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Using SDN and Connectionless for IoTs

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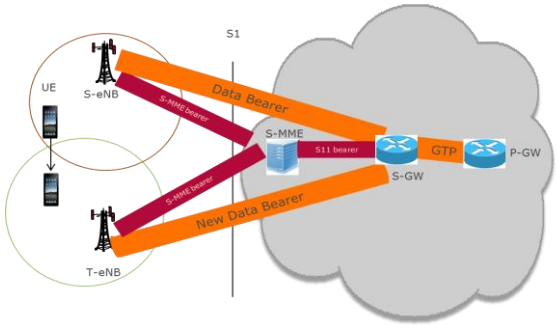
Abstract

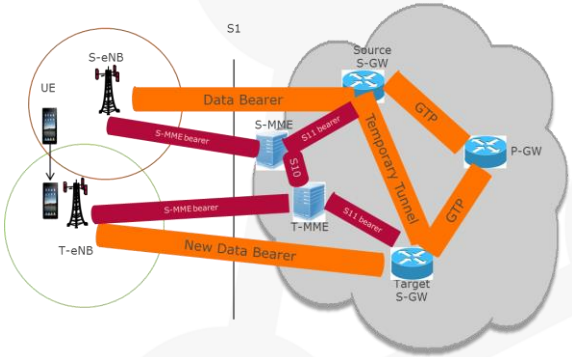
- Mobile traffic has been growing at a very fast pace. In addition, the variation of different types of end points, the variation of applications, and variation of mobility state of UE (whether a device is moving, and how fast) is growing. And the trend is continuing
- Traditional 3GPP tunnel/bearer based connection-oriented architecture will not scale cost effectively in 5G with 10's of billions of devices. This presentation describes how SDN and Internet Protocol (IP) can be combined to provide more flexible and scalable mobility across many wireless technologies, like LTE, Wi-Fi, and future 5G. Doing so, it also provides an efficient solution for the Internet of Things.

Existing Tunnel based Mobility Architecture

- Existing mobility architecture is based on connection-oriented GTP tunnel/bearers. While it has served well for mobile devices up to now, it faces significant challenges in supporting the emerging high-volume, low-ARPU IoT and M2M markets.



LTE S1-based intra S-GW Handover



LTE S1-based inter S-GW Handover

Connectionless Architecture Requirements

- We encourage the industry to explore other approaches to meet this challenge. Successful solutions need to meet the following high level requirements:
  - Support future wireless networks with higher degree of flexibility, programmability, and scalability. Efficiently support 10's of billions of devices.
  - Support many types of end devices and requirements, including:
    - IoTs with potential small and sporadic packet deliveries
    - M2M with mobile, nomadic, and fixed endpoints.
  - Need to reduce the amount of state and the replication of state maintained in the network – including large scale replication typical of supporting many disparate APNs.

A Connectionless Mobile Architecture

- The next few charts show an architecture that meets the requirements just presented.
- We introduce the interface (physical) IP address concept which is used by an SDN controller for mobility management.
  - UE physical IPv6 IP address - auto-derived through the following process:
    - Each cellular site, WiFi AP, or 5G TP has a prefix used for devices using the site over the air.
    - Each device has a burned-in physical address (e.g. lower 64bit).
    - The combination of the site pre-fix value and the device burned-in physical address can form an interface IPv6 address.
  - This physical IP address is used by the SDN controller for mobility management .
- In addition, we introduce Session layer address(es) as the service address for the device application layer such that the Session Management procedures in Cellular network layers becomes connectionless too.
- A device can have one or more such session address tuples for different application needs. This concept effectively replaces the concepts of APNs, PDP Contexts and PDN connections in the cellular network.

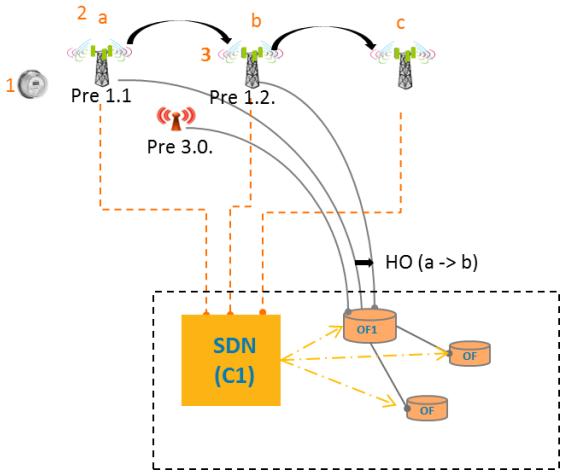
Use Case: Stationary or Nomadic Devices

Devices that are simple and stationary – like power meters, or smart city infrastructure.

Stationary devices – like those just listed – but with changes in attachment to the network either due to addition or removal of a base stations, or changing favored base stations based on signal variability.

Common smart devices – like smartphones – when the user is not mobile for some time. One or more applications can use this connectionless architecture during a period when it’s not likely to hand-off. For instance the user is sitting in a café watching a movie. This movie download can be delivered over this connectionless architecture.

A Connectionless based mobility Architecture



UE information (b4 HO for UE3)

UE	Session/Client address	Act1-addr	Act2-addr	Addr-1	Addr-2	Addr-3	Mob. state
1	10.10.0.1	1.1.0.1					S
2	10.10.0.2	1.1.0.2	3.0.0.2	1.1.0.2	1.2.0.2	3.0.0.2	S
3	10.10.0.3	1.1.0.3		1.1.0.3	1.2.0.3	3.0.0.3	M

Stationary IoTs

UE information (after HO for UE3)

UE	Session/Client address	Act1-addr	Act2-addr	Addr-1	Addr-2	Addr-3	Mob. state
1	10.10.0.1	1.1.0.1					S
2	10.10.0.2	1.1.0.2	3.0.0.2	1.1.0.2	1.2.0.2	3.0.0.2	S
3	10.10.0.3	1.2.0.3		1.1.0.3	1.2.0.3	3.0.0.3	M

Conclusion

- SDN & simple IP based connectionless architecture provides flexibility, programmability, quick TTM.
- Simpler and scalable wireless management primarily for IoT but also with re-use for nomadic and “sitting” devices.
- Decouples mobility from the wireless access, and thereby simplifies adaption of new Radio Access Technologies or mobility management features. This makes the approach highly adaptive to future changes and innovation.
- Common and open control across all wireless technologies, simplifies and provides software and system re-use.