DL TCP Low Throughput

Country/Region: B/R

Equipment: Ncell-F2240

Version: 5GNR_fa.tdd.fr1.2.3.0_397+Firmware_241.00.2_N78_20230314_v2.5.1
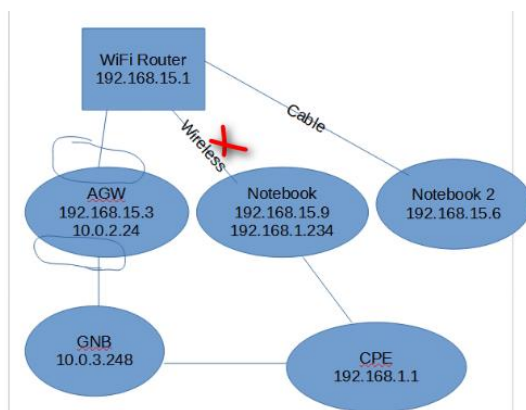
1. Issue Description:

TCP Downlink speed test is low as below.

2. Achieve Network Topology and NE Information

Attention: This networking is special at the beginning, the PC which connects CPE LAN by cable also connects to AGW by Wifi as a ftp server, but the Wifi bandwidth is only 72Mbit/s and the

3. Suggested Troubleshooting Methods:

3.1 Check the radio interface environment by pre-scheduling.

3.2 Determine if insufficient dispatch/Low MCS/ low RANK by mac-layer print watching.

3.3 Determine if transmission bandwidth is restricted by UDP testing.

3.4 Configuration parameter check by web check and xml comparation.

3.5 Gather log +User Plane +Signal plane + FAPI log analysis.

4. Troubleshooting Procedures:

4.1 Open DL pre-scheduling and observed full dispatch and good MCS, normal layers.

```
Displaying MAC throughput from the oldest second to last full second
Histogram size is: 301
last s:  DL tput (Mbps[MAC/RLC]: RBs(slice0~3)/Times: Ratio: AvgMcs: AvgLayers: UdpSdu/AllSdu)   UL tput (Mbps[MAC/RLC]: RBs(slice0~3)/Times: Rat
20:      728.5524/0.0000 (380473(0/0/0/0)/1401: 99.5481% :27.0000: 2.0000: 0/0)  7.3728/0.0000 (47700(0/0/0/0)/300: 29.1209% :8.0000: 1.0000)
19:      726.6838/0.0000 (380473(0/0/0/0)/1401: 99.5481% :27.0000: 2.0000: 0/0)  7.3974/0.0000 (47700(0/0/0/0)/300: 29.1209% :8.0000: 1.0000)
18:      727.8640/0.0000 (380473(0/0/0/0)/1401: 99.5481% :27.0000: 2.0000: 0/0)  7.3728/0.0000 (47700(0/0/0/0)/300: 29.1209% :8.0000: 1.0000)
17:      725.8888/3.6094 (380473(10818/0/0/0)/1401: 99.5481% :27.0000: 2.0000: 368/368)  7.5020/0.2121 (48685(0/0/0/0)/310: 29.7222% :8.0000: 1.00
16:      728.2327/0.0000 (380200(273/0/0/0)/1400: 99.4767% :27.0000: 2.0000: 0/0)          7.3756/0.0000 (42312(0/0/0/0)/301: 25.8315% :9.5096: 1.00
15:      727.0690/0.0000 (380473(0/0/0/0)/1401: 99.5481% :27.0000: 2.0000: 0/0)  7.3728/0.0000 (47700(0/0/0/0)/300: 29.1209% :8.0000: 1.0000)
```

4.2 DL UDP iperf3 test, speed can reach maximum 400 Mbps.

```
Displaying MAC throughput from the oldest second to last full second
Histogram size is: 301
last s:  DL tput (Mbps[MAC/RLC]: RBs(slice0~3)/Times: Ratio: AvgMcs: AvgLayers: UdpSdu/AllSdu)   UL tput (Mbps[MAC/RLC]: RBs(slice0~3)/Times: Ratio: A
vgMcs: AvgLayers)
20:      452.3369/448.8625 (250623(250623/0/0/0)/1122: 65.5738% :26.0000: 2.0000: 45579/45580)  5.1258/0.0053 (10716(0/0/0/0)/301: 6.5421% :21.4130: 1
.0000)
19:      480.4342/478.8398 (268055(268055/0/0/0)/1161: 70.1347% :26.0000: 2.0000: 48623/48624)  5.1052/0.0058 (11137(0/0/0/0)/301: 6.7991% :21.0000: 1
.0000)
18:      251.7197/246.3773 (139677(139677/0/0/0)/798: 36.5455% :26.0000: 2.0000: 25018/25018)  5.1778/0.0046 (11106(0/0/0/0)/301: 6.7802% :21.0000: 1
.0000)
17:      355.5318/355.6319 (197900(197900/0/0/0)/1002: 51.7792% :26.0000: 2.0000: 36112/36114)  5.0181/0.0072 (11109(0/0/0/0)/300: 6.7821% :20.9892: 1
.0000)
16:      362.5263/357.9453 (201001(201001/0/0/0)/1035: 52.5905% :26.0000: 2.0000: 36347/36347)  5.1955/0.0164 (11548(0/0/0/0)/301: 7.0501% :20.4762: 1
.0000)
15:      432.4353/426.9600 (238884(238884)/0/0/0)/1095: 62.5024% :26.0000: 2.0000: 42355/42355)  5.1227/0.0052 (10200(0/0/0/0)/300: 6.2271% :22.0000: 1
```

4.3 Check the configuration parameter and compare, no abnormalities found.

4.4 Original protocol version is 310, upgrade to version 397, but there is no improvement.

4.5 Collect gather log + fapi3+user plane log at gNB, and found lots of TCP out of order and TCP dup. Though appoint the packet length and packet gNodeB received is still bigger than the appointed packet length.

```
.035744000 中…  172.30.223.117  192.168.128.17  GTP <TCP>  1400  [TCP Previous segment not captured] 35418 → 5201 [PS
.035773000 中…  172.30.223.117  192.168.128.17  GTP <TCP>  1400  [TCP Out-Of-Order] 43998 → 5201 [ACK] Seq=17825 Ack=
.035779000 中…  172.30.223.117  192.168.128.17  GTP <TCP>  1400  [TCP Previous segment not captured] 35418 → 5201 [PS
.035784000 中…  172.30.223.117  192.168.128.17  GTP <TCP>  1400  [TCP Previous segment not captured] 43998 → 5201 [PS
.035788000 中…  172.30.223.117  192.168.128.17  GTP <TCP>  1400  [TCP Out-Of-Order] 35418 → 5201 [ACK] Seq=46841 Ack=
.035884000 中…  172.30.223.117  192.168.128.17  GTP <TCP>  1400  [TCP Out-Of-Order] 35418 → 5201 [ACK] Seq=49417 Ack=
.035894000 中…  172.30.223.117  192.168.128.17  GTP <TCP>  1400  [TCP Previous segment not captured] 43968 → 5201 [PS
.035899000 中…  172.30.223.117  192.168.128.17  GTP <TCP>  1400  [TCP Out-Of-Order] 43998 → 5201 [ACK] Seq=20401 Ack=
.035904000 中…  172.30.223.117  192.168.128.17  GTP <TCP>  1400  [TCP Previous segment not captured] 43958 → 5201 [PS
```

Collect tcpdump from ftp server and User Plane log of gNB at same time, same appearance with above capture.

Collect the tcpdump from ftp server, agw and user plane log of GNB at same time, observe that the packet length of many packets sent by agw are more than 2500, need AGW check the MTU and TCP fragmentation function.

```
172.30.223.117  192.168.128.19  TCP  1354  51272 → 5201 [ACK] Seq=977454 Ack=1 Win=65024 Len=1288 TSval=3105047272 TSe
172.30.223.117  192.168.128.19  TCP  1354  51314 → 5201 [ACK] Seq=796230 Ack=1 Win=65024 Len=1288 TSval=3105047272 TSe
172.30.223.117  192.168.128.19  TCP  1354  51314 → 5201 [PSH, ACK] Seq=797518 Ack=1 Win=65024 Len=1288 TSval=310504727
172.30.223.117  192.168.128.19  TCP  2434  51332 → 5201 [PSH, ACK] Seq=1682470 Ack=1 Win=65024 Len=2368 TSval=31050472
172.30.223.117  192.168.128.19  TCP  2642  51324 → 5201 [PSH, ACK] Seq=507638 Ack=1 Win=65024 Len=2576 TSval=310504727
172.30.223.117  192.168.128.19  TCP  1354  51314 → 5201 [ACK] Seq=798806 Ack=1 Win=65024 Len=1288 TSval=3105047272 TSe
172.30.223.117  192.168.128.19  TCP  2522  51296 → 5201 [PSH, ACK] Seq=1369182 Ack=1 Win=65024 Len=2456 TSval=31050472
172.30.223.117  192.168.128.19  TCP  2642  51264 → 5201 [ACK] Seq=722382 Ack=1 Win=65024 Len=2576 TSval=3105047272 TSe
172.30.223.117  192.168.128.19  TCP  2642  51262 → 5201 [PSH, ACK] Seq=1406558 Ack=1 Win=65024 Len=2576 TSval=31050472
172.30.223.117  192.168.128.19  TCP  2642  51286 → 5201 [PSH, ACK] Seq=1764038 Ack=1 Win=65024 Len=2576 TSval=31050472
172.30.223.117  192.168.128.19  TCP  2642  51286 → 5201 [PSH, ACK] Seq=1766614 Ack=1 Win=65024 Len=2576 TSval=31050472
172.30.223.117  192.168.128.19  TCP  1354  51286 → 5201 [ACK] Seq=1769190 Ack=1 Win=65024 Len=1288 TSval=3105047272 TS
172.30.223.117  192.168.128.19  TCP  1354  51286 → 5201 [PSH, ACK] Seq=1770478 Ack=1 Win=65024 Len=1288 TSval=31050472
172.30.223.117  192.168.128.19  TCP  2642  51332 → 5201 [PSH, ACK] Seq=1684838 Ack=1 Win=65024 Len=2576 TSval=31050472
172.30.223.117  192.168.128.19  TCP  2642  51332 → 5201 [PSH, ACK] Seq=1687414 Ack=1 Win=65024 Len=2576 TSval=31050472
172.30.223.117  192.168.128.19  TCP  2642  51286 → 5201 [PSH, ACK] Seq=1771766 Ack=1 Win=65024 Len=2576 TSval=31050472
```

After AGW changed the MTU of Ethernet card and enable TCP fragmentation function, the DL TCP speed rate improved to 179Mbps in public internet .

5. Conclusion:

Core Network network card TCP Segmentation offload function were not enabled, the packet size sent by AGW can't be handled properly by Femto and dropped.