International Telecommunication Union

ITU-T

Implementer's Guide to Recommendation ITU-T G.1028

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After its adoption in April 2016, Recommendation ITU-T G.1028 has been also circulated amongst experts on mobile network and on IMS as well as presented and discussed during workshops, allowing some informal and deep review of its content.

This Implementers' Guide puts together some interesting information collected during these discussions in complement to the Recommendation or helpful to understand and interpret some sections of the Recommendation.

1) Information provided on QCI in Table 1 of G.1028

The use of QoS Class Identifiers (QCIs) is a very important mechanism for VoLTE. It ensures that both signalling and real time flows associated with the service will be processed correctly, yielding a QoS at least comparable with existing mobile voice services based on circuit switched technologies. 3GPP TS 22.105 and TS 23.203 are the place where QCIs are defined, this is why they are mentioned as references in G.1028. Table 1 in G.1028 is even copied from TS 23.203, in order to illustrate in a concrete way how VoLTE flows must be processed on 4G networks.

Table 1 shows for the two bearers associated respectively to SIP signaling and real time flows of VoLTE sessions the corresponding characteristics in terms of:

- priority level,
- resource type (guaranteed bit rate or not),
- packet delay budget,
- packet loss budget.

The two first characteristics are really relevant information for G.1028, the two other seem to provide QoS targets (potentially in conflict to those proposed in Tables 3 to 6 of G.1028). In reality, as indicated in the Note below Table 1 of G.1028, these budgets are meant only for signaling messages exchanged between the radio access network and the IMS platform (and in particular the PCEF, i.e. mostly for charging procedures).

The new table below shows some realistic maximum values for packet delay budget on radio access for the user plane of VoLTE, as measured on some operational networks for mobile to mobile 4G calls on the same network (with 30 % HARQ assumed).

Step	Description	DL direction	UL direction
1	eNB Processing Delay (S1-U->Uu)	1 ms	1 ms
2	Frame Alignment	1,022 ms	1,423 ms
3	TTI for DL DATA PACKET	0,675 ms	0,675 ms
4	HARQ Retransmission	0,3 × 5 ms	0,3 × 5 ms
5	UE Processing Delay	1 ms	1 ms
6	S1-U Transfer Delay and aGW	7 ms	15 ms
	Total one way delay	**12,2 ms**	**20,6 ms**

Table 1 ImplGuide_G.1028: packet delay budget for user plane on 4G access network (4G-4G call)

2) Definition of Post Dialing Delay (Section 9, table 2)

Post Dialing Delay (or PDD) is defined in section 9 of G.1028 (Table 2). This comes with a mention that this definition is equivalent to those of Call Setup Time, as defined in ITU-T E.800, and Telephony Setup Time, as defined in ITU-T E.804. In section 10.3.1. (and consequently in section 3) the mention to E.800's Call Setup Time is repeated, as one of the existing materials in ITU-T Recommendations re-used in G.1028.

The "equivalence" expressed in Table 2 does not mean that Post Dialing Delay and Call Setup Time are two names for one unique metric. The only definition applicable for Post Dialing Delay is the

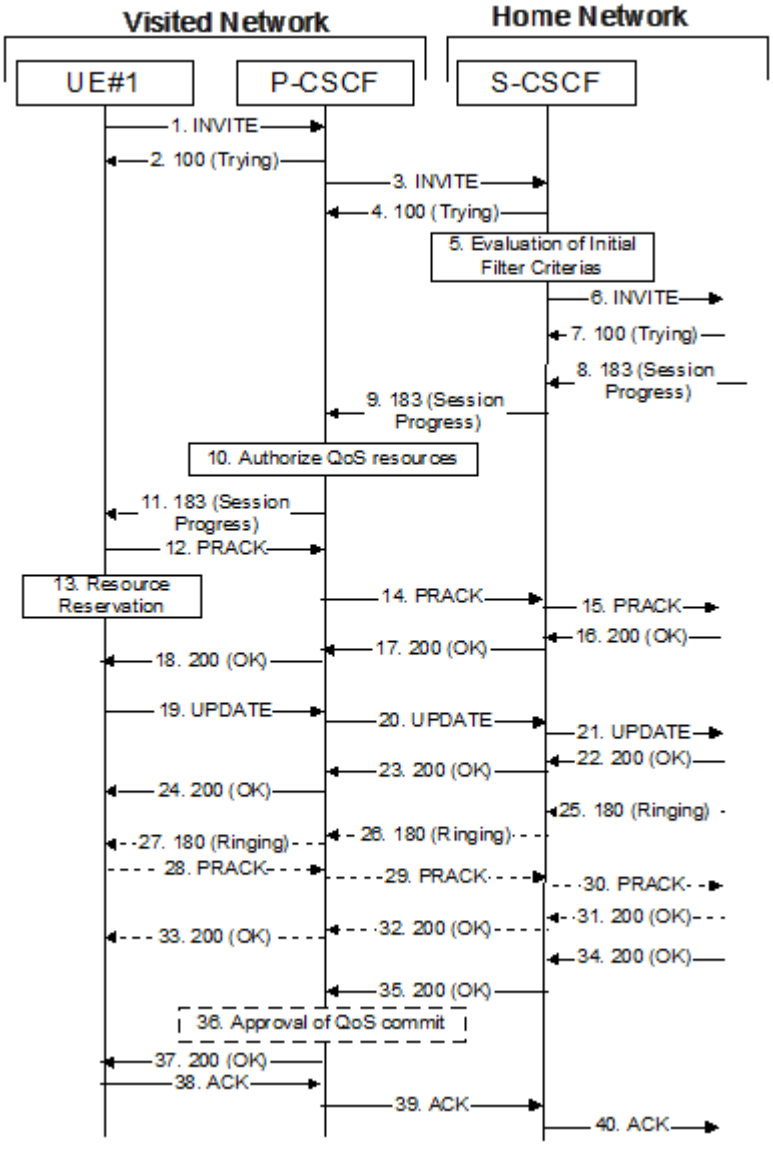
one provided in G.1028. Call Setup Time from E.800 and Telephony Setup Time from E.804 are only metrics “looking like” PDD, helpful to estimate PDD magnitude and variations.

3) Network call setup measurement (Section 9, Table 2)

In Table 2 in G.1028, the IP KPI associated with PDD (SIP session set up time) is defined as the “interval between sending INVITE message (with SDP) and ACK (180 or 200) message by the originating side”. No choice between 180 Ringing or 200 OK is proposed here.

However, these two SIP messages have specific and different meanings. Below are guidance concerning their usage for the measurement of SIP session set up time:

- From a user’s point of view, the meaningful information is the ringing tone he can hear back in his phone. This ringing tone is generally triggered by reception of a 180 Ringing message.
- In roaming situations, as illustrated in the figure below, some LTE networks are sending an 180 Ringing (arrow 25 in the figure) message to the calling user independent from the real status of the called user and network(in some networks the 180 Ringing can be sent independent from the preconditions status). The caller may hear a ring back tone when the call setup procedure has failed. Only the reception of a 200 OK after the 180 Ringing message (arrows 34 to 37 in the figure) can make sure that this is not the case. But this 200 OK message could arrive some time after the caller’s terminal is ringing, providing thus a overestimation of perceived PDD.



Therefore, it is recommended:

- to use the 180 Ringing message as trigger for the measurement of PDD as perceived by end users, with a strong restriction to the cases where one can be 100 % sure that the network does not send this message before the called party and network accept the call.
- to use the the 200 OK message in all cases to measure IP session set up time and qualify a call setup when the preconditions are fulfilled ; as well as trigger for the measurement of PDD as perceived by end users in all cases where the restriction above cannot be met.

4) Updated budget values in Table 3 of G.1028

The editor received a feedback for delays in the case of LTE-LTE calls inside the same 4G network. Table 3 of G.1028can be updated as per below (updated values highlighted in red colour):

End-to-end indicators	**TOTAL budget**	**Terminal**	**E-UTRAN**	**EPC**	**Mobile IMS**	**Transmission network**
Registration success rate	99,9%	99,9 %	99,9 %	100 %	99,9 %	No target
Service availability	99% Note 1	No target	No target	No target	No target	No target
Post Dialing Delay (PDD)	LTE-LTE: 3.5 s Note 2 CSFB: 6 s Note 3	No target	No target	No target	No target	No target
Voice Quality (MOS-LQxSW)	4 Note 4	No target	No target	No target	No target	No target
Mouth-to-Ear Delay	400 ms Note 5	190 ms (sending + receiving) Note 6	**5 ms**	**15 ms**	0	10 ms (may be bigger for large countries)
Call drop rate	2 %	No target	No target	No target	No target	No target
Note 1: Call processing performance objective according to ETSI TS 101 563is higher than 99.9% Note 2: ETSI TS 101 563 recommends 5.9 s, with 95% of probability below 2.4 s Note 3: only Circuit Switched Fall Back on mobile originating side is considered here Note 4: Assumes the use of AMR-WB at a 23.85 bit rate Note 5: ITU-T Recommendation G.114 specifies a preferred maximum value at 150 ms, impossible to reach currently; some network operators are able to provide national calls with delays below 250 ms Note 6: according to 3GPP TS 26.131						

Table 3 G.1028: Quality budgets for LTE-LTE communication on the same network