Multipath TCP Extension for Robust Session Establishment

draft-amend-mptcp-robe-01.txt

Markus Amend, Jiao Kang
markus.amend@telekom.de, kangjiao@huawei.com
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Updates since IETF105

- Merger with draft-kang-mptcp-initial-path-selection
- Renamed the original RobE_EXT from -00 draft to RobE_eSIM
- Adding new solutions RobE_IPS and RobE_TIMER
- Improved document structure with distinguishing between solutions requiring MPTCP protocol adaption or not.
- Started to define Fallback concepts
Definition for Robust Session Establishment

1. MPTCP RobE is a set of extensions to regular MPTCP [RFC6824] and its next upcoming version [I-D.ietf-mptcp-rfc6824bis]. 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.
The RobE_Timer Solution

In RobE_Timer, resiliency against network outages is achieved by modifying the SYN retransmission timer: If one path is defective, another path is used.

[Notes]:

1. How to set the Timer is TBD.

2. If there is the case that the first SYN on default path arrives earlier than that from the second path, the MPTCP connection will be initialized on the path of the first SYN. The server could treat the second SYN as obsolete and drop it.
The RobE_SIM Solution

RobE_SIM provides the ability to simultaneously use multiple paths for connection setup.

RST is used to terminate connections setup on other paths when connection has been established on the fastest path.

<table>
<thead>
<tr>
<th>Host A</th>
<th>Host B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address A1</td>
<td>Address B1</td>
</tr>
</tbody>
</table>

SA1: SYN + MP_CAPABLE(Key-A[*])  

SB1: SYN + MP_CAPABLE(Key-A'[*])

SA2: SYN + MP_CAPABLE(Key-A'[*])  

SB2: SYN + MP_CAPABLE(Key-A'[*])

SA3: SYN/ACK + MP_CAPABLE(Key-B)  

SB3: SYN/ACK + MP_CAPABLE(Key-B')

SA4: ACK + MP_CAPABLE(Key-A, Key-B)  

SB4: ACK + MP_CAPABLE(Key-A, Key-B)

SA5: RST

SB5: RST

SA6.1: SYN + MP_JOIN(Token-B, R-A)  

SB6.1: SYN + MP_JOIN(Token-B, R-A)

[Key-A in the first MP-capable is related to RFC6824 only and does not exist in RFC6824bis.]

Figure 3: MPTCP RobE_SIM Connection Setup
RobE_IPS provides a heuristic to select properly an initial path for connection establishment with a remote host based on empirical data derived from previous connection information.
The RobE_eSIM Solution

**RobE_eSIM** provides the ability to simultaneously use multiple paths for connection setup.

MP_JOIN_CAP is used for decreasing overhead, merging all simultaneous established paths without MP_JOIN process.

ROBE_eSIM_EN can be used for negotiation between both sides.

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Figure 11: MPTCP RobE_eSIM implicit Connection Setup

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Figure 15: Fallback to MPTCP when missing RobE_eSIM support
RobE_IPS with Server-RTT

For the asymmetric downloading service, the latest RTT for these subflows is calculated by data sender, i.e. application server and transformed to date receiver.

L_RTT_EN is used for negotiation of this capabilities between both sides during session establishment when RobE_IPS is enabled on client and returning latest RTT from server to client.
Combination of RobE_SIM and RobE_IPS

RobE_SIM can be used at the very beginning when the sender is ignorant about path info. And optimal initial path selection can be used for consecutive connections.

Figure 9: Combination of RobE_SIM and RobE_IPS
Combination of RobE_TIMER and RobE_IPS

When the system enables RobE_IPS and uses the selected initial path for session establishment, it sets the timer for path switching.

When timer is up, the system will change to another path for re-establish connection considering the requirement for time delay from application.

Figure 10: Combination of RobE_Timer and RobE_IPS
## IANA Considerations

<table>
<thead>
<tr>
<th>Value</th>
<th>Symbol</th>
<th>Name</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBD</td>
<td>ROBE_eSIM_EN</td>
<td>RobE_eSIM enabled</td>
<td>Section 3.1</td>
</tr>
<tr>
<td>TBD</td>
<td>MP_JOIN_CAP</td>
<td>Join connection directly in RobE_eSIM</td>
<td>Section 3.1</td>
</tr>
<tr>
<td>TBD</td>
<td>L_RTT_EN</td>
<td>Server RTT enabled</td>
<td>Section 3.2</td>
</tr>
</tbody>
</table>
## Overview RobE Features

<table>
<thead>
<tr>
<th>Scenario</th>
<th>MPTCP</th>
<th>RobE_TIMER</th>
<th>RobE_SIM</th>
<th>RobE_eSIM</th>
<th>RobE_IPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP packet loss</td>
<td>Delayed connection</td>
<td>In the scope of timer</td>
<td>No impact</td>
<td>No impact</td>
<td>Delayed connection</td>
</tr>
<tr>
<td>IP broken</td>
<td>No connection</td>
<td>In the scope of timer</td>
<td>No impact</td>
<td>No impact</td>
<td>No Connection</td>
</tr>
<tr>
<td>IP setup duration dependency</td>
<td>Default route</td>
<td>Default route (+ path 1..n)</td>
<td>Fastest path</td>
<td>Fastest path</td>
<td>Selected Path</td>
</tr>
<tr>
<td>MP availability duration</td>
<td>MP_CAPABLE HS + MP_JOIN HS</td>
<td>Sum_1..n( MP_CAPABLE n HS) + MP_JOIN HS</td>
<td>MP_CAPABLE HS + MP_JOIN HS</td>
<td>max (MP_CAPABLE_1 .. MP_CAPABLE_2 HS)</td>
<td>MP_CAPABLE HS + MP_JOIN HS</td>
</tr>
<tr>
<td>Guaranteeing session setup</td>
<td>Depend on the default route</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Depends on selection</td>
</tr>
</tbody>
</table>

IP: Initial Path; MP: Multi-Path; HS: Handshake
Next Steps

1. Ready for adoption?

2. Any comments welcome