Multipath TCP Robust Session Establishment

draft-amend-tcpm-mptcp-robe-00

Markus Amend, Jiao Kang
markus.amend@telekom.de, kangjiao@huawei.com
Kim Ju Hoon, Huangxian
J.Kim@telekom.de, huangxian@huawei.com

IETF-108, July, 2020

Definition for Robust Session Establishment

1. MPTCP RobE [draft-amend-tcpm-mptcp-robe-00]* is a set of extensions to regular MPTCP [RFC6824] and MPTCP v1 [RFC8684]. It is designed to provide a more Robust Establishment (RobE) of MPTCP sessions.

2. RobE includes RobE_TIMER, RobE_SIM, RobE_eSIM and RobE_IPS. It also presents the design and protocol procedure for the combination scenario in addition to these stand-alone solutions, i.e. the combination of RobE_SIM and RobE_IPS, the combination of RobE_TIMER and RobE_IPS.

*3rd iteration, originating from MPTCP WG. History at https://datatracker.ietf.org/doc/draft-amend-mptcp-robe/

Short solution recap

Regular MPTCP ☹

If the initial flow cannot be established, there is no connectivity!

RobE_SIM ⇉

Uses all path simultaneously.

RobE_TIMER 🕒

Uses SYN retransmission timer to try subsequent path.

RobE_IPS 🔀

Derives path quality from measurements and select promising path accordingly.

More details in
https://www.ietf.org/proceedings/106/slides/slides-106-mptcp-multipath-tcp-extension-for-robust-session-establishment-00

Changes since IETF-106

- “Evaluate MPTCP RobE at IETF107 hackathon” has been published (but ietf-107 hackathon was cancelled in COVID-19 times)

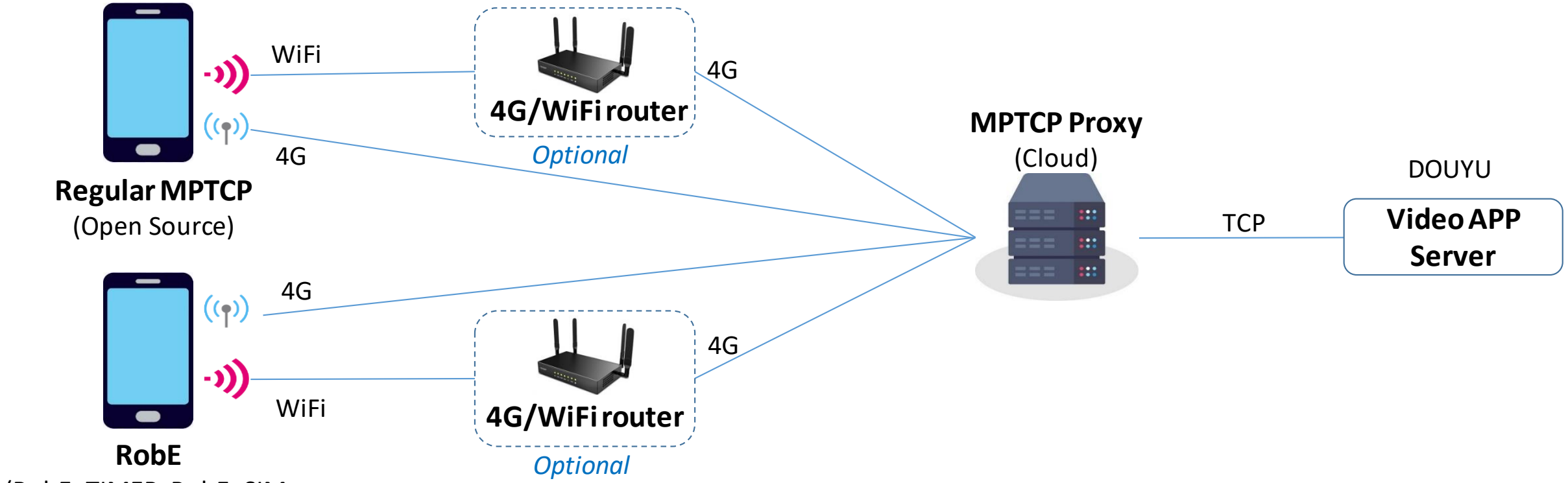
  https://tools.ietf.org/html/draft-amend-mptcp-robe
  https://trac.ietf.org/trac/ietf/meeting/wiki/107hackathon/mptcp-robe/testbed
  https://tools.ietf.org/html/rfc6824
  https://tools.ietf.org/html/draft-ietf-mptcp-rfc6824bis
  https://github.com/multipath-tcp/mptcp

- Implementation demo for IETF-108 is in this presentation

- draft-amend-tcpm-mptcp-robe-00 has been submitted:

  https://tools.ietf.org/html/draft-amend-tcpm-mptcp-robe-00

Demo Environment



1. 2 terminals
   - One with regular MPTCP
   - One with RobE: using switch to control the functions
2. Cloud service to host MPTCP Proxy
3. One 4G/WiFi router (*Optional*): transforming WiFi to 4G. When WiFi is in public area and uncontrolled, this router can be deployed for debugging of signal strength.

Notes: RobE_eSIM is postponed for the lack of developers.

Initial path selection logic in testbed

Default path determines the initial path for MPTCP establishment:

1. For “Regular MPTCP”, the process is same as that in open source community. The **default path is WiFi**.
2. The deployment of **RobE_TIMER** follows 1., the **default path is WiFi**.
3. For **RobE_IPS**, initial path selection will be performed based on signal strength for connection establishment every time, therefore **default path is variable.**
4. **RobE_SIM** initial path selection uses simultaneously Wi-Fi and Cellular. **Default path is irrelevant.**

Demo Use Case

1. **Calculate and compare "Start-up delay" for Video Service (App "DOUYU" is adopted in this demo)**

   - "Start-up delay" is computed by the formula:

   Start-up delay = Time 2 (homepage display) – Time 1 (click the app icon)

   - Elapsed time is counted manually

   A stopwatch is started before doing these steps (can be found in the videos). The elapsed time is counted manually so there must be a small proportion of deviation. *

2. **Scenarios**

   - WiFi.signal is weak and LTE.signal is strong
   - WiFi.speed is limited manually and LTE.speed is normal

* The results in the next slides represent one measurement each, with a real uncontrolled Internet service. Therefore, the absolute values should be understood as an indication.

Test Video (1)

Conditions: The signal of WiFi is limited to -70dBm ~ -75dBm. For LTE, the speed is same as that in normal environment. (Test one by one, comparison next slide)

Regular
Signal = -73dBm

RobE_SIM
Signal = -73dBm

RobE_TIMER
Signal = -75dBm

RobE_IPS
Signal = -74dBm

Videos can be found at https://github.com/markusa/ietf107hackathon-mptcp-robe/tree/master/testbed_results_july_2020

Demo Evaluation (1)

- The signal of WiFi is limited to -70dBm ~ -75dBm. For LTE, the speed is same as that in normal environment (see in Page 7).
- Test one by one, in different places, in order to create the environment of weak WiFi signal. You can obtain these data from Test Videos (see previous slide).

Solutions	Use Case	Total elapsed time
Regular MPTCP	WiFi Signal = -73dBm	8s
RobE_SIM	WiFi Signal = -73dBm	5s
RobE_Timer	WiFi Signal = -75dBm	5s
RobE_IPS	WiFi Signal = -74dBm	5s

Test Video (2)

Conditions: The speed of WiFi is limited to 30kb/s in our lab. For LTE, the speed is same as that in normal environment. (comparison next slide)

Regular vs RobE_Timer

Regular vs RobE_SIM

Regular vs RobE_IPS

Videos can be found at https://github.com/markusa/ietf107hackathon-mptcp-robe/tree/master/testbed_results_july_2020

Demo Evaluation (2)

- The speed of WiFi is limited to 30kb/s in our lab. For LTE, the speed is same as that in normal environment (see in Page 9).
- It's one of the test results. You can get these data from Test Videos (see previous slide).

Use Case	Regular MPTCP	RobE_TIMER	Gain
LTE.speed is normal and WiFi.speed is limited to 30kb/s	8s	5s	**~40%**

Use Case	Regular MPTCP	RobE_SIM	Gain
LTE.speed is normal and WiFi.speed is limited to 30kb/s	14s	7s	**50%**

Use Case	Regular MPTCP	RobE_IPS	Gain
LTE.speed is normal and WiFi.speed is limited to 30kb/s	12s	6s	**50%**

Conclusion

✓ Different implementations available at Huawei (current) and DT (early)

✓ Successful independent validation of RobE with clear benefit over regular MPTCP session setup.

Next Steps

1. Enhanced measurement setup for better comparison of testbed results
2. RobE_eSIM integration in testbed

Ready for adoption?

Any feedback is welcome.