Different Faces of Information Centric Networking

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Abstract—In this paper, the feasibility of current internet framework for future usage is investigated. Internet has been a huge success. However, the scale of its use has given rise to issues and challenges which were not taken into account when it was created. There is a strong perception in the research community that current internet framework is not adequate to meet the current needs and challenges. A fresh blank slate approach should be developed for future internet. This paper discusses some of the issues in current internet framework and explores alternative solutions which have been proposed to overcome the challenges.

I. INTRODUCTION

Current Internet framework has been in popular use since early 90’s. The growth of internet has been remarkable in the time since then till now. Internet now envelops almost all facets of modern life style. Its use and applicability has grown manifolds. Throughout its evolution, internet has faced different challenges but managed to cope with them in a manner which was mostly transparent to the end users [1]. However, the current usage of internet is enormous. This increase has led to many questions about its ability to handle the extensive work load [2]. Some of the issues that have arisen are

A. Problems

- **Resource Sharing**: The current internet framework was intended to be used as a resource sharing infrastructure. Since the equipment costs in early 80’s to 90’s were significant, it made sense to share them.
- **Trust**: The internet was designed assuming that all the entities are trust worthy. The security aspects were introduced later on as an add-on. This assumption led to inherent security deficiencies in internet architecture.
- **Sender Based Working**: The current internet communication model was motivated through the public telephony network. Hence, the communication is controlled by the sender. Any one can send data to a destination. The architecture does not take into account the intended destination’s desire about data acceptance.
- **Where vs What**: The routing in the current internet is based upon locations. There is a direct coupling between information and location. This coupling introduces problems in the way of scalability, mobility and roaming.
- **Lack of Persistent Naming**: Another issue that stems from using locations as identifiers is that of Persistent Naming. Because of this, a location or URL change means that although the information remains the same but it has to be accessed differently.
- **Monopoly of Tier 1 Operators**: The routing back bone of the internet has different layers. The topmost layer is controlled by a select group of companies [3]. This control might not necessarily mean misuse but still it violates the guiding principles of internet.
- **Source of Revenue**: A major guiding principle of internet was its use as a free service. However, increasingly the commercial aspects have dominated how it is being utilized.
- **Massive Demand for Replicated Content**: The boom of social media has led to more and more content being replicated and transported in the internet. The common examples can be Youtube videos which have been viewed thousands of times. The current way of treating a new request independently leads to transportation of same content over and over again.
- **Security Issues**: The current internet suffers from security problems like Denial of Service attacks. The DOS attack is due to the current internet’s sender based communication paradigm rather than technological aspects.

II. INFORMATION CENTRIC NETWORKING

Information-Centric Networking (ICN) concept is one of the more prominent and significant research topic in the context of future internet. In ICN, the principal paradigm is not host-to-host communication as in the current Internet architecture. Instead, the focus is on information, properties associated with information and receiver interest in the network. This has been motivated by trends in current internet like an increasing demand for similar content, scalable and efficient distribution of content and security issues. Corresponding network architectures use leverage in-network storage, multiparty communication through replication and interaction models such as publish-subscribe to provide general platforms for communication services. Such technologies are visible in current internet in the form of Multicast, Content Delivery Networks and Overlay networks.

There are lots of projects investigating alternate approaches to current internet. Three of them are being analyzed here.

III. ICN APPROACHES

A. Data Oriented Network Architecture

DONA [5] framework is based on the notion that lot of problems in the current internet - like naming persistence, data availability and authentication - are linked to Domain Name
System (DNS). DONA employs an information based identification system backed up by Anycast\(^1\) routing principle. These techniques address the issues pertaining to data availability and naming. In DONA Information Object (IO) is published into the network by Sources. Nodes that are authorized to serve data register to the resolution infrastructure. Once a given content is registered, requests can be routed to it. Resolution Handlers have a hierarchical structure. Requests are routed by name in a hierarchical fashion. The resolution infrastructure routes requests by name and tries to find a copy or the content closest to the client. DONA’s anycast name resolution process allows clean support for network-imposed middleboxes (e.g. firewall, proxies). In purely data-oriented operation, IOs are routed back along the same path of the request.

B. Content Centric Networking

The main idea of CCN is that a request for an information object is routed towards the location in the network where that information object (IO) has been published. The intermediate routers check for a possible match of the request. As soon as an instance of IO is found (a cached copy or the source IO) it is returned to the requester along the path the request came from. All the nodes along that path cache a copy of the IO in case they get more requests for it.

C. Publish/Subscribe Internet

The Publish/Subscribe Internet (PURLSUIT)\(^2\) \[^8\] project is the successor to the older PSIRP\(^3\) project. The framework is based on data routing using Publish/Subscribe paradigm. The network is partitioned into three major layers. Rendezvous layer is responsible for data routing and discovery decisions, Forwarding layer handles actual data transfers and Topology layer handles management functions. Information objects are published into the network by the sources. Receivers can then subscribe to IOs that have been published. The publications and subscriptions are then matched by a Rendezvous system. The matching procedure results in a rendezvous identifier (RI) that can be seen as an identifier for a communication channel. The RI then, in turn, can be resolved (within a scope) to a forwarding identifier that can be used for routing of data object through the forwarding network.

IV. ICN AND IOT

<table>
<thead>
<tr>
<th>Feature</th>
<th>DONA</th>
<th>CCN</th>
<th>PURLSUIT</th>
</tr>
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<tbody>
<tr>
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<tr>
<td>Messaging</td>
<td>Find / Register</td>
<td>Interest / Data</td>
<td>Publish / Subscribe</td>
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<td>Compatibility With current IP</td>
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<td>Passive</td>
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<td>Self certifying+ trust</td>
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<tr>
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<td>yes</td>
</tr>
<tr>
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<td>Feasibility Demonstration</td>
<td>Simulation Level / Modeling</td>
<td>Secure Voice</td>
<td>Simulation Level / Modeling</td>
</tr>
</tbody>
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\(^1\)http://en.wikipedia.org/wiki/Anycast

\(^2\)http://www.fp7-pursuit.eu/

\(^3\)http://www.psirp.org/
Figure 4 shows a comparison between the different approaches that have been discussed in this paper. From an IOT perspective, ICN offers lot of advantages. Some of them are

- Simpler and energy efficient communications.
- Security is provided in the network architecture rather than as add on.
- There is inherent support for data availability and naming persistence.
- The communication model works on mutual interest of sender and receiver.
- Content caching reduces redundant traffic and latencies.

The ICN model appears to be an attractive alternate to the current internet framework. One aspect that is lacking in the current researches is the lack of real applications. This needs to be addressed before it can be utilized practically.

REFERENCES


