Considerations for MPTCP Operation in 5G

https://tools.ietf.org/html/draft-defoy-mptcp-considerations-for-5g-00

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What Changed Since IETF 100 (new ID)

- A draft [previous-ID] was presented in IETF 100. Feedback included:
  - Attendees showed interest on the topic and pointed to related work (NICT research including on dual connectivity, community bits in draft-duchene-mptcp-add-addr).
  - Handling of multiple IP addresses per network interfaces by itself was not seen as a problem (e.g. it is common with IPv6). Our conclusion: we need to clarify the problem – for example, those multiple IP addresses are, in 5G, provided by different network anchors. What does this mean for MPTCP?

- A new draft [current-ID] presented today in IETF 101 takes a step back towards a higher level and broader analysis:
  - It describes how new behavior in 5G can impact MPTCP – especially the Session and Service Continuity feature.
  - It describes how MPTCP can complement 5G – especially for the Dual Connectivity feature.

- Possible outcomes for this work include:
  - A set of guidelines for MPTCP and 5G stack developers.
  - A set of derived requirements on MPTCP, on 5G, or both (whether they are new is TBD).

[previous-ID] draft-purkayastha-mptcp-considerations-for-nextgen-00

[current-ID] draft-defoy-mptcp-considerations-for-5g-00

SSC and Related Concepts in 5G

Session and Service Continuity (SSC) addresses various continuity requirements of applications.

- SSC is based on a distributed mobility system (where network anchors have a service area).
- It has multiple SSC modes (1:fixed anchor, 2:distributed anchors + BBM, 3:distributed anchors + MBB).
- A 5G device selects an appropriate SSC mode for each application, based on local policy – otherwise the network selects it.

PDU Session is a unit of network service that can hold multiple QoS flows.

- Connected to a single data network, through one or more network anchors (“multi-homed PDU sessions”).
- Associated with a single, non-modifiable session continuity mode, network slice, and type (IPv4/IPv6/Ethernet/Unstructured).
- Goes over a single radio access type at a given time.
- Corresponds to a network interface on the device (probably – it’s a likely implementation choice).
- Different applications running on a device may use different PDU sessions (e.g. for different data network, SSC mode or slice).

When used with 5G, MPTCP should…

- Be aware of the SSC mode, to adjust its behavior.
- Know the mapping between applications and PDU sessions (i.e. network interfaces).

SSC Mode 1

5G behavior:

- A fixed network anchor provides a fixed IP address to the device (i.e. device mobility is not visible to application nor MPTCP).
- The network MAY add/remove an additional network anchor dynamically (i.e. a new IP address may be added/removed dynamically to the network interface in use).

MPTCP in SSC mode 1 should…

- Always keep using the initial IP address, which is guaranteed to stay available over time.
- Use new IP addresses while they are available to the application.

SSC Mode 2

5G behavior:

- The IP address changes when the device leaves a network anchor’s service area.
- This is a break-before-make IP address change.

MPTCP in SSC mode 2 should…

- Use existing BBM behavior even when only on cellular (application should not request a specific network interface when opening a socket).
- Maintain a valid backup IP address by using this BBM behavior.

SSC Mode 3

5G behavior:

- The IP address changes when leaving a network anchor's service area.
- This is a make-before-break on the same or a new network interface.
- The lifetime of the old IP address is communicated by the network to the device.

MPTCP in SSC mode 3 should…

- Always create and use new subflows when a new IP address becomes available to the application.
- Stop using older subflows gracefully (after slow start, before release) – this is to help for performance and to recycle resources faster.
- Not close subflow(s) using the latest IP address (since only this IP address will remain after a transition period).
- Maintain a valid backup IP address using the latest SSC mode 3 IP address.

Dual Connectivity (DC) in 5G

5G behavior:

- DC relies on two paths over radio access – individual QoS flows (in same or different PDU sessions) use one path or the other.
- Typically DC is not visible outside of the radio access technology layer.

Our proposal: the Dual Connectivity feature of 5G can leverage MPTCP to support robustness/ reliability and bandwidth aggregation.

- This avoids duplicating MPTCP features in 5G, and implements them at higher layer, with some exposure to applications.

To use MPTCP for DC…

- Multiple DC radio links should be exposed by 5G for use by MPTCP (through different or over the same network interfaces/PDU sessions).
- MPTCP should split or possibly duplicate traffic between subflows over different DC radio links.

Next Steps

Collect feedback on this new draft

- Discuss value for MPTCP and 5G communities

Moving the draft forward

- Refine SSC aspect, develop DC aspect, integrate feedback
- Identify clearly new requirements for MPTCP and possibly 5G
- Looking for any additional 5G features with potential MPTCP impact…