

Application-aware Networking and Path Awareness

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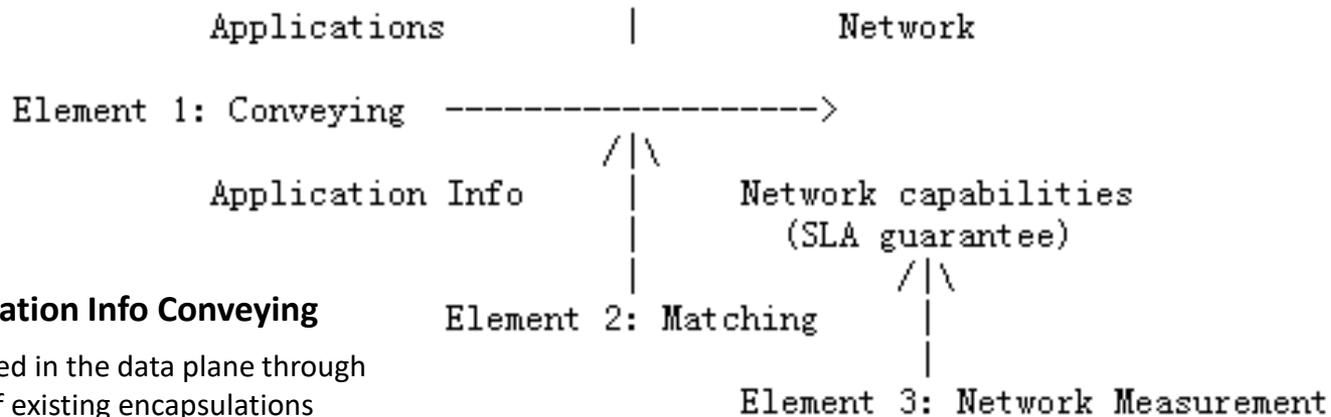
Motivations – Why APN6?

- The network operators need to be able to provide fine-granularity and even application-level SLA guarantee to achieve better Quality of Experience (QoE) for end users
 - 5G and verticals generates more and more applications with diverse network requirements
 - Revenue-producing apps: online gaming, live video streaming, enterprise video conferencing with much more demanding requirements
- Network operators are typically unaware of which applications are traversing their network, which is because network is decoupled from app
 - Not able to provide fine-granularity traffic operations for specific applications
 - Without corresponding revenue increases that might be enabled by differentiated service providers.
- **Adding application knowledge to the network layer** enables finer granularity requirements of applications to be specified to the network operator (even by app)
- As IPv6/SRv6 is being widely deployed, the programmability provided by IPv6/SRv6 encapsulations can be augmented by conveying app info

How APN can help?

- APN6 aims to
 - satisfy the application-awareness/visibility requirements demanded by new services
 - provide differentiated service treatment and fine-grained traffic operations
- APN6 uses IPv6/SRv6 network programmability to convey app info in the data plane allowing finer grained requirements from apps to be specified to the network
- APN6
 - conveys the application information into the network infrastructure
 - ✓ E.g. application identification, SLA/service requirements
 - allows the network to quickly adapt and perform the necessary actions for SLA guarantees
 - ✓ E.g. steer into an SRv6 path with SLA guarantee

APN6 Key Elements



Element 1: Application Info Conveying

- App info conveyed in the data plane through augmentation of existing encapsulations
- SHOULD NOT be enforced but provide an **open option** for app to decide whether to input this app info into its data stream

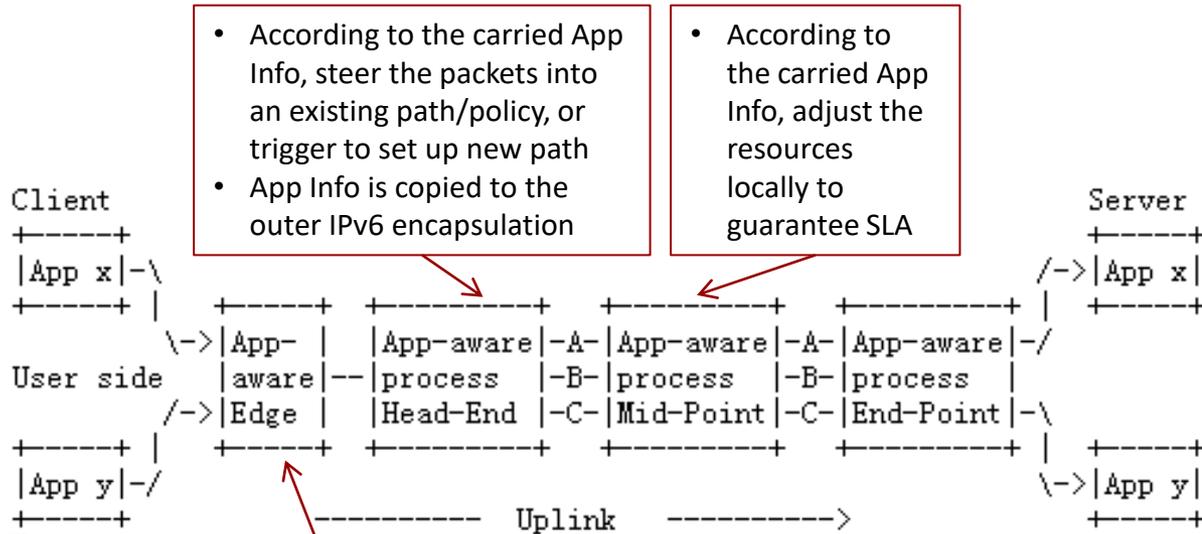
Element 2: App info and network capabilities matching

- Open the network capabilities to apps
- According to the app info, appropriate network services are selected, provisioned, and provided to the demanding applications to satisfy their performance requirements

Element 3: Network performance measurement

- According to the measurement to update the match between the app and corresponding network services for better fine-granularity SLA compliance

APN6 Framework



- With APN6, the network is aware of the service requirements specified by applications or derived
- According to the service requirement information in IPv6 packets the network is able to adjust its resources fast in order to satisfy the service requirement of applications
- The flow-driven method also reduces the challenges of inter-operability and long control loop

The advantages of using IPv6 to support APN6

- **Simplicity**
 - Conveying application information with IPv6 encapsulation can just be based on IP reachability
- **Seamless convergence**
 - Much easier to achieve since both app and the network are based on IPv6
- **Great extensibility**
 - IPv6 encapsulation can be used to carry very rich information relevant to applications
- **Good compatibility**
 - If the application information not recognized, the packet will be forwarded based on pure IPv6
- **Little dependency**
 - Information conveying and service provisioning are only based on forwarding plane of devices
- **Quick response**
 - Flow-driven and direct response from devices since it is based on the forwarding plane

APN6 Use Cases

- The use cases that can benefit from the application awareness introduced by APN6
 - Application-aware SLA Guarantee
 - ✓ enable to provide differentiated services for various apps and increase revenue accordingly
 - ✓ enable network operators to provide fine-granularity SLA guarantees
 - Application-aware network slicing
 - ✓ have customized network transport to support some app's specific requirements, considering service and resource isolation
 - ✓ serve diverse services and fulfill various requirements of different apps at the same time, e.g. the mission critical app can be provisioned over a separate network slice
 - Application-aware Deterministic Networking
 - ✓ Match to a demanding app flow into a specific deterministic path
 - Application-aware Service Function Chaining
 - ✓ Match to an app flow into a specific SFC and subsequent steering without the need of DPIs
 - Application-aware Network Measurement
 - Application-aware Networking Use case of Edge Computing
 - ✓ Edge Computing is a new trend that might influence the network. It may be difficult to update all the operator's devices, but more easily to change the edge device.

Security Considerations

- Since the application information is conveyed into the network, it does involve some security and privacy issues
- APN6 only provides the capability to the apps to provide their profiles and requirements to the network, but it leaves the apps to decide whether to put or not
 - If the applications decide not to provide any information, they will be treated in the same way as today's network and cannot get the benefits from APN6
- Once carried, the IPv6 extension headers, AH and ESP, can be used to guarantee the authenticity of the added application information
- An accurate valuation of security mechanism would be required in order to prevent any leak of critical information
 - Welcome to work together with us
- Some additional considerations may be required for multi-domain use cases.
 - For example, how to agree upon which application information/ID to use and guarantee authenticity for packets traveling through multiple domains (network operators)

IETF 105 & Next Steps

APN6 Side Meeting @ IETF105

- Thursday Morning @Notre Dame
- Attendee: 50+

Agenda

1. **Admin** (Chairs) [5 : 5/75]
2. **Problem Statement and Requirements** (Zhenbin Li) [10 : 15/75]
3. **Application-aware Information Conveying**
 - a) Framework of App-aware IPv6 Networking (Shuping Peng) [10 : 25/75]
 - b) Firewall and Service Tickets (Tom Herbert) [10 : 35/75]
 - c) SRH Metadata for Simplified Firewall (Jim Guichard) [5 : 40/75]
4. **App-aware Services**
 - a) IPv6-based DetNet (Yongqing Zhu) [5 : 45/75]
 - b) SRv6 Path Segment (Fengwei Qin) [5 : 50/75]
 - c) IPv6-based IFIT (In-situ Flow Information Telemetry) (Haoyu Song) [5 : 55/75]
5. **Shaping Our Discussion** (Chairs and Room) [15 : 70/75]
6. **Wrap Up** (Chairs) [5 : 75/75]



Operators, Vendors, Universities, OTTs, Enterprises

<https://github.com/shupingpeng/IETF105-Side-Meeting-APN6>

Next Steps:

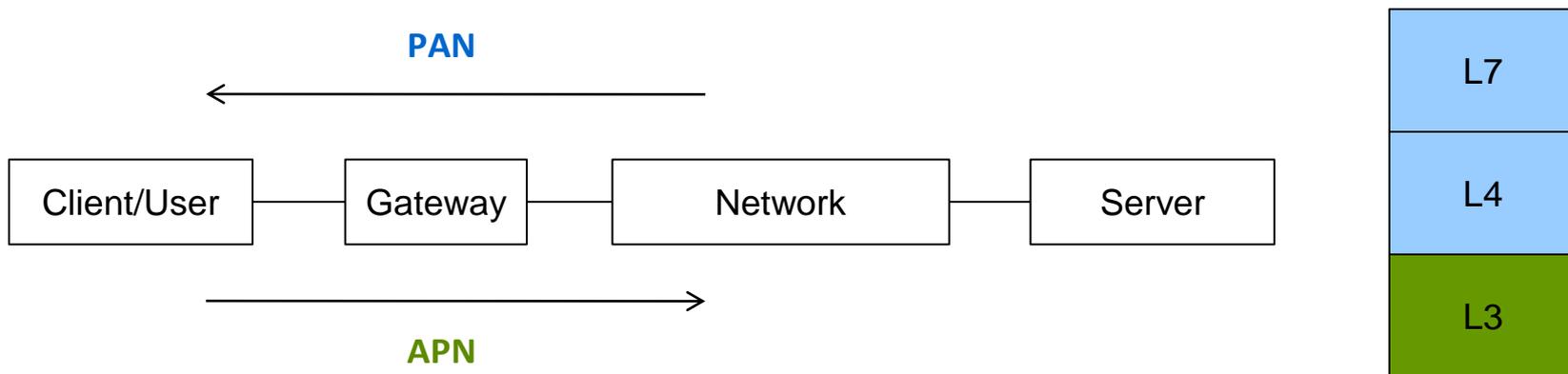
- Setup Mailing list to continue discussions
- BoF @IETF108

Looking for suggestions on how to move forward

Area	Topic	Draft
APN6	Problem statement and use cases	draft-li-apn6-problem-statement-usecases
	Application-aware IPv6 Networking	draft-li-apn6-app-aware-ipv6-network

The connection between PAN and APN

- What is same?
 - Better network and application service
 - The interaction between network and user/endpoint/application
- Differences



PAN: endpoints/applications get path information, and select path. Working in L4/L7.

APN: endpoints/applications tell the requirements to network. Working in L3.

Some considerations about PAN

- Today's network: best effort, so customer won't expect too much of it. In most cases, they can tolerate its reliability/instability.
- Network will be better than before.
 - 5G of mobile network can give a low latency, high bandwidth and multi-access connection.
 - Some new trends like TSN、DetNet、Computing in the network put forward high demand of network
 - Network programmability: the interaction between network and user/endpoint
- What Pan wants to do may be related to these new directions.
- Some protocols that are not feasible after analysis in draft-irtf-panrg-what-not-to-do-07 may have the possibility to be used or give the direction of some new protocol/technique.
 - IPv6 Flow label
 - Non-deployment because of the endpoint Implementation and operational support
 - SRVP
 - Non-deployment because of the cost to update devices and maintainance of every flows' status.

Some considerations about PAN

- Existing services that are little similar with PAN
 - When downloading something, users can choose
 - ✓ different servers
 - ✓ different network points
 - ✓ different operators
 - When playing games, users can choose
 - ✓ different network points by themselves
 - ✓ automatic service which will choose different paths by application

Some considerations about PAN

- Key problem

Business : who operates the network, endpoint/app or operator?

Cooperation:

APP provider can rent network's operation right from operator.

Motivation:

A few typical applications which account for most traffic may be care more about the SLA.

If operator can really have some benefits from sell the controlling right, it can be done.

Difficulties:

It requires the development of device in operators' network, and some new management about the new bussiness.

Technology: which protocols can make pan successful?

draft-irtf-panrg-what-not-to-do-07 gives a good analysis.

Need common exploration of multiple technologies.

Thanks! !