

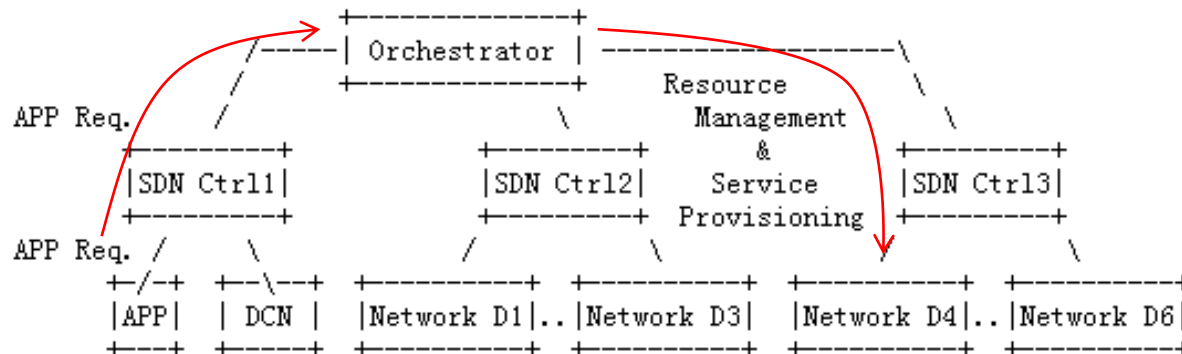
APN6: Application-aware IPv6 Networking

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 prov.
- **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 is being widely deployed, the programmability provided by IPv6 encapsulations can be augmented by conveying app info

Challenges of Traditional Differentiated Service Provisioning

- The packets are not able to carry enough information for indicating applications and expressing their service/SLA requirements
- The network devices mainly rely on the 5-tuple of the packets or DPI
 - 5-tuples used for ACL/PBR matching of traffic
 - ✓ Indirect application information and not capable enough for new app identification
 - Deep Packet Inspection (DPI)
 - ✓ Introduces CAPEX and OPEX and Security/privacy issues
- SDN-based Solution
 - Orchestrator introduces application requirements so that the network is programmed accordingly
 - ✓ The loop is long not suitable for fast service provisioning for critical applications
 - ✓ Too many interfaces are involved in the loop introducing challenges of inter-operability

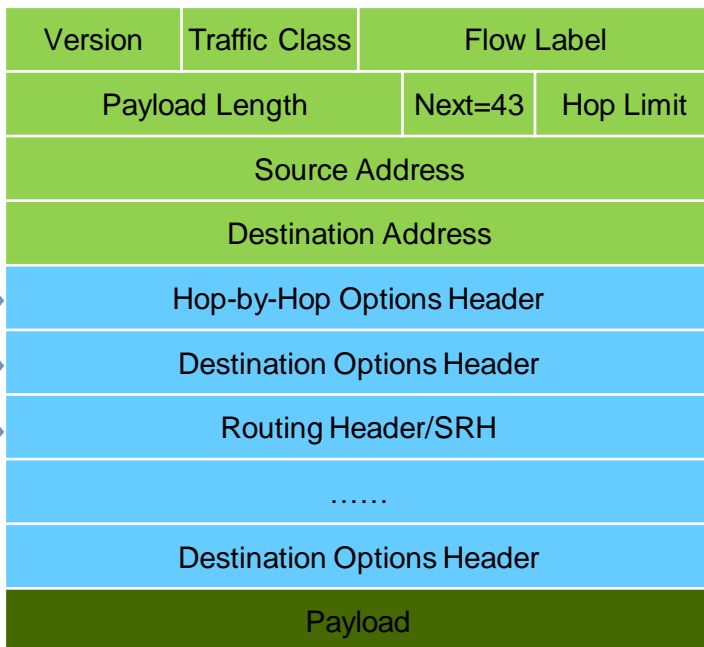


How APN can help?

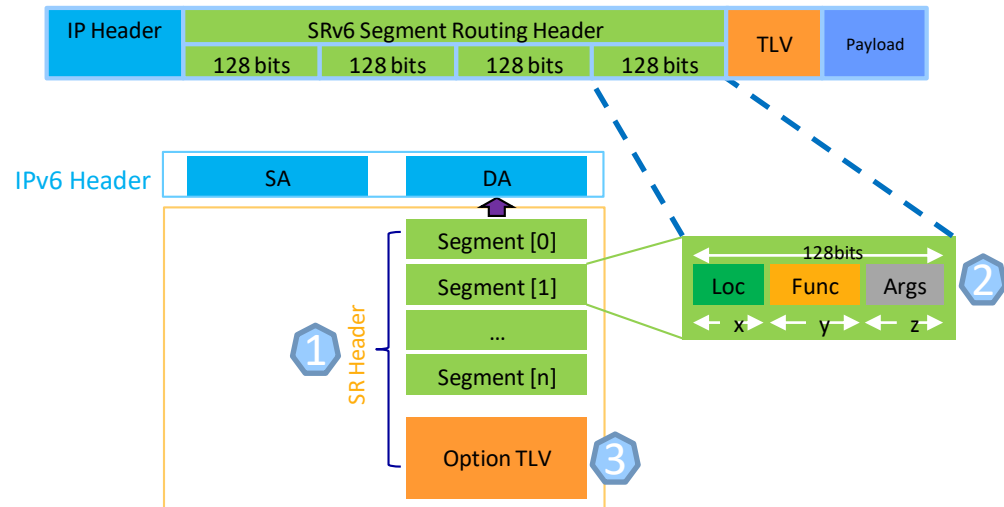
- APN6 aims to
 - satisfy the application-awareness/visibility requirements demanded by new services
 - provide differentiated service treatment and fine-grained traffic operations
- APN6 uses IPv6 network programmability to convey app info in the data plane allowing finer grained requirements from apps 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

Foundations for APN6 - Future-proof Programmability

IPv6 Extension Headers

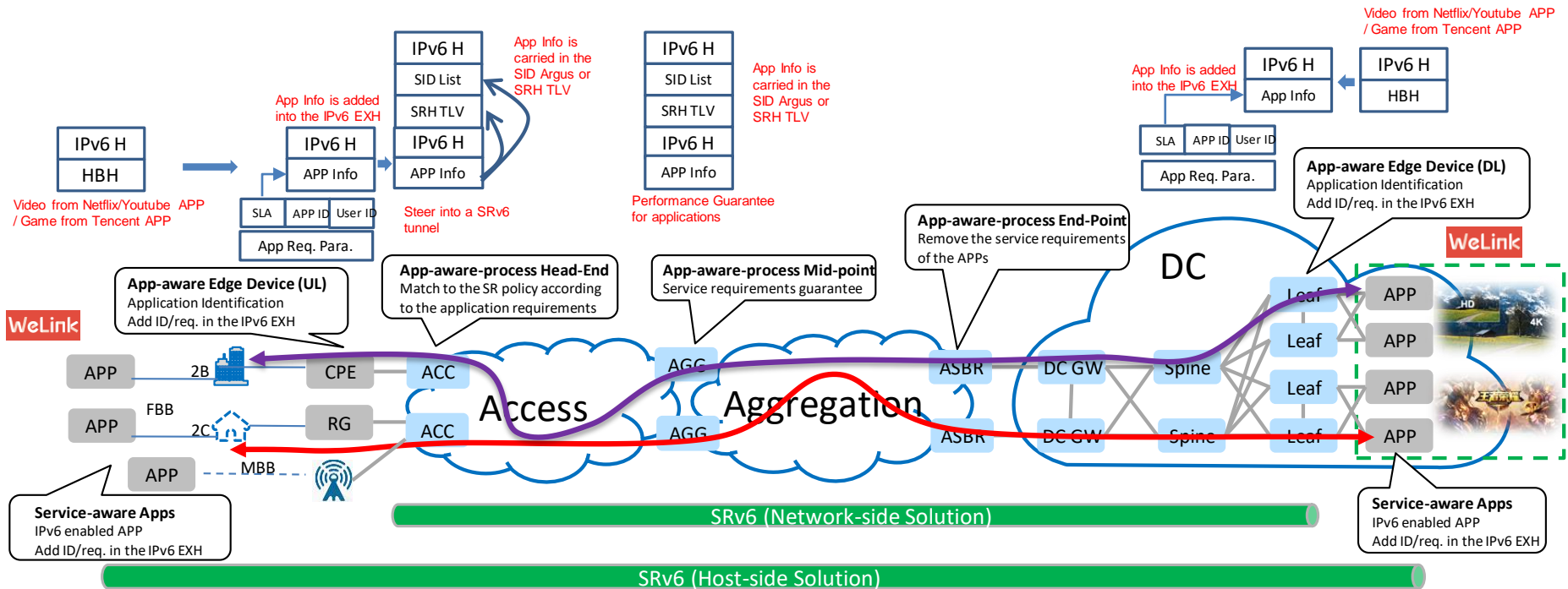


SRv6 SRH: Three Levels of Programmable Space



Application-aware IPv6 Networking (APN6)

- Make use of IPv6 extensions header to convey the service requirements along with the packet to the network
- To facilitate the service deployment and network resource adjustment to guarantee SLA for applications



App-aware IPv6 Networking (APN6) Framework

- APN6 is to make use of **IPv6 Extension Headers**
 - to convey the application related information including its requirements along with the packet to the network
 - to facilitate the service deployment and guarantee SLA

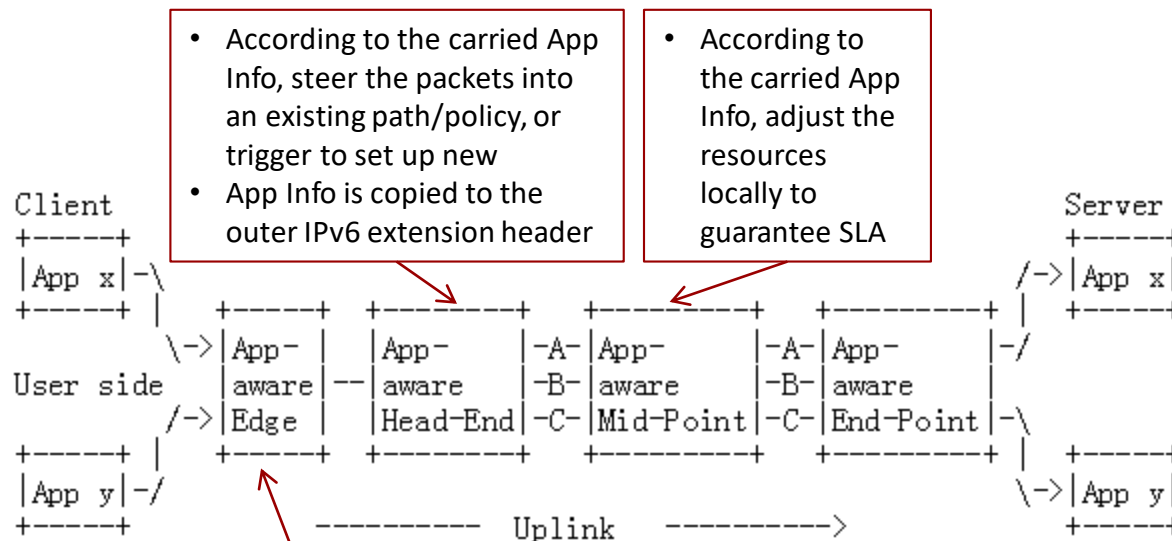


Figure 1 App-aware IPv6 Network

Optionally add the app information (ID, service requirements) in an IPv6 extension header

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- Derived from L2 QinQ Info

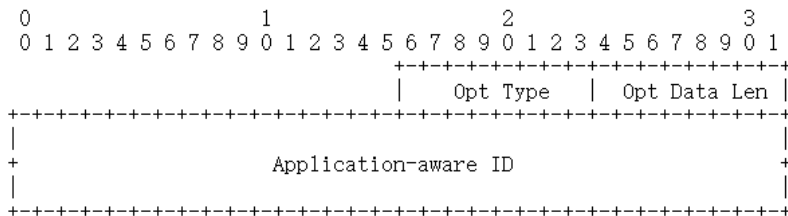
<https://tools.ietf.org/html/draft-li-6man-app-aware-ipv6-network>

Application-aware Options

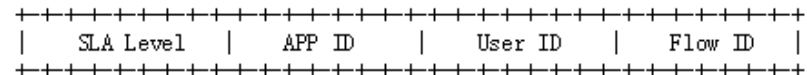
- **Application-aware ID option**
- **Service-Para Option**

Application-aware ID Option

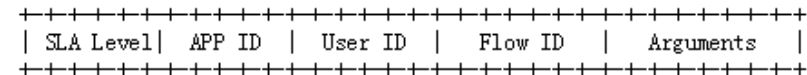
- Carrying application ID, user ID, flow ID, and service requirements/SLAs
- The length of the APP-aware ID depends on the locations
 - 128bits = IPv6 address = SRv6 SID = A address



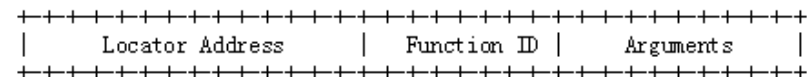
Structure I: Any combination of SLA level (e.g. Gold, Silver, Bronze), APP ID, and/or user ID, and/or Flow ID



Structure II: Any combination of SLA level (e.g. Gold, Silver, Bronze), APP ID, and/or user ID, and/or Flow ID, plus the arguments which indicating the service requirements of the identified application

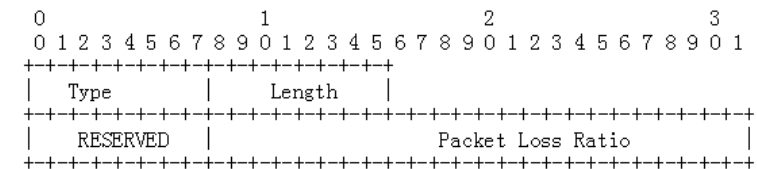
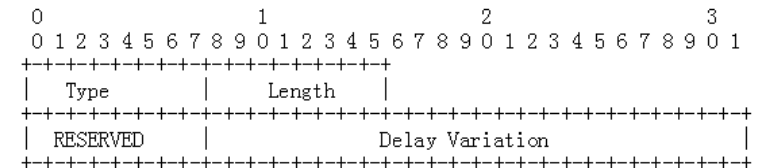
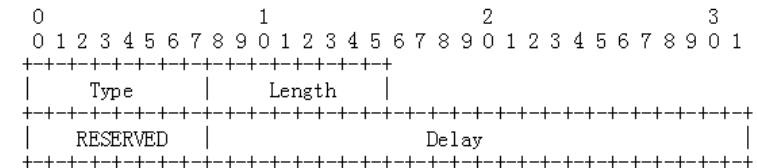
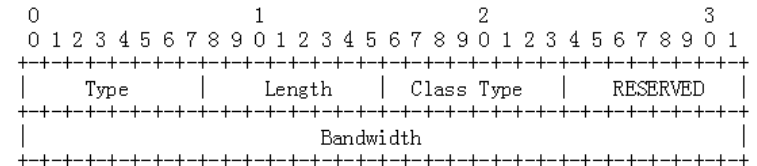
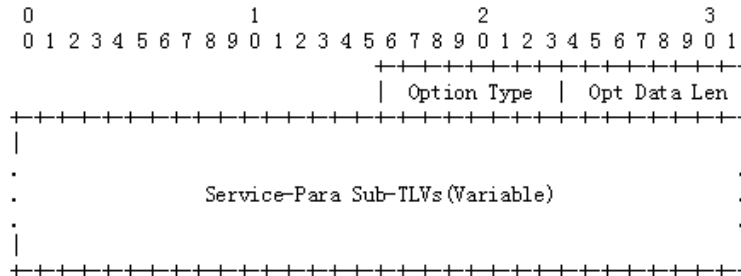


Structure III: An SRv6 SID, with its arguments as the information specified in Structure II

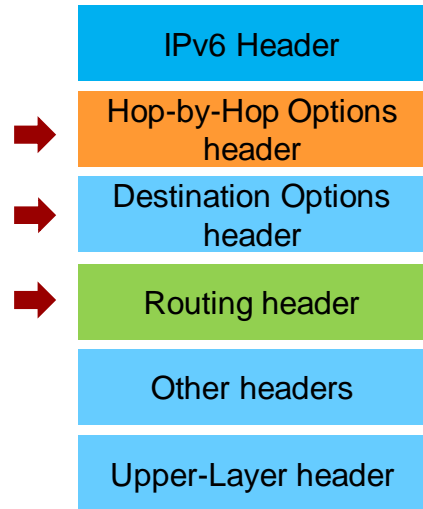


Service-Para Option

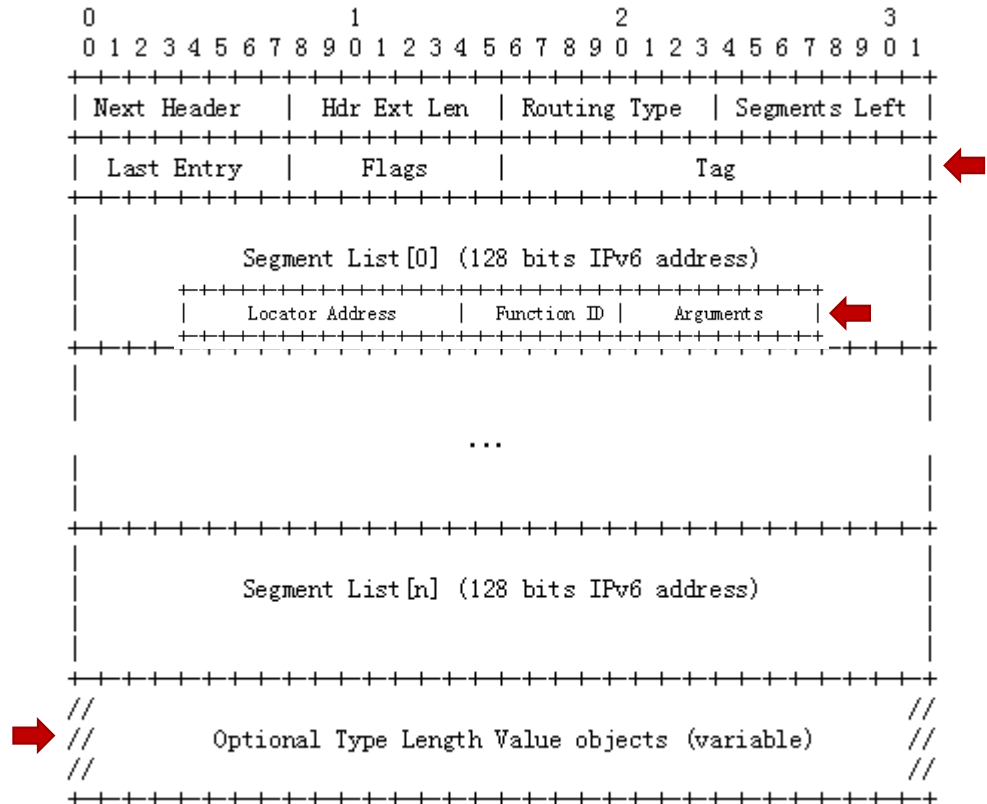
- Carrying the service requirement parameter



Locations for Application-aware Options

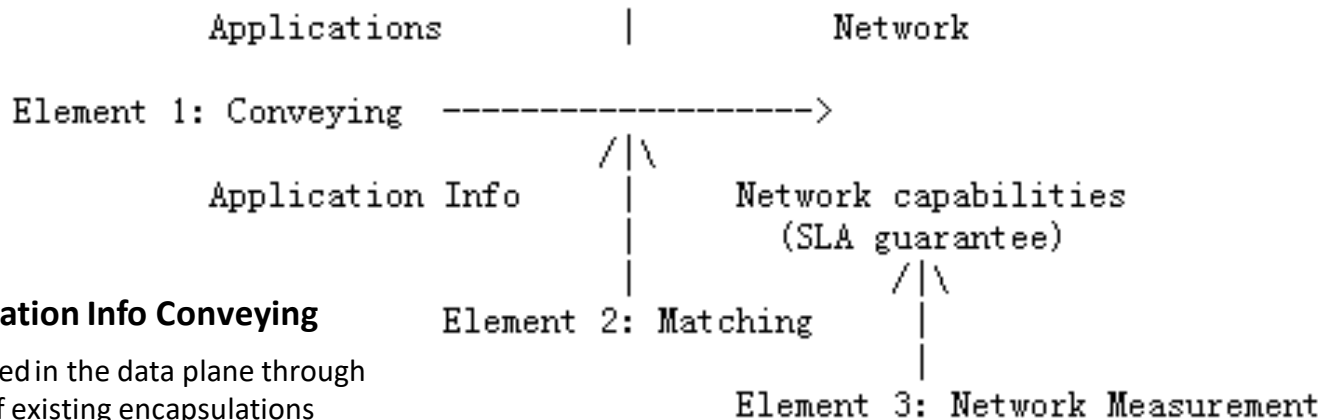


IPv6 Header [RFC8200]



draft-ietf-6man-segment-routing-header

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 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

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)

The Value of APN6 are Widely Received by Industry

APN6 first presented @ IETF104

APN6 Side Meeting @ IETF105

- 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]

<https://github.com/APN-Community>

Next Step

- IETF BoF/Side Meeting



Gov	中国信通院
Operators	
Vendors	
Research	
OTT	腾讯
Verticals	

Area	Topic	Draft	Authors
APN6	Problem statement and use cases	draft-li-apn6-problem-statement-usecases	
	Application-aware IPv6 Networking	draft-li-apn6-app-aware-ipv6-network	
	APN use cases in EC	draft-liu-apn-edge-usecase	
	APN use cases in Game Acceleration	draft-zhang-apn-game-acceleration-usecase	

Thank you!