ALTO Re-charter Item:
ALTO Cellular Network Information Service

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Proposed Paragraph

Extensions of ALTO to provide cellular network information to applications. Increasingly more applications use cellular networks to support mobile devices (user equipment, UE), and recent evaluations have demonstrated that information about cellular networks such as base station status and link status can improve application performance such as QoE. The working group will investigate extensions of basic ALTO information services to expose to mobile clients/applications about cellular network information on links between the UE and the network (e.g. throughput, delay, jitter) via obtaining general base station network information (e.g. CQI, SINR,MCS, RSRP/RSRQ). The extensions should clearly address dynamicity issues and security issues including authentication, authorization, and confidentiality about UE and network information. The working group will first define clearly its scope, in particular regarding its coordination with key SDOs including 3GPP defining related efforts such as NEF (network exposure function).

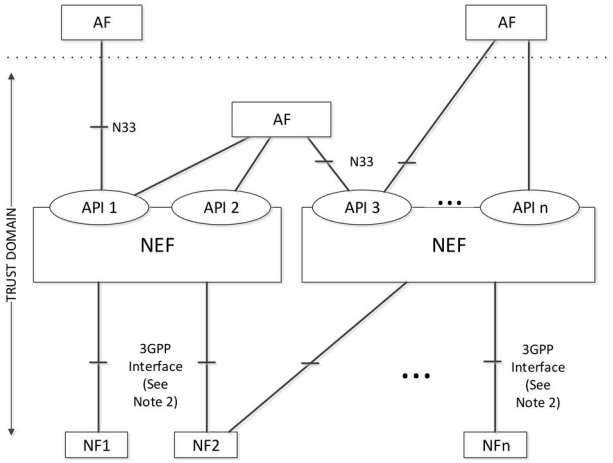
Details: Problem

- Issue 1: Whether it is feasible to obtain the cellular information?
- Issue 2: How does ALTO server obtain cellular information from 5G NEF?
- Issue 3：What cellular information is from ALTO server to ALTO client?
- Issue 4：What cellular information is exposed from 5G network to ALTO server?

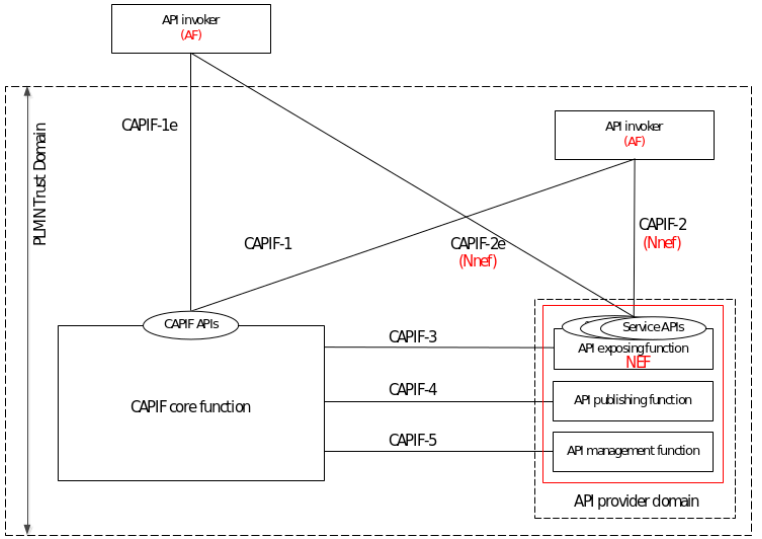
Details: A Potential Solution for Issue#1

(Whether it is feasible to obtain the cellular information)

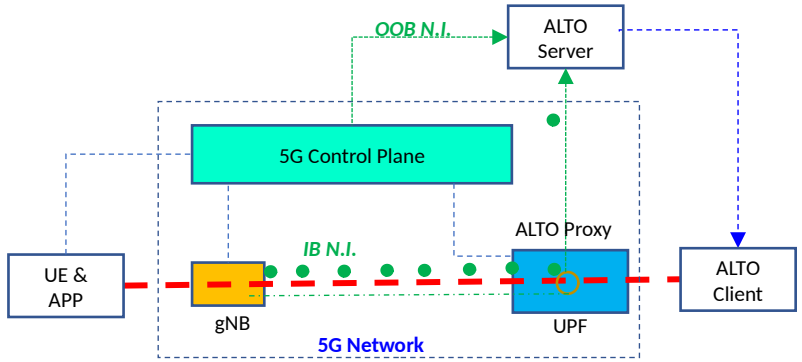
- It is feasible to obtain the cellular information from NEF
- Reuse the CAPIF defined in 3GPP
- Leverage the release-17 Edge computing Enhance to provide cellular network information with low-latency.



5G Network Exposure Function



The Common API Framework (CAPIF)

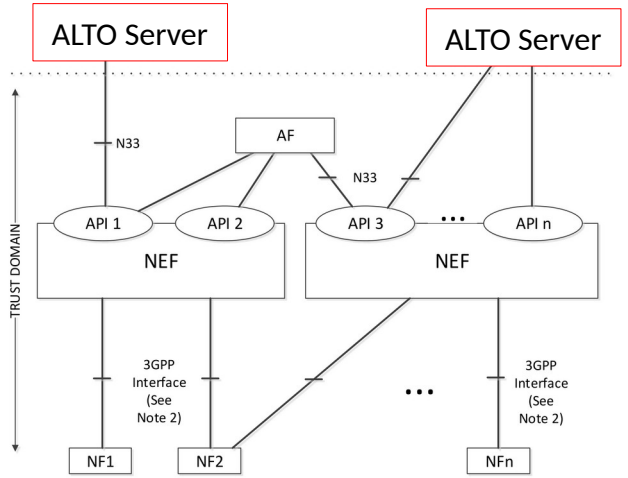


5G R17 EC Exposure Function

Details: A Potential Solution for Issue#2

(How does ALTO server obtain cellular information from 5G NEF)

- For OB solution, it is proposed that the ALTO server reuses current standard to obtain the cellular information via NEF northbound interface.
- For IB, it is proposed to investigate the potential solution and leverage the existing standardization outputs.
  - TCP Header/IP Header
  - ICMP
  - ECN
  - RTCP



Details: A Potential Solution for Issue#3
(What cellular information is from ALTO server to ALTO client)

- Measurement information: bandwidth, latency, jitter
- Predicted information: available bandwidth for next a few seconds

Details: A Potential Solution for Issue#4

(What cellular information is exposed from 5G network to ALTO server?)

- Radio channel status: e.g. SINR, RSRP/RSRQ, CQI, MCS
- L2 user plane measurements: e.g. throughput, latency
- In addition, different levels can also be considered, i.e. flow, UE, slice, serving cell and neighboring cell. For those information defined but not exposed from 5G network, we can send LS to 3GPP to ask for such information exposure.

Details: Key Remaining Issues

- Security/sensitivity of info
  - It is not sensitive for OB solution and
  - for future study for IB.
  - For OB+IB solution defined in 3GPP EC in Rel-17, it is treated as OB solution for IETF ALTO.

- Given 3GPP/layer 2 SDO are defining this interface/service, why do we need ALTO to do it as well? Why Internet standard, and 3GPP standards are not enough?
  - GPP NEF provides low layer information, which is hard for application usage directly.
  - ALTO server can aggregate such original cellular information, and have capability and possibility to process that information and provide it to applications (ALTO client) with more easy to use via a single interface.

- Is the info really useful?
  - The results from IETF MOWIE draft paper can prove the benefit of utilizing such cellular information. -

- Are the providers willing to provide the info?
  - It depends on business model. On one hand, operators can increase revenue by charging from OTT vendors. On the other hand, it is helpful to improve user QoE and increase user loyalty.

- Is the info from a single device or a set of devices, where the devices involved can span multiple autonomous domains, multiple wireless links may get involved? What does mean for this context?
  - For local breakout scenario, the NEF and radio network are within the same operator, no problem to get information.
  - For home domain routed scenario, the NEF and radio network belongs to different operators, but since the home routed traffic, there is a roaming agreement for multiple domains and NEF can provide some cellular network information.

Details: Who Will Work on It

- Chunshan Xiong, Tencent
- Gang Li, China Mobile
- Richard Yang， Yale University
- Yannis Zhang, Tencent
- Young Lee， Samsung
- …

Details: Potential Milestones (1-2 years)

- Mar. 2021 (IETF 110): Problem Description on support cellular network
- Nov. 2021 (IETF 112): **Extend ALTO Information Service with Cellular network information and its information freshness**
- July 2022 (IETF 114): Best Practice to provide deployment guideline for network information exposure

Benefits of cellular information exposure

- **Use case1: ABR for Cloud gaming**
  - Exposing radio channel status, e.g. MCS, to derive predicted bandwidth for adaptive bitrates of cloud gaming
  - Lagging ratio (MTP>200ms) is significantly reduced from 63% (a constant bit rate of 7.5 Mbps) to 19% (average bit rate of 6.7 Mbps)
- **Use case2: TCP Performance optimization**
  - Available UE radio bandwidth and Available UE buffer size for TCP sending window adjustment every 100 ms
  - Under the good and medium coverage, the throughput is significantly improved by more than 50%

More info refer to: *MoWIE: Toward Systematic, Adaptive Network Information Exposure as an Enabling Technique for Cloud-Based Applications over 5G and Beyond*, *SIGCOMM '20: Annual conference of the ACM Special Interest Group on Data Communication on the applications, technologies, architectures, and protocols for computer communication. ACM, 2020.*

Related References

- https://datatracker.ietf.org/doc/draft-huang-alto-mowie-for-network-aware-app/