION OF DATA OBJECTS

Data Objects categorization is the process of organizing the data objects into different categories for their most sufficiently efficient utilization. In order to realize such operational fringe benefits, the data objects can be classified into four categories.

A. Category-I-Open access Data Objects

As per the classification, the data objects of Category-I are intended for general public usage. This category includes all those data objects which are straightforwardly accessible and have no restrictions for their retrieval. All the DAN users can request and be served with these categories of objects from a nearest DAN element. Some examples of the data objects that falls into category-I are: Public notices, advertisements, contact information, product prices, route maps, etc.

B. Category-II- Local access Data Objects

The data objects of Category-II are intended for the local usage within the organization/functional component in which the actual data objects are being produced. These data objects are intended for use by the local/internal users and permitted partners. This category should include all those data objects that have pre-defined geographical access limitations, say within the organization. Some examples of the data objects that falls into category-II are: Organization policies and procedures, personnel code of conduct, internal correspondences, etc.

C. Category-III-Privileged access Data Objects

The data objects of Category-III are intended for appropriate access for a specific organization/functional components in which the actual data objects are being produced. These data objects are sensitive and intended for use only by the admissible users with access limitations. All the privileged users with valid access rights can request and be served with these categories of objects from a nearest DAN element. Some examples of the data objects that falls into this category are: Health records, passports, personal information, etc.

D. Category-IV-Restricted access Data Objects

The data objects of Category-IV are intended for restricted access. This category includes highly sensitive data objects, which are intended for use only by a fairly limited number of approved users. Only the legitimate users with pertinent access rights can request and be served with these categories of objects from their nearest DAN element. Some examples of the data objects that falls into this category are: Passwords, credit cards, organizations financial documents, shareholders private correspondences, etc.

III. STRUCTURE OF A DATA OBJECT

A data object can be composed in a way that can be easy to identify and discover the essential information about it, which assists the DAN elements to implement an effective find-retrieve-forwarding strategy. Therefore, by combining the aforementioned categorization requirements, the proposed structure of a data object can be visualized into two parts:

I) Header Part
II) Data Part

Figure1 below shows the proposed structure of the data objects

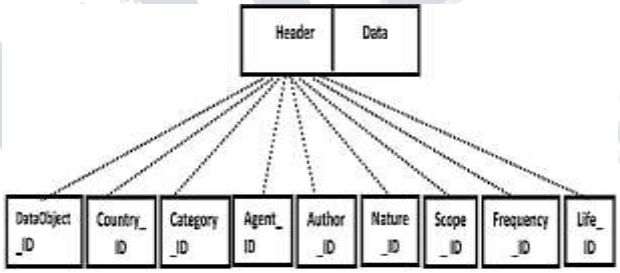

Figure 1: Structure of a Data Object

The header part of a data object is composed of various key attributes that can provide essential information required for the DAN components to process a data object. While the data part contains the actual content of that data object the possible attributes in header section includes the following:

A. DO_ID

The Data Object ID (DO_ID) is the unique ID with associated name of the data object that distinctly identifies it. The name of a data object must be persistent and provided with the property of uniqueness in order to enable the DAN users to access it irrespective of its location.

B. Country_ID

A data object can be better recognized when provided the name of the country or region from which it was being published. This helps the DAN elements in identifying the geographical limitations if any applies to a data object before serving it to a requester, which not only empowers the availability and maintenance of data objects but also promotes fairness in its delivery, subject to its underlying geographical restrictions.

C. Category_ID

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Category_ID is an attribute useful to identify the category of a data object and thus for its efficient organization accordingly. Category_ID can also be helpful for DAN to consider access restrictions if any applicable for a data object in order to achieve a fair delivery of it. As discussed earlier in section 2, an openly accessible data object can be disseminated to requestors without any access limitations. While the restricted category data objects are liable to certain pre-determined access restrictions as imposed by their producers.

D. Agent_ID

Agents are one of the essential functional elements of DAN. These elements are the authenticated agencies for the provision of ample assistance in publishing the data objects by the original publishers or their appointing authorities. Moreover an agent element should be capable of identifying and registering various publishers, categorize, assign them with appropriate author_id and manage their identity accordingly by offering necessary functionalities for registering their data objects to DAN.

Agent functionality can be effectively realized by distributing among the following three units:

- Regional Agents (RA)
- National Agents (NA)
- Local Agents (LA)

Regional Agents:

A Regional Agent (RA) is an agent element of DAN that operates in its corresponding region. Each regional agent can be identified and authenticated with its corresponding Regional Agent ID (RA_ID). Each RA provides all the aforementioned agent operations in its jurisdiction and coordinates the activities of its subsequent national agents and ensures their management of data objects in an efficient manner. Thus the RAs worldwide can operate with a prime goal of the legitimate distribution and trustworthy maintenance of the data objects.

National Agents:

A National Agent (NA) is an agent element of DAN that allowed operating in its own country or province. Each national agent can be identified and authenticated with its corresponding National Agent ID (NA_ID). Each NA can be operated under the control and coordination from their corresponding regional agents and is responsible for coordinating the activities of its subsequent local agents and governing the data objects within its specific country.

Local Agents:

A Local Agent (LA) is an agent element that operates under the supervision of its concerned NA. Each local agent can be identified and authenticated with its corresponding Local Agent ID (LA_ID). Each LA can be operated under the control and coordination from their corresponding national agents. LAs are considered as functionally essential elements as they are having direct relations with various producers of the data objects in its local area or state.

The relationship between all the three different levels of agents can be shown in figure2, using a top-down agent hierarchy.

Figure 2: Agent Hierarchy

E. Author_ID

Authors are the elements of DAN that can create, publish the data objects. An author might represent an individual, an organization or any agency with an aim to publish their data objects over the DAN. An author who desired to publish his/her data objects initially would require communicating with an authorized agent in order to register himself and obtain authorization for further publication activities.

F. Scope_ID

The Data objects in DAN can be distributed according to their corresponding scope. The extent of an area where a data object can be accessible is known to be its scope. Determining the scope of a data object becomes an essential requirement that facilitates a fairly rightful delivery of it. Consequently the data objects can be organized around two scopes, either local or global. The data objects are required to be unique in the given scope. However a local data object required to be unique in its local scope/region whereas a global data object required to be unique in the entire global scope.

G. Frequency_ID

Frequency indicates the extent of demand for a data object. Based on the Frequency_ID, DAN can determine the compulsion of caching and maintaining a data object. A data object having a higher frequency can assume top priority from the DAN elements

H. Nature_ID

The nature of a data object indicates its endurance. A data objects nature can be either persistent or transient. A

persistent data object persists forever or for a precise time span, whereas a temporary data object ruins in a shorter time. A Persistent data object is the one which maintains several version of it. It conserves its earlier versions when a new version is released or the existing one is modified. Whereas, a Transient data object is the one which maintains only one version of it. It maintains only one version of it. A newer version of transient data object always replaces the earlier one.

I. Life_ID

The lifetime of a data object is the period of time between its creation/publication and removal/withdrawal from the DAN repository and as well as from their caching points. The lifetime of a data object varies from one another. The proposed structures of the data object in this paper are unrivalled and are useful in designing a more efficient and effective structuring of data objects for DAN. The list of attributes present in the header part sufficiently assists DAN in recognizing, identifying and retrieving them from their point of presence.

IV. CONCLUSION AND FUTURE WORK

Data Objects are the principal elements in DAN that supports name based data access, which can erect the DAN as an innovative approach in data dissemination. DAN can serve its users with a requested data object regardless of its location, possibly from a nearby intermediary element. This promotes the DAN to quickly respond against each request and also fosters them to serve the possible requests natively. This paper presented the categorization of the data objects in DAN and also proposed a novel structure for the data objects. However, much needed information for DAN elements about each data object will be furnished by the attributes present in the header part of the proposed data object structure. In continuation to the work proposed in this paper, we are working on implementing the same by assigning suitable IDs for each attribute in the structure, which makes it possible to attain pre-eminent data object maintenance in DAN.

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