Multi-path Transport Deployment on Smartphone Apps

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Agenda

- What’s been done ;
- Lessons we learned ;
- Issues we found ;
- Some thinking about future work;

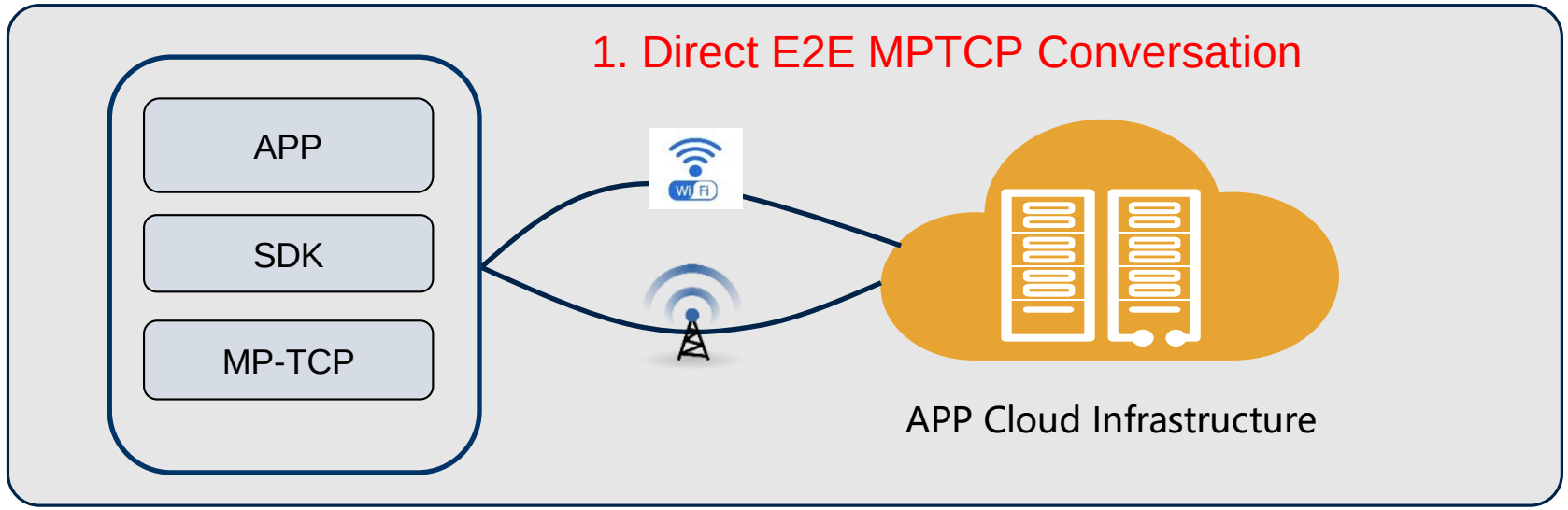
In a nutshell

- What we have done:
  - Deployment of MPTCP on Honor V20 (View 20), one of the flagship product of Huawei Honor brand since Jan 2019;
  - Up to now, ~seven applications have been enabled (more are coming), making it happen with the direct collaboration of third-party applications & Cloud/CDN provider;
  - Users can turn it on/off through an UI named ‘network acceleration’;
  - In addition to MPTCP, we also support UDP multipath through user-space networking [MPUDP], to complement the scenarios where applications only use UDP flows;
  - Operated only in China now, and still working on to bring it elsewhere.

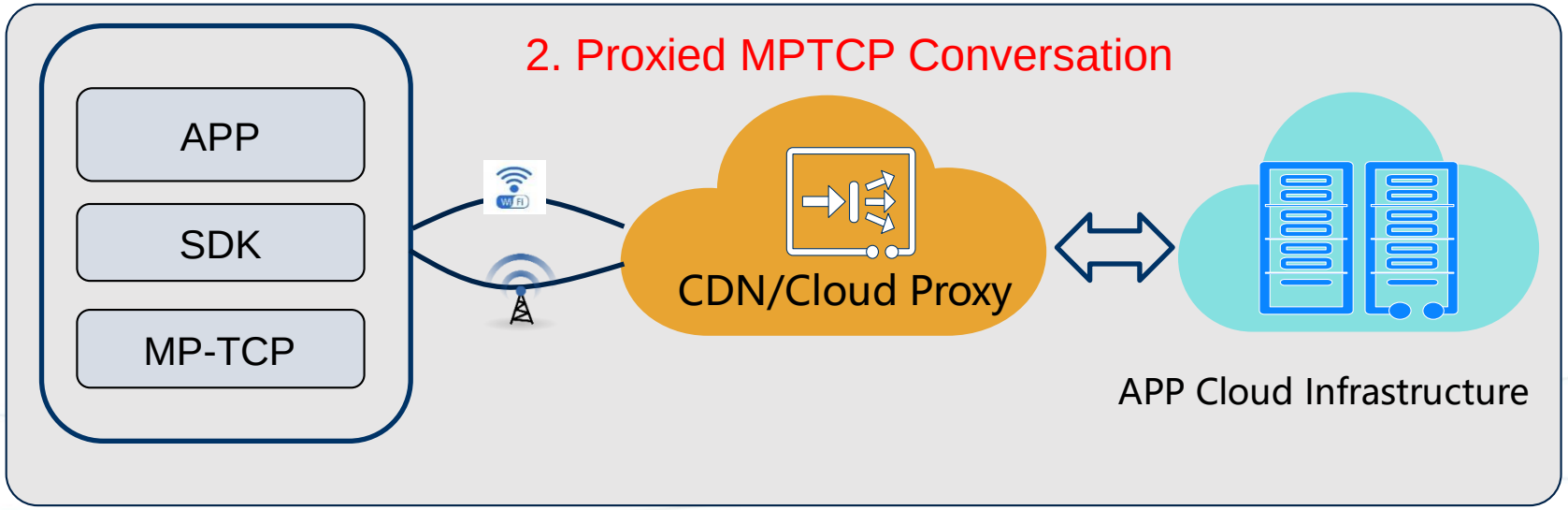
Current Deployment status

- Use cases
  - Video downloading: for higher speed video downloading coupling WiFi and LTE together;
  - Mobile Live Video: for better experience under weak/broken WiFi links;
  - Mobile online games: for low latency interactions and seamless handover between WiFi and LTE;
- User experience improvement:
  - Video downloading rate has been effectively accelerated in general ;
  - Live video experience improvement when some path has been deteriorated ;
  - Lower latency gaming experience when any path being congested;
  - Still has some counter-productive cases where improvement is not visible;
  - Keep collecting user feedback ;

MPTCP deployment use cases



- SDK to glue Android APP to MPTCP
- App cloud infrastructure updated to MPTCP

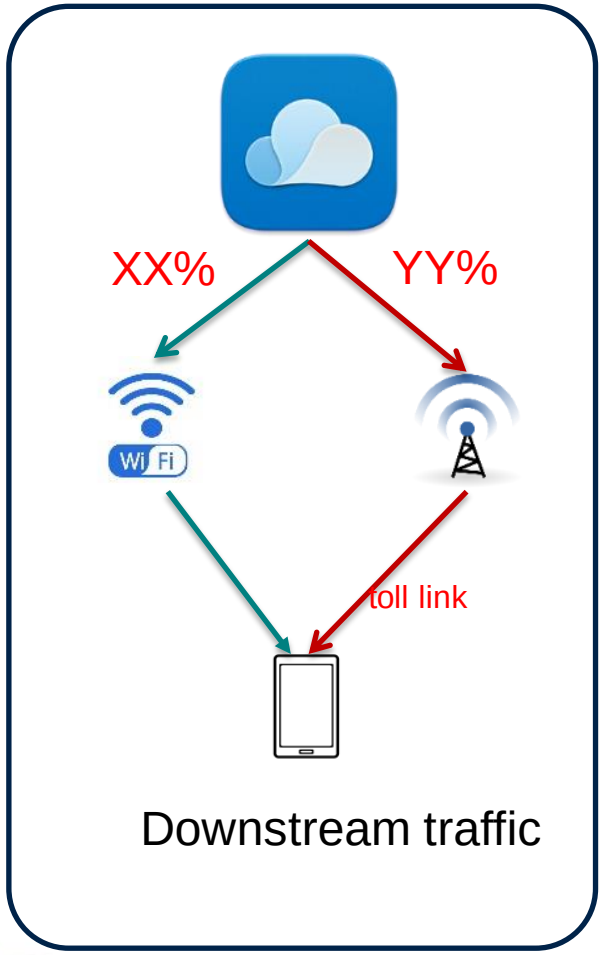


- Proxied via CDN(wangsu) or Cloud Provider(Huawei Cloud)
- Minimal changes on the APP cloud infrastructure

Lessons we have learned: deploying MPTCP could be easier

- Blocking issues:
  - Simultaneous use of multiple links without user permission is highly discouraged ;
  - Middlebox issues: unsuccessful MPTCP connection establishment & OAM issues;
  - Mobile applications: want to see visible user experience improvement, as the impact on the infrastructure/business operation is huge ;
- Ways taken:
  - A specific UI for user opt-in is a MUST to shift the choice to users;
  - Notifications of data over use, and overall, the data plan keeps becoming cheaper;
  - Some ports has been taken special care/quickly failover to a regular TCP connection in many weird cases;
  - Close collaboration with the application vendors, turning on MPTCP on a small set of use cases first of all, and trying to expand to other scenarios;
  - Performance is very important, as users expect much more if two links are turn on simultaneously;

Priority aware scheduling



Current issue:

- the cloud side does not know which path is toll-free
- by using the default scheduler of minRTT, more data will be scheduled to the metered link if it is quicker;

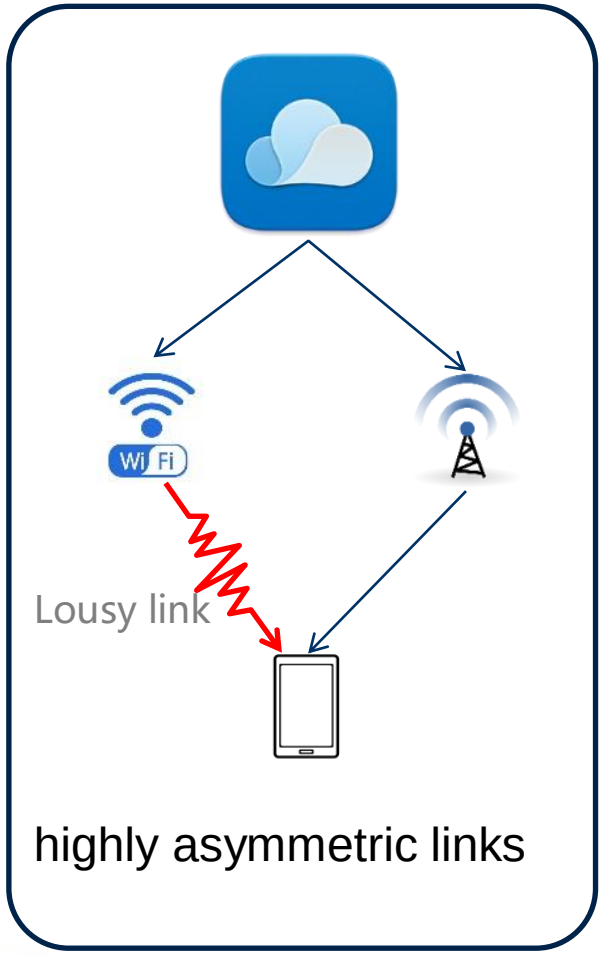
Challenges:

- No way to mark the fine-grained priority of the flows;
- The client does not have fine grained control of the scheduler used at the server;

Possible ways: [based on the mailing-list discussion]

- Fine-grained control of the policies ;

Aggregation performance



Use expectation: when using multiple paths, users usually expect that the performance being better than any single path;

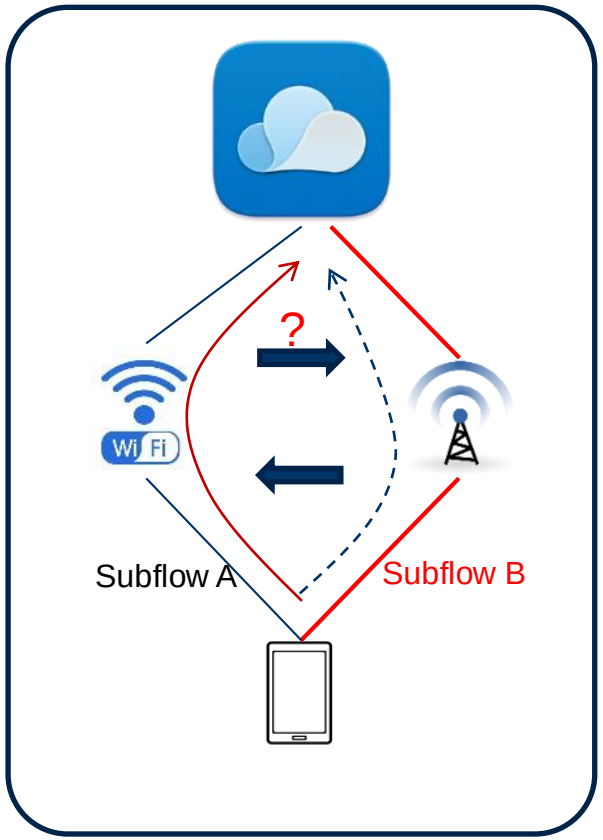
The problem: if the quality of two links largely departs from each other, the aggregated transmission is less efficient than the best available path alone;

It's been difficult:

- Faster path is not fully utilized, and needs to wait for the slower one to accomplish before being filled with more data;
- Sending on the lousy link sacrifices the time of sending it over the faster one;
- Many academic work around this issue;

Suggestion: documenting the problem and possibly some scheduler to avoid performance degradation [draft-zuo-mptcp-degradation-00]

Low latency multi-path transport



Issue:

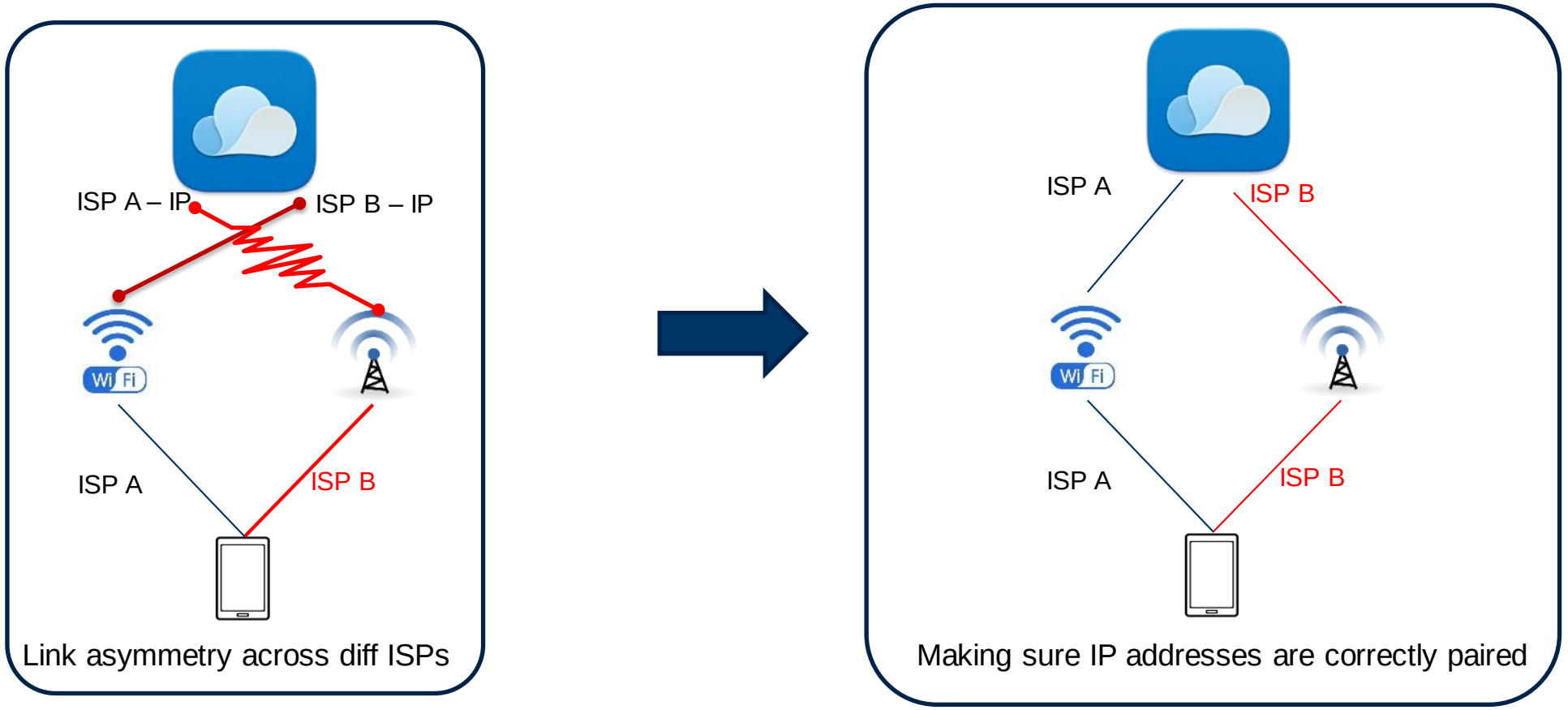
- For mice flow, MPTCP cannot acquire the RTT of the unused flow (not data overflowing to the other subflow)
- How can it be switched between the two links, as there is no active latency probe mechanisms at MPTCP layer;

Discussion:

- Active probing of the latency via a special frame;
- Make-before-break by bridging to redundant mode ;

Recommended way of doing this will be greatly expected.

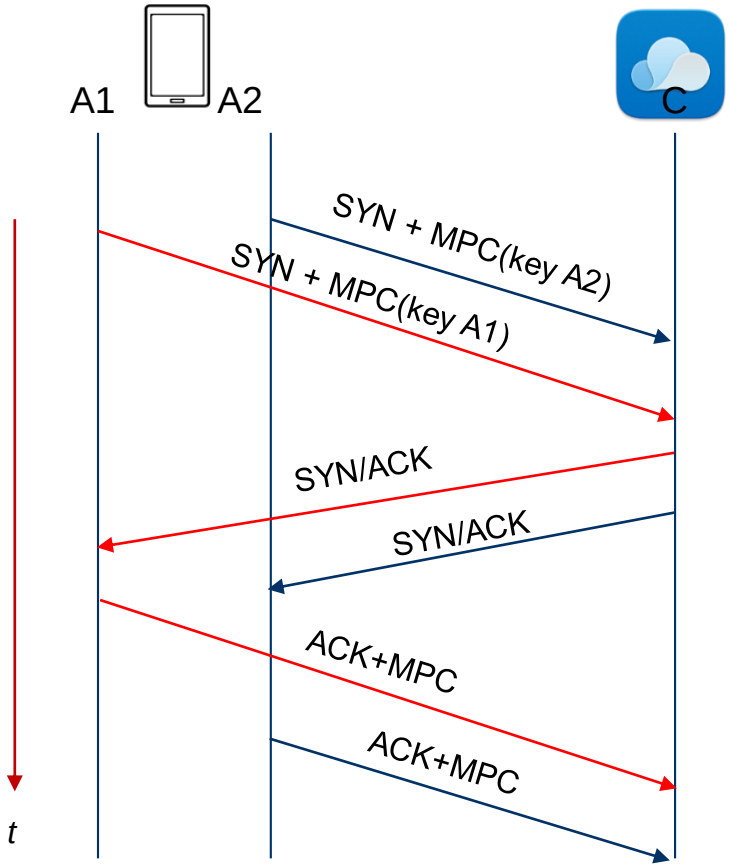
Low latency path manager across ISPs



Problem: subflows established between IP addresses of different ISPs will result into longer delay and path discrepancy.

Gap: existing MPTCP path managers do not support such features yet.

Robust and optimal connection establishment



Motivation:

- If the initial path is broken, the connection cannot be establishment
- If the initial path is lousy, the initial data exchange will be poorly performed , which has obvious impact on the user experience

Solutions:

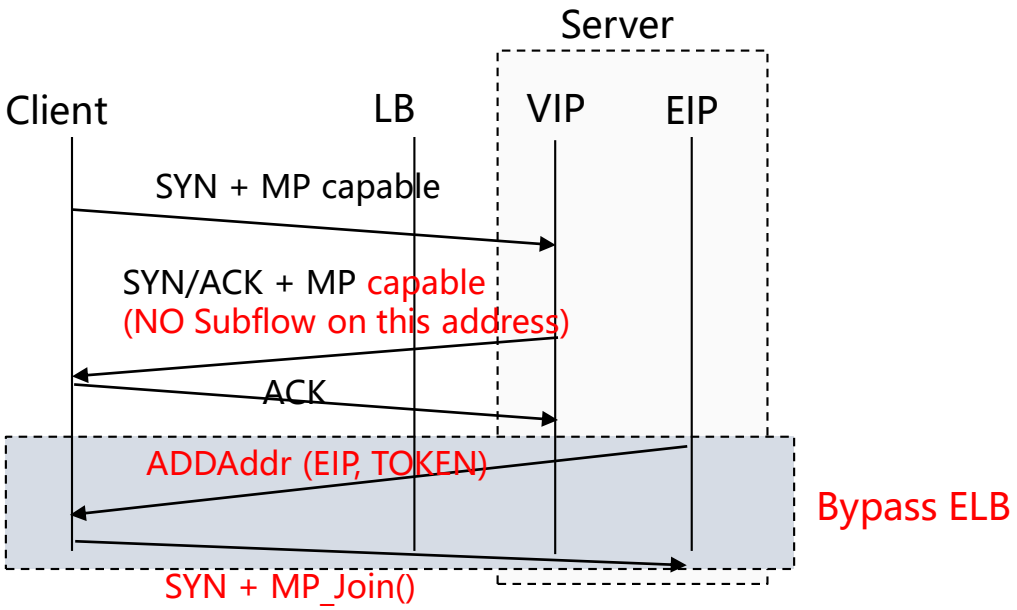
- Three alternatives have been discussed in [1];
- Need to coupled with initial path selection modular;

Discussion:

- Document such practice, could be experimental;
- Overcome the server burden issue by software engineering approaches outside IETF;

[1] slides-99-mptcp-a-proposal-for-mptcp-robust-session-establishment-mptcp-robe-01

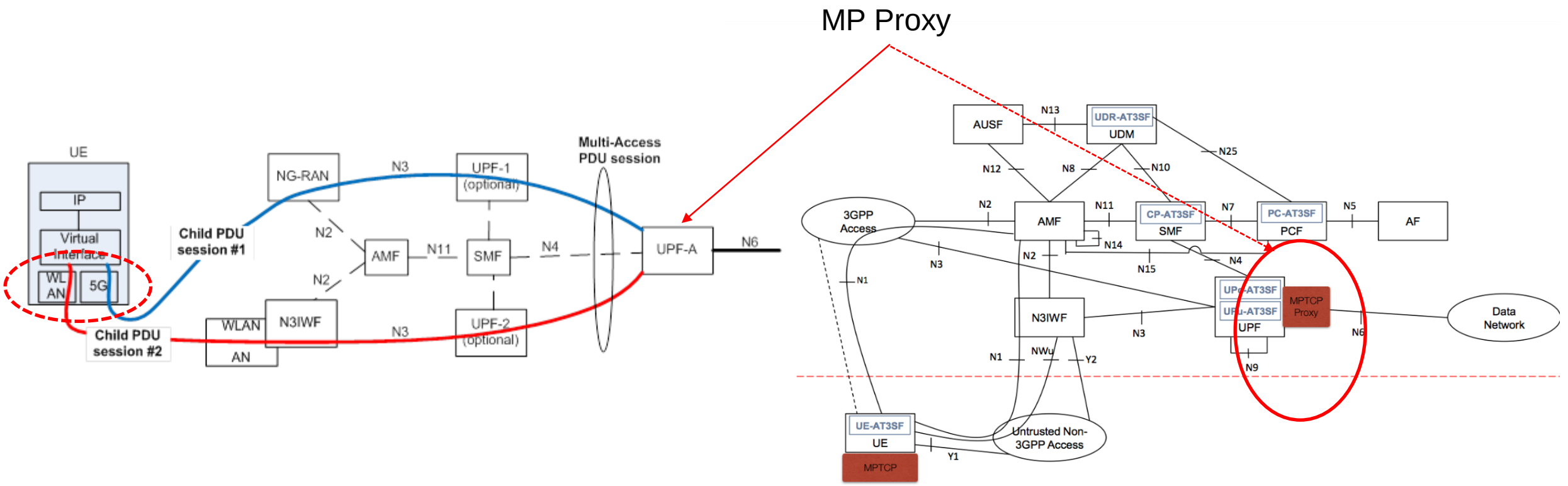
Load balancing of Multipath flows



- It's a well-known issue, i.e., how to map two subflows with diff source IP to the same server IP;
- Two possible ways:
  - Wait for a stateful mptcp LB;
  - Minor changes to the protocol, and there are some well-engineered solutions [2];
- Already in RFC6824-bis, it is useful to also mentioned that in the mptcp experience RFC document;
- **Need to revisit if ROBE is turned on.**

[2] ICNP'17, Making Multipath TCP friendlier to Load Balancers and Anycast

MPTCP in 5G



- SA2 Work Item: ATSSS (Access Traffic Steering, Switch and Splitting support in the 5G system architecture)
- Also considering bundling of UDP flows [3]

[3] MP-DCCP at IETF104 HotRFC session

To summarize

- Multiple path transport use cases on smartphone applications;
- Issues and clear gaps (addressing them can make it even easier):
  - Priority-aware scheduling;
  - Scheduler negotiation;
  - Robust connection establishment + Initial path selection;
  - Low latency MPTCP Path Magr and active probing;
  - Load balancing solutions for MPTCP ;
- Looking ahead
  - 5G and Edge

Thank You