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A Survey on Publish-Subscribe Internet Routing Paradigm

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ABSTRACT

Current internet is incompetent and inept for the current trends of communication. The architecture of current internet was drafted almost 40 years ago and it is unable to cop up the problems aroused in context of security, mobility, robustness, congested traffic and vice versa of this millennium. In this paper, publish–subscribe internet routing paradigm (PSIRP) a reengineered architecture of internet is comprehensively studied, which will resolve many of the problems faced by the internet today. Keeping in view the importance of information/data, the reengineered architecture of PSIRP proffers the information–centric communication instead of host–centric communication, in response to which many of the problems of current internet will be resolved automatically. As major portion of internet is publish/subscribe in nature so PSIRP can provide a flexible, efficient and powerful architecture for future internet network design.

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1. INTRODUCTION

Since the inception of current internet architecture in 1970's, it has experienced a tremendous growth in traffic due to emerging applications like voice chats, video streaming, social networks etc. The internet design closely resembles the old telephone network where the focus was on to communicate the end-points which give rise to host-centric communication and the important portion "Information" was ignored [1].

With escalation in new applications and technological revolution which give birth to many new technologies like mobile services, multimedia contents, social networking, virtualization of data, cloud computing, consequently threats like security concerns against viruses, spams and denial of service attacks, scalability, quality of service and economics issues escalated. These short falls in turn brought many challenges to this architecture and experts all over the world are more conscious and emphasizing on regarding the contents keeping in view the critical importance of information [2].

Recognizing the importance of internet in every pasture of life and information from which the whole technology woven around, manifest this way a shift towards information oriented future Internet and so the need for a new clean slate internet architecture sprouted in the early years of this millennium [3].

The PSIRP approach aimed to design a fresh new internetworking architecture based on publish-subscribe paradigm to remedy the problems of current internet. The goal of this approach is to structure a new information-centric publish-subscribe form of internetworking and redesign of all Internet communication layers by bringing major changes to the current network layer [1] – [2] – [3].

In this new architecture, senders "publish" what they want to send and receivers "subscribe" to the publications that they want to receive. So subscriber will get rid of unwanted data and will not pay the cost of data other than their data of interest. [1], [2] ,[3]. By keenly observing the Internet applications we have come to know that they are already publish/subscribe in nature. For instance if we look at software updates, delivery of breaking news announcements, general media broadcasting, periodic and aperiodic messaging, they are already resembling the publish/subscribe mode.

The PSIRP project actually redesign the entire Internet architecture from the pub/sub point of view in which multicast and caching is the norm and security and mobility is designed immediately into the architecture instead of being added as afterthoughts. We can summarize the structure of the paper as follow: Section 1 briefly introduces this paper by elaborating the topic overview, objectives, and scope of paper.

The remainder of the paper proceeds as follows. Section 2 covers the issues and problem with current internet and emphasis on major problem that internet have today. Section 3 contains the related work so far done for improving the performance of current internet architecture. Section 4 describes the mission and objective of PSIRP Project while Section 5 discusses the architecture of PSIRP by showing up the detailed diagrams of the architecture of PSIRP and flow diagrams of internetworking of PSIRP. Section 6 shows the discussion on findings of the paper. Finally Section 7 offers some conclusions and suggestion for further research.

2. PROBLEMS WITH THE INTERNET TODAY

Despite the success of internet in many ways and forms, still there are many inefficiencies and several design flaws from which internet is suffering. In this section we will discuss those inefficiencies and blemishes briefly.

2.1. Emerging Applications:

Emerging applications in the past two decades congest the traffic so much. The capacity of internet digests more than 2.4 billion users out of total world population which count to be approximately 7 billion. The wide use of video streaming, voice chats, social networks etc create a cumbersome traffic that is hard to handle for the current architecture.

More than 1 billion unique users visit YouTube each month, Over 4 billion hours of video are watched each month on YouTube, 72 hours of video are uploaded to YouTube every minute. [3] The daily usage of social networks has crossed 600 million users per day. More than 400 million people use facebook daily and at least 250 million photos are uploaded to facebook daily. [4]

The rapid variation in data growth and augmenting users masquerade defy to bandwidth along with timely reliable delivery. The impact of fast fluctuation of Internet traffic is not limited to capacity but also the quality of service and performance of expected intensity of routing within the internet is distressed. [4],[5]

2.2. IP address is not scalable

Internet Assigned Numbers Authority (IANA) is responsible for the allocation of IP addresses and autonomous system numbers used for routing Internet traffic, globally. IANA do not make allocations directly to ISPs or end users except in specific circumstances Instead it make allocation to five regional Internet registries (RIR) connected to it which are responsible for assignment to end users and local Internet registries, such as Internet service providers, in their designated territories. [6]

The most commonly used version of IP address are IPv4 addresses which was initially deployed on 1 January 1983. IPv4 addresses are 32-bit numbers expressed as 4 octets which mean that there will be approximately 4.294 billion addresses available for allocation to RIR’s in blocks of approximately 16.8 million addresses each which is then further allocated to end users and ISP’s. On 31 January 2011, IANA announced it had wiped out its free pool of IPv4 addresses due to dramatic growth of internet users. [6]. Another version of IP addresses is IPv6. Deployment of the IPv6 protocol began in 1999. IPv6 addresses are 128-bit, expressed using hexadecimal strings. IPv4 addresses cloud is very large but it is only a transitory approach to deal the problem and not a permanent solution to the unanticipated number of user linking to the internet.

2.3. Host-Centric Communication

Traditionally the internet architecture was designed based on the endpoint addressing and forwarding principles. But as mentioned before that vast portion of network communications are content-centric so this is quite problematic to deal with such a complex network in context of every parameter like security, mobility etc. [3],[5]

The initial design of the internet was designed in a way to provide an end-to-end connectivity substrate for the delivery of data. The goal aims at communicating end points. By analyzing the current Internet architecture we will observe the evolving of interconnection of thousand networks that act as simple carriers providing basic packet delivery services without guarantees, using IP addresses to identify end-hosts for data forwarding without taking into account what is being delivered. A host-centric design accentuate on the topological location of information as opposed to the nature of the information itself [3, [5]. For example, a user requesting http://abcd.com in today's Internet must:

1) Find the content's human-friendly name (i.e. its URL),

2) Query DNS to translate the URL into a locator which is the IP address and

3) And then direct a request to the physical endpoint designated by the IP address.

This "middleman" approach is inefficient as it introduce a lot of overheads. Unfortunately, this endpoint-centric communication model does not cope with the overwhelming usage in current Internet anymore. [3],[5]

2.4. Security Problem with Contents and Services

Traditionally internet architecture have a close resemblance with the conventional telephone network facilitating communication between two uniquely addresses endpoints which trust each other and swap data through an internetworking infrastructure. But the rapid variation in current networking trends makes it impractical. The trust was lost due to widespread attacks of viruses and worms and there is no reliance anymore. Moreover up till now the internet architecture provide mechanism for securing the channel to the source but is not securing the data which is more important than channel itself. [7]

Also if we look at the other side of the scene in context of security, an imbalance of powers exists in the current Internet. The sender is complete incharge of communication and we can say that it is a sender-driven communication because the sender can send any data, whether the receivers want to receive the data or not. Ultimately it will escort to problems such as denial of service attacks and spam email. [7]

To deal with the situation a lot of mechanisms were deployed most notably network address translation (NAT) and spam filters however this doesn't proved to be an effective and permanent solution to the problem.

2.5. Poor Mobility Support

A node is uniquely identified by its IP address. This address imposes severe limitations on mobility because endpoints are not fixed in today's advance era where mobile users are multiplying day by day. As an endpoint move to some other topological location in current network architecture, it's unique address i.e. IP also changes which badly effects and limits the mobility in current internet architecture. In today's world mobility is given a keen consideration because of its widespread use and need [2], [7].

3. RELATED WORK

To cop up the problems stated above, a lot of research has been done and many good proposals were presented to debate these issues. Here some of these approaches to tackle these issues are discussed.

The most important approach to shift from historical design (host-oriented) to current usage (data-oriented), in which the architecture will be built around service and data access is Data-Oriented Network Architecture (DONA) [7],[8]. Data- Oriented Network Architecture (DONA) replacing DNS names with flat, self-certifying names, and replacing DNS name resolution with a name-based anycast primitive that lives above the IP layer. DONA names are expressed as a <P,I> pair , P is public key which owns data and L is a label. DONA separate resolution handlers (RHs) are used to resolve <P,I> pair in to topological routes and IP header extension mechanism add the DONA header to IP header. DONA mechanism for data transmission is in form of triplet including actual data, the principle public key and a signature using the principal's private key. So the receiver can only verify the authenticity when it collects the complete data items that are the triplet [7],[8].

The Content-Centric Network (CCN) is a new approach to networking that enable networks to self-organize and push relevant content where needed. CCN is a research effort that proposes routing based on hierarchical naming. In CCNx consumers ask for content by broadcasting 'Interest' packets that contain the name of the content in request. Any 'Data' packet whose content name is a suffix of the name in the 'Interest' packet is conspired that it satisfies this interest.

4. THE PSIRP MISSION

The PSIRP mission is quite clear and simple but challenging and complex also. It will redesign the Internet architecture from the pub/sub point of view.

PSIRP architecture woven around the issues and how to debate the major concerns of security, routing, wireless access, architecture design, and network economics, in order to design, develop and validate an efficient, flexible and effective fresh architecture. The new pub/sub-based internetworking architecture will be well suited to meet the challenges of information-centric applications.

The PSIRP project's main objectives are as follows:

- Design a new information-centric internetworking architecture based on the publish-subscribe paradigm
- Make “information” the centre of attention and remove the “location-identity split” that plagues current networks
- Implement innovative multicasting and caching features to optimize performance and efficiency
- Implement security functionality as a native core component of the architecture
- Implement and validate the new architecture under realistic operational scenarios

5. PSIRP CONCEPTUAL ARCHITECTURE

Cut the internet connection and many businesses are out of business, so one cannot refute the importance of internet in any precinct of our routine life. Though there are many flaws and challenges which the current network façade, but we have to find solutions to these problems and will improve the performance in a deliberate way by redesigning its architecture.

The PSIRP architecture is divided into three main parts.

- Component Wheel
- Networking Architecture
- Service Model

5.1. Component Wheel

The PSIRP conceptual architecture is based on a modular and extensible core, called the PSIRP component wheel. The architecture swapped the traditional stack or layering of telecommunications systems, by components that may be decoupled in space, time, and context. Haggle architecture [10] proposed the idea of such a layerless network stack before. The novelty of the PSIRP proposal is to use publish/subscribe style interaction throughout the conceptual architecture, and thus supports a layerless and modular protocol organization [1] - [2].

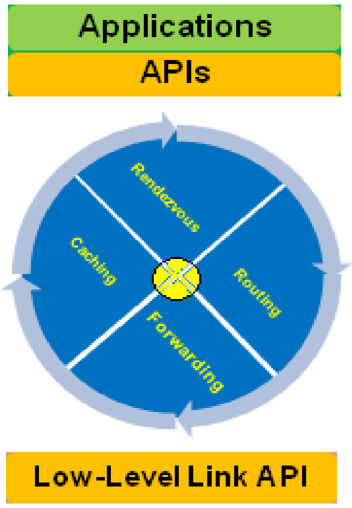

Figure 1. PSIRP Component Wheel [2]

Figure 1 shows a sketch of the conceptual architecture with the PSIRP component wheel in the middle. Above the wheel, we have APIs that allow for using different networking features available in the system. The figure illustrates the typical components needed in the wheel for inter-domain operation, namely forwarding, routing, rendezvous, and caching [1] - [2] - [10].

5.2. Networking architecture

Based on the component wheel we have group of entities that form the network architecture of PSIRP. The network architecture of PSIRP consists of the following entities:

- Identifiers
- Data and metadata
- Scoping information
- Subscribers and publishers
- Domains

5.2.1. Identifiers

We can view the global network of information as an acyclic graph of related pieces of data, each identified and scoped by some identifiers. The function of identifiers is to delineate the associations between the pieces of information in PSIRP network on the different levels, such as the application or networking level. The following classes of identifiers uptill now have been proposed by [1],[2].

Application Identifier

Applications can use many concepts including flat and structured identifiers and namespaces to identify relevant objects and information such as people, network locations and devices, units of information, communication sessions, geographical locations etc. Application names and identifiers are likely to follow human readable or meaningful structures and they are resolved into network Rendezvous Identifiers (RIds).

Rendezvous Identifiers

The preliminary function of Rendezvous Identifiers (RIds) is to match Publication with Subscription & Initialize the Forwarding Process. This mean that RIds is Bridging the higher level Identifiers with lower level Identifiers like application identifiers to scope identifiers.

Scope Identifiers

Though Scope Identifiers (SIDs) is a separate class of identifiers but functionwise it can be considered a specialized subclass of rendezvous identifiers (RIds) that are used by the rendezvous system of the PSIRP architecture to aggregate other rendezvous identifiers. Publications and subscriptions to a RId will be made within a context of a SId and hence will be seen by the components of the rendezvous system that have subscribed to that scope identifier. The purpose to deploy such type of identifier is useful in delimiting the reachability of given information.

Forwarding Identifiers

The forwarding function of the PSIRP architecture make use of Forwarding Identifiers (FIds) to communicate data between publishers, subscribers, and system components. Where the rendezvous system makes use of RIds and SIds (on the slow path), FIds are used by the fast forwarding fabric. This enables the operation of a scalable and flexible rendezvous system that just maps the publication with subscription or we can say publication and subscription requests.

5.2.2. Data & Metadata

Data is the centre of attention in PSIRP. A rendezvous identifier which maps publication with subscription is implicitly linked with data sets, consisting of one or more publications.

The data sets may also have associated metadata, which may include, e.g., scoping information and other useful information either for ultimate receivers or for network elements. For instance suppose we have picture data so the information on picture size, date of picture taken etc are metadata for this data.

The metadata can also be deemed as data. It may be provided to the network within a publication to which it relates, or it may be provided as a separate publication to a rendezvous identifier. In Application level metadata symbolized itself as plain data to the network level. Network metadata is soft state within the network–access control, flow control, error notification, and congestion notification.

5.2.3. Concept of Scope

Scope delineates a dominant notion that can construct social relation between entities, representing consumers and providers of information that is subscriber & publisher and the information itself. This is illustrated in Figure 2, where certain information (e.g. a picture) is available to family and friends, while other information is only perceptible to colleagues. Each scope is attached with a governance policy, represented as metadata, which may include authentication information for potential receivers of the information and some other related information.

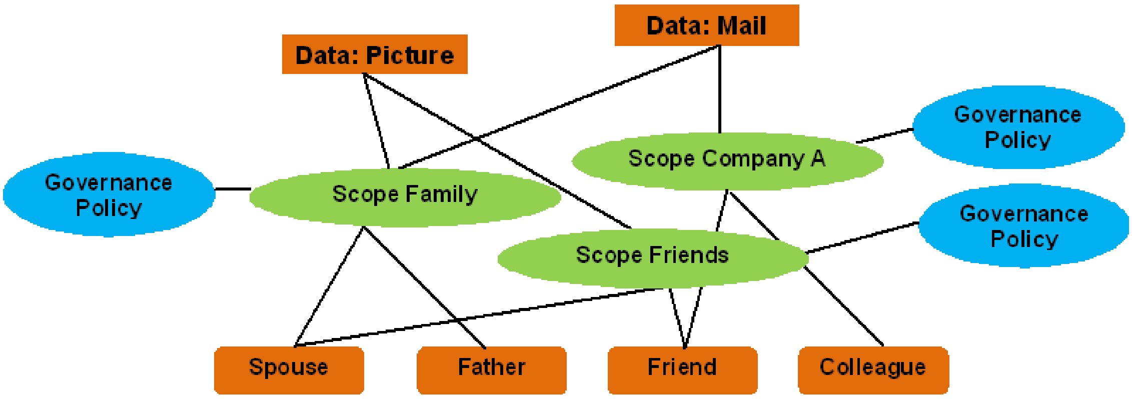

Figure 2. Concept of Scope [1],[2]

The ambition of PSIRP to facilitate networks to reveal social structures and information grouping in a dynamic and vibrant fashion can be easily accomplished by the fact that scopes can be easily re-constructed, removing certain parties from the scope, adding new publications to the scope, and assigning information to a new scope. The publisher/sender interface supports publication of data. Each publication has an associated flat label (i.e. the rendezvous identifier), and an optional metadata part.

5.2.4. Key Entities of the Architecture

The relationships between the key entities of the PSIRP architecture is illustrated in figure 3 given below.

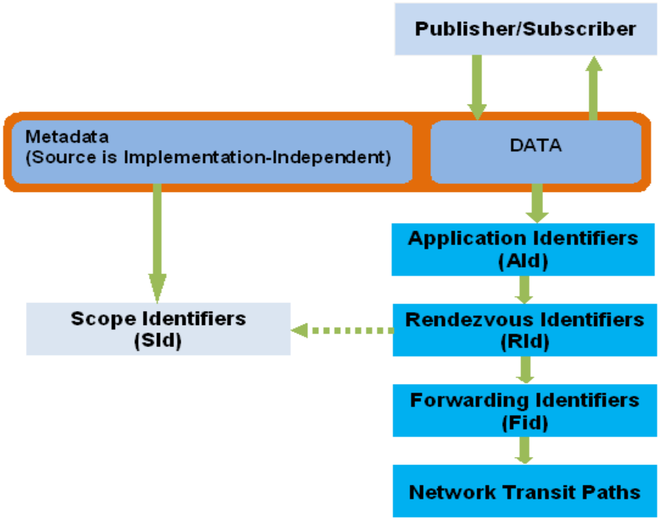

Figure 3. Key Entities of conceptual Architecture [1],[2]

Data packets and their associated metadata are published and subscribed in a domain. Typically, the data is associated with one or more application identifiers and one or more scopes. There are multiple opinions where to include the scoping information; for example, the scoping information may be included in the metadata part of the packet or it may be represented as a separate identifier in the packet header. [1] - [2]

Each application first resolves application identifiers to rendezvous identifiers and then hand over the rendezvous identifiers to the network, using the scopes to properly map each rendezvous identifier to one or more forwarding identifiers, both within a domain and between domains. Within a domain this is called Intra-domain routing and forwarding, and between domains this is called inter-domain routing and forwarding. [1],[2]

5.2.5. Publisher/Subscriber

As mentioned in the previous sections, PSIRP architecture is based on the principle that the notion of information in the centre of attention through addressing information directly (via rendezvous identifiers).

In pub/sub networking, senders "publish" what they want to send and receivers "subscribe" to the publications that they want to receive. A subscriber has the authority not to receive any data to which they have not explicitly expressed an interest by way of subscription. The result is a powerful yet flexible infrastructure with a high degree of resiliency.

From figure 4 we may say that publishers are information providers that feed information elements into the pub/sub network by virtue of publications. Subscribers are consumers that explicitly express their interest in a specific publication by issuing subscription messages [1],[2],[7],[11].

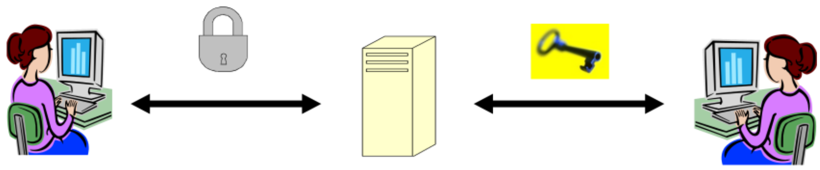

Figure 4. Publisher and Subscriber Concept [11]

5.2.6. Domains

Domains are administrative network areas that can be connected using the inter-domain forwarding architecture [2].

There are three logical notes in each domain; these are topology node (TN), Branching Node (BN), and forwarding Nodes (FN) as shown in figure 5 below. The topology node handles management of intra-domain topology and also performs the load balance between branching nodes. Exchange of inter-domain path vectors are also exchanged by the topology node. Topology nodes relay this information to the branching nodes of the domain. [8]

Branching node is accountable for the steering subscription message emerging from subscribers flowing towards data sources and most important function of caching the data. Branching node can also duplicate the data in case of multiple subscribers, thus becoming a branching point. [8]

Forwarding nodes execute a simple and fast algorithm using a bloom filter based forwarding. Forwarding nodes also forward information about its neighborhood to the topology node and branching node at regular intervals. [8]

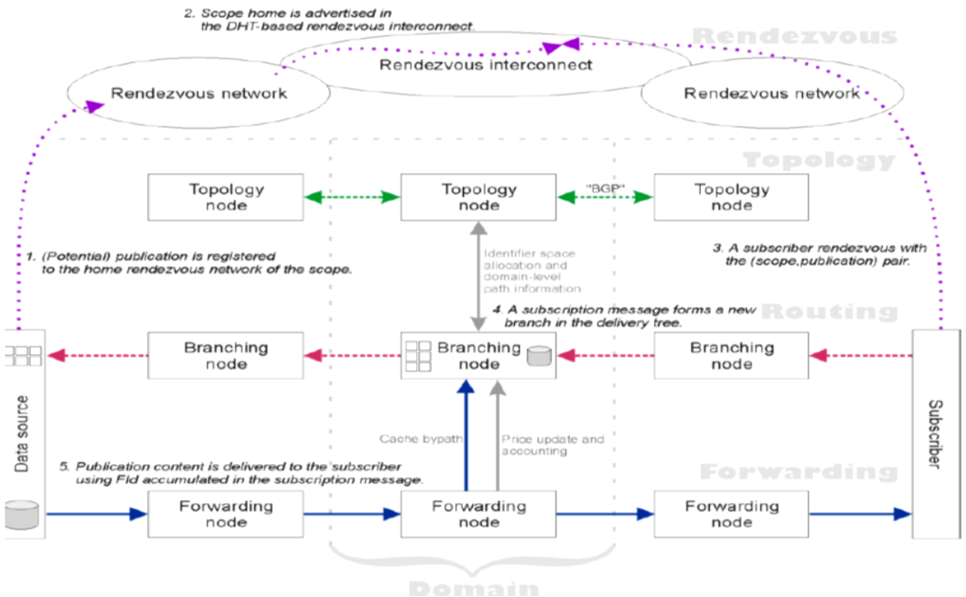

Figure 5. PSIRP Network Functions [8]

A detailed description of all the nodes is impossible to elaborate here due to certain constraints but detailed description can be found in [12].

5.3. Service Model

The PSIRP service model determines the information flow and semantics that are supported by the network. The interface between the network and applications, and the interface between the network and network management tools are briefly described by the service model.

The service model is categorized into three parts, namely publisher/sender, subscriber/receiver, and network services. The first part defines how data can be sent to and over the network and what primitives are offered by the network for this. The second part defines how data can be received from the network and defines an interest-registration service and the necessary upcalls for data reception. The third part defines the monitoring and controlling points offered by the network for management purposes

5.3.1. Publisher/Sender

The publisher/sender interface maintains publication of data. A flat label associated with each publication, known as the rendezvous identifier, and also has an associated optional metadata part. Such metadata could, for instance, specify the usage policy for a particular publication and other information related to publisher or publication.

The publisher/sender interface has the following features.

1. **Metadata:** Publisher includes metadata for the network or for the eventual receivers. Such metadata may be represented as a separate "meta"-publication, or through other means as discussed in earlier sections
2. **Publisher anonymity:** Network ensures publisher anonymity upon request by the publisher. But publisher remains (locally) accountable, though
3. **Multicast:** The publication can be published by the Publisher only once and it can be sent to many subscribers, this feature is known as multicasting
4. **Data correlation:** By using metadata a Publisher can designate that certain publications are likely to be subscribed together. But it does not guarantee that network understand correlations fully, because of the fact that some implementations may not care about such correlation information
5. **Caching:** The process of temporary storage of data in the network is known as caching. Publisher can indicate caching preferences to the network
6. **Anycast:** Functions like local discovery use the feature of Anycasting in which Publisher can send anycast publications that are delivered to only one subscriber. But as stated by many researchers that it is unclear whether global generic anycast can be supported or only local specialized anycast-like services
7. **Scoping:** Scoping information offer privileges to specific users to be subscribed to a publication. Publisher must indicate one or more scopes for a publication. To publish a publication in several scopes may require multiple operations
8. **Accountability:** Publisher is authorized by the network. The network operator may be later able to prove that the publisher has indeed published a given publication. However, similar to Anycast feature it is also vague what such proof exactly means or what are the expected semantics for publisher identity

5.3.2. Subscriber/Receiver

A subscriber instigates a receiver-driven communication by using a rendezvous identifier, specified in an act of subscription. Like the publisher, the subscriber can specify additional metadata surrounding the request

1. **Subscription state removal:** Different techniques may be offered by the network for removing subscription state, for example, explicit leave, implicit leave, auto leave, and expiration
2. **Publisher authentication:** Network authenticates publisher upon subscriber request. However, as indicated above, it is unclear what exactly is meant with publisher identity, and therefore the exact semantics of publisher authentication must also be left open.
3. **Data integrity:** The network delivers only data that has known origin and is integrity protected upon request by the subscriber.
4. **Accountability:** Subscriber is authorized by the network. The network operator may be later able to prove that the subscriber has indeed subscribed to given publication. However, it is also unclear like

Publisher Accountability that what such proof exactly means or what are the expected semantics for subscriber identity.

5.3.3. Network Services

The network services part of the service model is responsible for supporting various administrative services, such as network management and measurement tools. From the management point of view, there are two key phases in communications: First, we have the rendezvous phase, which sets up or re uses existing forwarding state from publishers towards subscribers. Second, we have the forwarding phase, in which data is delivered using the forwarding state from publishers (or caches) to subscribers. The rendezvous phase is slower, because it needs to manage policies and process metadata associated with a subscription or a publication. The forwarding phase is faster given that it is done using existing forwarding trees and using the forwarding identifiers. Network management features, such as policy decision making and policy enforcement, are expected to happen in the rendezvous system. This means that changes to policies are first processed by the rendezvous system and they may or may not imply changes to the forwarding states. Features specific to certain publications or scopes are expected to be expressed as metadata linked to the respective identifiers.

6. RESULTS AND DISCUSSIONS

By complete restructuring of the current internet architecture, maximum of the issues are out of scene automatically. In this section we will thrash out how PSIRP resolves those challenges posed by current internetworking architecture, as discussed in section 2.

6.1. Intelligent Data Caching

The determining factor for successful operation of any system can be measured in term of efficient and reliable usage of the resources. In order to improve network resource usage PSIRP will introduce intelligent data caching amongst network nodes based on sophisticated statistical and analytical techniques. With this, the overheads and inefficiencies associated with unoptimal data fetching operations will be significantly reduced.

Simply, any data published over a rendezvous identifier may be cached. This can result either from requests by the publisher, or by the subscriber. For example, the subscriber may indicate that it wishes a certain time period or number of packets to persist within the network. Alternatively a publisher may indicate such instructions since it has knowledge about its subscriber base (i.e. the application that is served by publishing to the rendezvous identifier). Ultimately the decision is up to the network cache [2],[11].

6.2. No need for IP Address

The most notable challenge for traditional architecture of the internet is to give a unique name/address to each end-point for effective and robust communication. Since tremendous growth in population of the subscribers of internet in this decade is surprising and irrepressible, it is impossible to uniquely identify each end-point. The length of IP address was increased to accommodate more end-points that is the migration from IPv4 to IPv6 and also use of NAT (Network Address Translation) handle the rising problem for some time. But these techniques merely provide us temporary solutions without scalability for future and moreover the burden of huge headers and long addresses is quite problematic in itself having certain impacts on other issues also like traffic growth, mobility, scalability, security and other architecture flaws. In PSIRP a permanent solution to this problem has been developed by removing the use of IP address completely and now a subscriber can be identified by a set of identifier like rendezvous identifiers etc. This led us to a scalable, secure and permanent way to the solution to the issue.

6.3. Information Centric Communication

Information is the core element in the PSIRP architecture; everything is information and information is everything. The content in demand is placed at the center of attention instead of the content's location and network address.Users directly request content via a known friendly name and the network delivers it irrespective of its physical location [11],[13].

6.4. Security

Security is integrated to all parts of the system in PSIRP design contrasted to the inherent security of current internet. Since pub/sub paradigm focuses on that subscriber do not deliver any unwanted data except those publications/data to which it is subscribed so strict security measures are applied to the rendezvous and forwarding layer. To achieve this goal PSIRP utilize elliptic curve cryptography (ECC) ECC key is 160 bit and as strong as 1024 bit RSA key in conventional internet. ECC provide strong security with short key and signature sizes and the whole public key in incorporated in RIds and SIds in every packet. Most notably, a technology known as Packet Level Authentication (PLA) is also incorporated to protect network traffic by adding cryptographic signatures to every individual packet. PLA is used for securing rendezvous and subscription traffic with also providing extra security on forwarding layer. Therefore malicious, unwanted, or modified packets can be dropped before they reach their destination, mitigating attacks and freeing resources in the network. Public key cryptographic operation are expensive that's why they are only used for signaling traffic by default. Dedicated hardware acceleration allows PLA to scale to high-speed networks and low-power devices, While elliptic curve cryptography (ECC) reduces the bandwidth overhead of cryptographic keys and signatures. Publication contents are integrated to the publisher's public key through public keys inside the rendezvous identifiers and cryptographic signatures, by this way the subscriber can authenticate and verify the integrity of the publication.

6.5. Mobility

Mobility is a two dimensional problem. The scale of mobility i.e. global or local is the first dimension of the problem while the second dimension concern about the handling of mobility by the architecture in context of static or dynamic mobility. Through the use of static host identifiers and a potentially flat namespace host mobility consideration are resolved which allow nodes to freely move about the topology with minimal negative impact on connectivity. When the mobile router moves, it simply updates the publish and subscribe requests to the rendezvous system, which updates the forwarding tables in the network to deliver data to the new location.

7. CONCLUSION AND FUTURE WORK

This paper outlined the work done in the PSIRP project so far to promote and prop up the vision of future internetwork design by giving complete description of implementation and architecture of PSIRP. In particular, we elaborate clear objectives against which we can compute current and any future progress of work in this area. We observe that publish/subscribe paradigm proffer a flexible, scalable, and secure architecture design for future internet. The PSIRP is quite competent and proved to be a very functional and practical architecture in resolving many of the issues of current traditional internet architecture. Most notably mobility, security, scalability, robustness and data caching problems are resolved in a very intelligent and smart way by this new born architecture from which one can determine the effectiveness and efficiency of PSIRP.

Hence, many of the issues addressed in this paper, such as identifiers, the concept of scope, rendezvous, caching, forwarding and transport, will see further progress in the near future. This is a fresh new design for future internet and also not very mature though PSIRP is very competent solution as compared to all other proposed solution, still there are a lot of work remains to be done. Some of those future considerations are given here.Since mobile devices are multiplying day by day so PSIRP should debate how to optimize the rendezvous system for this. Also the network should be optimized to support for countless handovers and multithoming.

Migration plan from current network to the new PSIRP based network is a very long term work so deployment issues must be deeply studied and a migration plan should be proposed. Labels could be defined to include public keys so that all pub/sub operations are forced to employ authentication and encryption services. Moreover, entities could generate their own public/private key pairs for use in situations where anonymity is desired. The publisher identity, Subscriber identity and anycast feature globally or locally as discussed in this paper, are some unresolved features that must be addressed in time for the successful deployment of this new flexible and reliable architecture.

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