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BROADBAND INDIA FORUM
"Think Tank for Digital Transformation"

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16th September, 2020

Mr. Sachin Rathore,
ADG (NT-1),
Networks & Technology Wing,
Department of Telecom,
Ministry of Communications,
New Delhi

Sub: Seeking Comments from various stakeholders on New Framework for IP as proposed by Huawei Technologies, et al

Dear Sir,

This is with reference to your mail dated 9th September seeking inputs on the aforesaid subject.

At the outset, to assess the impact that accepting or rejecting this proposal will have on the functioning of the Internet, which is the *de facto* backbone for Digital India, we wish to state that we need more time to deliberate over the proposal with a larger group of stakeholders which includes industry, tech and research institutions, academia, civil societies, etc. It is only after a careful study along with deliberations, that a clear position can be evolved which takes into account the merits and demerits of the proposed framework in the context of:

1. Openness and multi-stakeholder participation in Internet governance, which the proposal effectively goes against by prescribing a more centralized approach.

2. Promoting a level-playing field and encouraging a bottom-up approach so that technical standards are informed by users and the industry and controlled by a few interested parties.

3. Maintaining inter-operability so that Internet users, whether individual consumers, business or even governments, can continue accessing the information and services from around the world without incremental barriers.

4. Data privacy and data security aspects, which need to be studied in great detail to ensure that the proposed new architecture does not allow bad users to manipulate access to and use of the Internet based on by overtaking the central controls and otherwise encroach on users' privacy and other rights.

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5. Costs and risks of migrating to and sustaining the proposed new architecture, including determining if these costs could trickle down to the end-user, restrict access to the Internet and widen the digital divide.

6. Whether there is an actual need for a complete overhaul of the current protocol system, given that it has proved to be resilient and adaptable over several decades, and that existing multi-stakeholder standards development organizations are already working to resolve many of the issues highlighted by the new proposal.

7. Innovation, and how the new proposal may actually discourage it instead of allowing it to thrive as the existing protocol has done.

8. Regulatory concerns from the perspective of net neutrality, law enforcement and data privacy, amongst others.

Our suggestion would be for the Govt. of India to request ITU-T for more time to deliberate on the proposal especially in the light of the COVID-19 pandemic which has emphasized the importance of the need for open, seamless, and robust networks, and given the major investments already made in the current architecture. While we understand that this is still at a proposal stage, it is important to ensure that an informed discussion takes place. The extended time would enable India to study the proposal more intensively before preparing a carefully crafted nuanced position, based on inputs from several important sets of stakeholders, which could be specific for emerging nations such as ours. Given the fact that the existing framework is still working and there are no credible reasons as on today, to believe that they will not continue to adapt to future needs. We would therefore request for more time to be provided to be able to carry out a more detailed assessment of the same.

Our preliminary point-by-point response to the initial set of questions in your letter is also attached herewith, for your kind perusal.

Thanking you,
Yours sincerely,
For Broadband India Forum

T.V. Ramachandran.
President.

Point-by-Point Response to the Queries

a) ***Shortcomings highlighted above in the existing IPv4 and IPv6 systems.***

The shortcomings highlighted are mostly shortcomings that are related to very specific deployment domains which usually are deployed on 'Intranets'. One of the main arguments is that in these specific application domains the IP stack provides a lot of overhead.

"The current system is not capable to handle heterogeneous networks" - IP internet working architecture was designed to support heterogeneous networks with different underlying technologies. Over decades of its existence and evolution, IP has shown remarkable scalability, both in terms of transmission speeds (from 2.4Kbit/s to Tbit/s), technologies (from xDSL, fiber, radio and satellite communications) and applications from file transfers and remote terminals to streaming high-resolution video. IP has been designed specifically for this purpose - to provide a common network layer for a wide diversity of interconnected networks - a corner stone of network interoperability. IP can also meet the requirements of specialized networks, such as IoT. An example of this is 6LoWPAN, a work track in the IETF that addresses the needs of IoT devices that operate on extremely low power in order to attain decades of battery life. [See https://tools.ietf.org/html/rfc4919 for an overview of the requirements that are the basis of various specifications].

The IP layer itself does not introduce the constraints mentioned (e.g. inability of deterministic forwarding or lack of trust and security) - these capabilities can be built at the upper layers of the architectural stack, providing adequate solutions to specific requirements.

Most of the shortcomings mentioned are not technical but economic in nature. Inter-domain quality of service (needed for high-resolution immersive multimedia over the Internet) can be offered using current day signalling mechanism in IP (The IETF's work in this area dates back to the 1990s and spans the development of such technologies as Integrated Services (IntServ), Resource ReSerVation Protocol (RSVP), Multiprotocol Label Switching (MPLS), Differentiated Services (DiffServ), and Active Queue Management (AQM). Over the last five years we have seen an intense focus in this area targeting HTTP; Transport Layer Security (TLS); QUIC; Deterministic Networking (DetNet); and Low Latency, Low Loss, Scalable Throughput (L4S), among others.) However, inter-domain quality of service depends on contractual relations across the full mesh of network providers in the path which are simply not available.

In controlled (single domain) networks we often see these QOS guaranteed by layer 2 technologies. An example of that is triple play - where consumers are offered television, telephony, and broadband Internet services. Note that in these cases the fact that IP is still the interoperability layer (IP-tv and voice over IP respectively) makes for cheap consumer devices.

This is not to say that current-day IP technology is sufficient to solve tomorrow's use-cases. The argument is that IP has proven to be able to evolve based on the abilities that individual networks offer, and the needs that applications have. TCP/IP has proven incredibly adaptable and resilient for over 50 years and has been uniquely responsible for the success and global growth of the Internet. It has consistently demonstrated the ability to adapt to new technologies, use cases, and demands, including the use cases that the new proposal outlines. The problems New IP purports to address are either unfounded or already the subject of work in existing standards development organizations like the IETF.

b) How the existing IP (IPv4 & IPv6) architecture are addressing the requirements of claims proposed in the new architecture i.e. how the existing IP framework is going to support heterogeneous networks, deterministic forwarding, intrinsic security, ultra-high throughput and user-defined customized request for network services?

The Internet and its IP based architecture have always supported heterogeneous networks - wired and wireless, low and high bitrates, etc. They have *demonstrated* to be flexible enough to support many different applications.

There might be highly specialized applications where IP is not the protocol of choice - these are often also cases where inter-networking may not be required. A set of factory robots may not (and probably should not) be connected directly to the Internet, their controller may. In other words, the network between the controller and the robots is highly specialized whilst the controller is generic.

Some of the requirements are related not to the IP protocol itself, but other protocols of the TCP/IP suite, for instance transport protocols. It is entirely possible to develop a new protocol on top of IP to meet such specific requirements. An example of such development is QUIC [https://tools.ietf.org/html/draft-ietf-quic-transport].

The IETF liaison statement makes the case that "*heterogeneous address spaces without a common substrate implies complex translation to achieve interchange among the different domains. Such translation likely increases fragility and latency while requiring additional network state to achieve interoperability.*"

c) What are the current position of developments by domestic/ international standardization bodies in reference to challenges mentioned in Sr. No. 2.

We support ongoing work within multi-stakeholder standards development organizations like the IETF, IEEE, and W3C to continue the Internet's technical evolution.

We refer to the IETF liaison statement. In addition, we note that deterministic networking is being

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studied and standards are being developed in several key organizations:

- IEEE 802.1 Time Sensitive Networking (TSN) Task Group [TSN] is developing extensions to support time sensitive networking using IEEE 802.1 networks.
- IETF Deterministic Networking (detnet) and Reliable and Available Wireless (raw) working groups are developing RFCs to support deterministic networking on routed networks and to interwork with IEEE 802.1 TSN. The IETF's Transport Area also continues its work in this area, for example its investigation of Low Latency, Low Loss, Scalable Throughput (L4S) Internet Service and active queue management.
- 3GPP is defining standards to support its 5G ultra-reliable low latency communications (URLLC) capability over the Radio Access Network (RAN) as well as interworking with 802.1 TSN networking.
- ITU-T SG15 is working with IEEE 802.1 TSN and 3GPP (5G) related to its transport-related recommendations.

The above listed efforts tend to focus on applications that exist within a single administrative domain.

It should also be noted that the 5G architecture, of which the IP architecture is an integral element, offers possibilities for specific applications through its slices. In addition, current LTE (4G) mobile services use IP as the data bearer in worldwide deployed network architectures.

d) Whether basic objective of internet which was designed to interconnect different network types cannot fulfill requirements to inter-connect various autonomous subsystems?

The Internet architecture was designed to interconnect diverse autonomous networks. This architecture also allowed the individual networks to evolve to meet specific requirements (e.g. CDNs). This ability to interconnect and facilitate interoperability is the strongest feature of the Internet architecture and IP in particular.

e) How the existing traditional IP architecture shall be able to address new future requirements that are arising from recent developments in emerging technologies.

The IP architecture has been able to address requirements that have arisen so far and has a track record of being flexible in its application.

The IP layer itself does not introduce the constraints mentioned (e.g. inability of deterministic forwarding or lack of trust and security) - if needed, these capabilities can be built at the upper layers of the architectural stack, providing adequate solutions to specific requirements.

Today, billions of smart/IoT devices are connected to the Internet, with service providers offering dedicated platforms that allow to seamless experience for the end user, whether a consumer or an enterprise. Access to the Internet can be through various mobile services, or Wi-Fi or more specialized access protocols such as LoRaWAN - for low power, low bandwidth devices. The key point is that the Internet, today, is able to accommodate the explosion of connectivity requirements resulting from proliferation of smart interconnected devices as an emerging technology.

Part of the flexibility also arises from the "bottom up" approach followed so far, which reflects multi-stakeholder collaboration and collaborative governance practices. In contrast, New IP establishes a "top down" system completely controlled by a single chokepoint. This could, in the long run, end up compromising on the flexibility of the system in addition to risks of partisan interests dominating regulation of the internet. It also gives rise to significant concerns on exercising mala fide powers to exercise a switch-off function, discriminate between users, and enable surveillance.

f) What may be the estimated Cost and migration time for Migration to a new architecture.

Technical costs

The network effect of the IP architecture, that allows billions to connect to billions, is apparent to any observer. We cannot estimate an exact number, but the following factors are relevant in thinking about the economics:

- In order to provide 'backwards compatibility' with the IP architecture - which is needed to benefit from all services and applications that are built on top of IP - this may involve gateways that impose cost (either by introducing some jitter, delay, or fragility or by imposing a service fee). Experience has shown that network protocol interworking through gateway functions result in significant impact on end-to-end quality of service delivery due to mismatch of quality of service classifications.
- India has made enormous investments in IPv6 deployments and is one of the leading countries with close to 70% deployment (see https://stats.labs.apnic.net/ipv6).
- The new architecture is more service based and less towards offering a commodity service. This will impact consumer prices.
- A new architecture will mandate the deployment of new network hardware components. This will impose a significant cost of replacing existing networks and jeopardizing investments made by service providers over the years.

Adoption of IPv6 may give an indication of how challenging a transition in an inter-domain environment may be. When effective use of a technology depends on other parties (other autonomous networks) diffusion of innovation may take a long time, and co-existence may create technical challenges and increase cost. Compared to IPv6, which did not alter the architecture, migration to the new architecture will be much more expensive. It may also significantly

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undermine interoperability between the networks and applications, undermining investments and reducing social and economic benefits that the Internet delivers today.

We are of the view that retaining and evolving the current Internet Protocol suite would allow both existing and future use cases to benefit from the building on present set of technologies. That would mean significant capital and operational savings as well as avoiding the uncertainties, risks and costs of transitioning to an entirely new system.

Regulatory costs

In addition to technical costs, the regulatory considerations and costs of switching to a fundamentally new kind of network also need serious deliberation. At present, the “end-to-end principle” is one of the defining features of the Internet, and it essentially states that network features should be implemented as close to the end points of the network (the applications) as possible. This is commonly expressed by describing the system as a "dumb" network with "smart" terminals. Intelligence being held by users rather than networks has often been characterized as one of the primary determinants of success of the internet.

The new model proposes “application aware” networks, which is a divergence from the established norms on the internet. Thus, we have to carefully review any proposal which changes the nature of the network to assess its compatibility with regulatory aspects of net neutrality, law enforcement access etc.

g) Whether existing architecture may be scalable or a complete new architecture is needed keeping in view of Network 2030 and beyond requirements and their complexities.

Existing architecture has proven to be able to meet changing demands, by adapting or developing new technology building blocks, like better transport protocols, or by deploying interoperable specialized networks, like CDNs. There is no reason to suggest the new requirements cannot be met. It is true that some of the building blocks may need to be developed, but that can be done within the existing architectural framework. We need a thorough gap analysis identifying building blocks that need to be developed, not a top-down wholesale redesign. Once specific new requirements are identified, following a thorough gap analysis, these requirements can be addressed at relevant Standards Development Organizations (SDOs) - e.g. IETF, IEEE, 3GPP.

It is important that such development follows an open and inclusive standard development process. Also, as stated in the IETF liaison statement to the ITU-T TSAG (in response to "LS on New IP, Shaping Future Network"): "The IETF maintains copyright and change control for the IP specifications in the interests of global interoperability. If the intent is to extend IETF protocols, we would like to draw your attention to the previously published IETF Best Current Practice document “Procedures for Protocol Extensions and Variations” (RFC 4775, BCP 125) which

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describes the general procedures to be followed in extending or modifying IETF specifications. Requirements for extensions or modifications to IETF technologies must be discussed with the IETF before any are worked on in other SDOs, including the ITU-T."

We are of the view that technology should reach a sufficient maturity before standardization. New IP is only theoretical at this point, so we believe it is inappropriate to develop a technical standard for it at present.

h) How interoperability issues may be addressed in present IP Architecture regime?

The present IP architecture supports interoperability between networks both on network, transport and application layers. Technologies and networks that cannot directly interoperate with IP will need sophisticated gateways to interconnect with the Internet. In such a scenario, deployment strategy will be very challenging - for example while in IPv6 case it was relatively easy to provide tunnels through the IPv6 networks to interconnect isolated IPv6 islands, it is much more complex and expensive to build tunnels that support QoS requirements. Experience has shown that network protocol interworking through gateway functions result in significant impact on end-to-end quality of service delivery due to mismatch of quality of service classifications.

i) How proposed claim i.e. flexible address space that can contain IPv4 or IPv6 addresses, may address interoperability issues presently with IP routing or the Internet.

The question implies that there are interoperability issues presently with IP routing or the Internet - we do not agree with that premise.

We again refer to the IETF Liaison Statement - which argues that the New IP architecture is likely to have some issues when it comes to routing "*heterogeneous address spaces without a common substrate implies complex translation to achieve interchange among the different domains. Such translation likely increases fragility and latency while requiring additional network state to achieve interoperability.*"

In other words, going from one 'flexible address' to another will need some form of translation. For interoperability between different networks with different address classes, that may lead to interoperability issues when the translator between those address classes is not available (e.g. because of price, or upgrade path).

j) How guaranteed delivery of information over a network certain parameters may be ensured with current IP regime?

The IP architecture is designed to deal with packet loss - it assumes that not all packets will arrive and allows transport protocols (like TCP and QUIC - a now 8-year-old transport protocol) to correct for transmission errors. Those transport protocols guarantee delivery of information.

As for specific quality of service elements such as jitter and delay, several technologies are available (Integrated Services (IntServ), Resource ReSerVation Protocol (RSVP), Multiprotocol Label Switching (MPLS), Differentiated Services (DiffServ), and Active Queue Management (AQM), and based on market pressures and service requirements, new ones can, and will, no doubt be developed.

In addition, research and development of new standards addressing deterministic network performance is the focus of collaboration of several standards development organizations, including:

- IEEE 802.1 Time Sensitive Networking (TSN) Task Group [TSN] is developing extensions to support time sensitive networking using IEEE 802.1 networks.
- IETF Deterministic Networking (detnet) and Reliable and Available Wireless (raw) working groups are developing RFCs to support deterministic networking on routed networks and to interwork with IEEE 802.1 TSN. The IETF's Transport Area also continues its work in this area, for example its investigation of Low Latency, Low Loss, Scalable Throughput (L4S) Internet Service and active queue management.
- 3GPP is defining standards to support its 5G ultra-reliable low latency communications (URLLC) capability over the Radio Access Network (RAN) as well as interworking with 802.1 TSN networking.

Also, the ITU-T SG15 is working with IEEE 802.1 TSN and 3GPP (5G) related to its transport-related recommendations.

k) How the present system can address the physical limitations associated with data traversing distance?

Physical limitations such as speed of light and limits of spectral capacity are limits exposed by physics, they cannot be solved by engineering efforts - for **any** system. This sets some natural limits on communication. For instance, in glass fibre, light will take 1 ms to traverse approximately 200km. Making sub ms responses (two way) becomes impossible around 100km distance.

Reference documents on the topic:
Discussion Paper: An analysis of the "New IP" proposal to the ITU-T published by Internet Society