# Application-aware IPv6 Networking (APN6)

draft-li-apn6-problem-statement-usecases-01
draft-li-apn6-framework-00

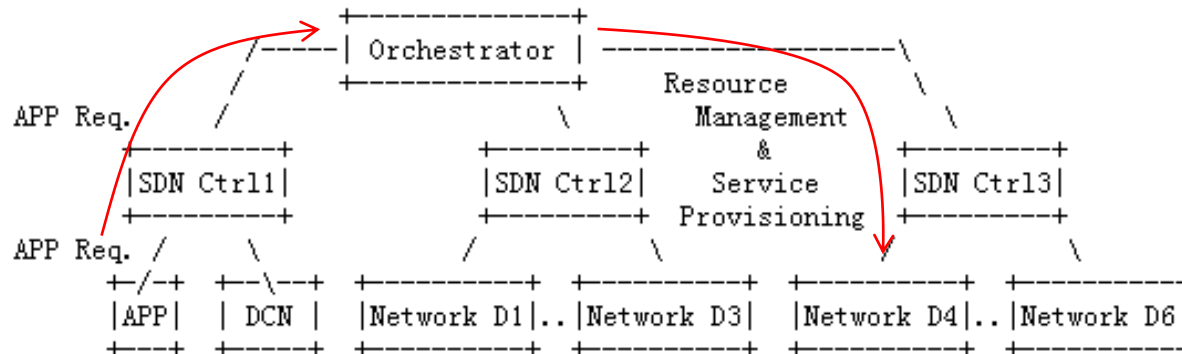| | |
|---|---|
| Zhenbin Li | Huawei |
| Shuping Peng | Huawei |
| Daniel Voyer | Bell Canada |
| Chongfeng Xie | China Telecom |
| Peng Liu | China Mobile |
| Chang Liu | China Unicom |
| Kentaro Ebisawa | Toyota |
| Stefano Previdi | Individual |
| James Guichard | Futurewei |

# 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/SRv6 is being widely deployed, the programmability provided by IPv6/SRv6 encapsulations can be augmented by conveying app info

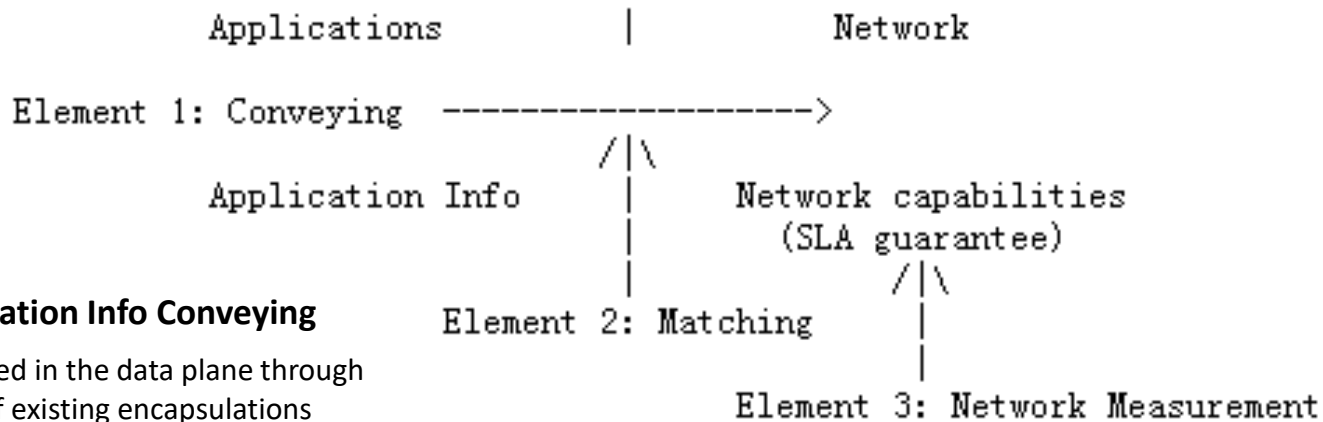# Challenges of Traditional Differentiated Service Provisioning

- 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

```
                              +--------------+
                      /-----| Orchestrator | ------------------\
                     /        +--------------+   Resource        \
 APP Req.           /                  \         Management        \
       +---------+              +---------+          &          +---------+
       |SDN Ctrl1|              |SDN Ctrl2|       Service        |SDN Ctrl3|
       +---------+              +---------+     Provisioning      +---------+
 APP Req. /      \              /         \                      /          \
   +-/-+  +-\--+  +----------+ +----------+  +----------+  +----------+
   |APP|  | DCN |  |Network D1|..|Network D3|  |Network D4|..|Network D6|
   +---+  +-----+  +----------+ +----------+  +----------+  +----------+
```

3

# 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

```
Applications              |          Network

Element 1: Conveying   ------------------->
                                /|\
Application Info         |     Network capabilities
                         |        (SLA guarantee)
                         |              /|\
             Element 2: Matching        |
                         |              |
                Element 3: Network Measurement
```

**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
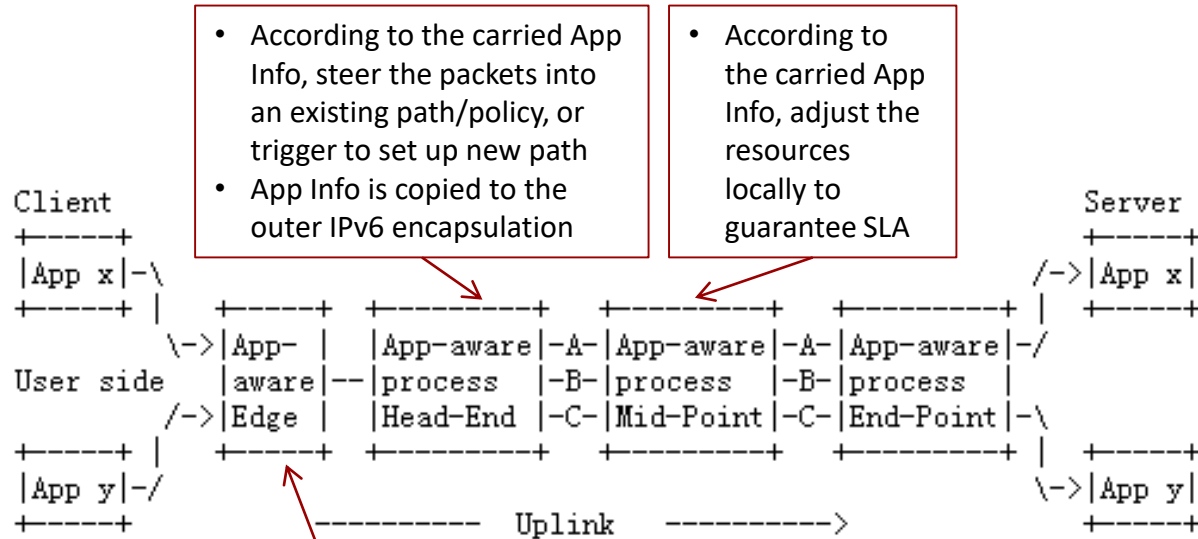
**Element 2: App info and network capabilities matching**

- 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

- According to the carried App Info, steer the packets into an existing path/policy, or trigger to set up new path
- App Info is copied to the outer IPv6 encapsulation

- According to the carried App Info, adjust the resources locally to guarantee SLA

```
Client                                                                              Server
+-----+                                                                             +-----+
|App x|-\                                                                      /->|App x|
+-----+ |    +-----+  +---------+  +---------+  +---------+ |   +-----+
        \->|App-  |  |App-aware|-A-|App-aware|-A-|App-aware|-/
User side  |aware|--|process  |-B-|process  |-B-|process  |
        /->|Edge |  |Head-End |-C-|Mid-Point|-C-|End-Point|-\
+-----+ |    +-----+  +---------+  +---------+  +---------+ |   +-----+
|App y|-/                                                                      \->|App y|
+-----+           ---------- Uplink  ---------->                          +-----+
```

Optionally add the app information (ID, service requirements) in IPv6 encapsulation

- Optionally add the app information (ID, service requirements) in IPv6 encapsulation on behalf of applications
- Derived from L2 QinQ Info
- Local policies

- 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

6

# 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

# 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 @IETF107

| 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 |