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Technical Report

3rd Generation Partnership Project; Technical Specification Group Services and System Aspects; Study on Application specific congestion control for data communication (Release 13)



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Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

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- x the first digit:
 - 1 presented to TSG for information;
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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

Introduction

UEs which user can easily download applications from web site are rapidly increasing in the world and a wide variety of applications are constantly created and installed on the UEs. Specific applications can (intentionally or unintentionally) cause congestion over RAN/CN. While network is congested, it is not preferred to allow these applications to access to network in order to protect the network resources. Several SDOs identified key issues related to network inefficiencies caused by such UEs and by the variety of applications. Also there are applications that can cause problem, e.g. the ones that disclose privacy information without user consent, and applications that encourage illegal activities that are prohibited by the local regulations. It is therefore preferable to provide a mechanism to prohibit these problematic applications accessing the network.

On the other hand, for example in Japan, after the severe earthquake on March 11th, 2011, the packet based communication applications to confirm the safety of their relatives are recognized as the important applications (e.g. Disaster message board service, Disaster voice messaging service) when disaster occurs. Therefore, Japanese government strongly expects Japanese operators to provide the connectivity at least for such services even when the network is congested, while other services are barred to free up the resources for important services.

1 Scope

The present document provides a study on Application specific Congestion control for Data Communication (ACDC). This Study investigates the following aspects:

- Identify the use cases and potential requirements to allow/restrict the communication initiation of particular applications defined by operator, subject to regional regulations;
- Gap analysis with existing access control mechanisms.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [x] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [x].

3.2 Symbols

For the purposes of the present document, the following symbols apply:

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [x] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [x].

4 Use Cases

4.1 Use Case 1 - ACDC activation for UE-initiated applications

4.1.1 Description

Besides traditional emergency services, some additional services like "disaster message board" (DMB) might also be activated when a disaster occurs. This is to allow people to upload their safety status, and also allow their relatives to

get the status by browsing the DMB. In addition, within the disaster area, people might use their phone/camera to record a video and upload it to the Internet.

When network becomes congested, these disaster-related services, like DMB, should be assigned allowance for UE to initiate, while other services should be delayed until congestion is alleviated.

4.1.2 Pre-conditions

Alice and Bob are not roaming.

A disaster occurs in a university area and a DMB service is activated.

Alice is the student who stays at the University while her parents live away at their own home. Alice tries to inform her parents by uploading her status via the DMB service, while her parents are eager to know her status via browsing the DMB.

Meanwhile Bob is a student who stays at the University while his parents live away at their own home. Bob tries to inform his parents by uploading his status via the DMB service, while his parents are eager to know his status via browsing the board. In addition, Bob takes videos of the disaster situation and tries to upload those videos to his blog.

- pre-condition:

- Both Alice and Bob's UEs are pre-configured to use the ACDC function.
- Both Alice and Bob's UEs obtain an ACDC list, which consists of an allowed list of applications to be triggered by the UE. The ACDC list can either be pre-configured statically or sent from the network dynamically.
- The DMB service is included in the above ACDC list, while the video service is not.
- When the network is not congested, such ACDC list will not be activated for use, i.e. the ACDC function is deactivated in default cases.
- Alice's UE is trying to update her safety status via DMB service.
- Bob's UE is trying to upload his video to the Internet in addition to updating his safety status via DMB service.

4.1.3 Service Flows

The network indicates to UEs in the disaster area that the ACDC function is currently activated.

Alice's UE receives this message and activates the ACDC function. Since the DMB service is within the ACDC whitelist, the UE decides to initiate the service as usual.

Bob's UE also receives this message and activates the ACDC function. Since the DMB service is within the ACDC whitelist, the UE decides to initiate the service as usual. On the other hand, the UE determines that the video application is not included in this ACDC list and decides not to initiate any further video applications.

Editor's NOTE: It is FFS whether other Access Class Barring mechanisms should be applied or ignored once the ACDC function is activated.

4.1.4 Post-conditions

Both Alice and Bob successfully contact their families via DMB service to indicate their safety.

The network indicates to UEs in the disaster area that the ACDC function is deactivated.

The ACDC function is deactivated in both Alice's and Bob's UEs. Bob can initiate video uploading as usual.

4.1.5 Potential Requirements

The requirements derived from this use case are:

- The UE shall be able to be pre-configured with ACDC allowed application list based on operator's policy, subject to regional regulations.
- The network shall be able to configure ACDC allowed application list dynamically in the UE based on operator's policy, subject to regional regulations.
- The network shall be able to activate/deactivate ACDC control for UE-initiated applications in a specific area dynamically based on operator's policy, subject to regional regulations
- When the ACDC control is activated, the UEs, irrespective of in idle mode or in connected mode, shall allow/restrict UE-initiated applications based on ACDC allowed application lists.

Editor's NOTE: It is FFS whether other Access Class Barring mechanisms should be applied or ignored once ACDC is activated.

Editor's NOTE: It is FFS how ACDC deals with an ongoing service that is being barred.

Editor's NOTE: It is FFS how ACDC works for roaming cases, for different regulations.

4.2 Use Case 2 - a simplified use case, pseudo PS barring

4.2.1 Description

In disaster case, relative priorities are given conceptually in the order of (1) priority calls, (2) emergency calls, (3) Disaster Message Board (DMB), (4) voice, (5) the others, under the assumption that the network breakdown is prevented and that each user is fairly treated. In heavy congestion, (3) is not the case. Specific access barring mechanism(s) is used for each specific event.

There have been workable, sufficient measures for 3G network operation, as shown below.

	Events	Necessary barring measures for 3G	Measures in 3G
1	New year's Eve	PS only barring	DSAC
2	Massive earthquake	CS only barring	DSAC
3	Local event, e.g. fireworks display	CS/PS barring, the same barring rate	ACB
4	Equipment fault	RNC: CS/PS barring, the same barring rate GGSN/SGSN: PS only barring MSC: CS only barring	ACB DSAC DSAC

For LTE network operation, that is not the case. (In the context of LTE below, CS refers to MMTEL and PS refers to the other PS communications.) As a note, the characteristic of event 2 is changing to that for event 5, as a result of penetration of Smartphone.

	Events	Necessary barring measures for LTE	Measures in LTE
1	New year's Eve	PS only barring	No measures available
2	Massive earthquake	CS only barring	SSAC* (to be enhanced)
3	Local event, e.g. fireworks display	CS/PS barring, the same barring rate	ACB
4	Equipment fault	EPC: CS/PS barring, the same barring rate IMS: CS only barring	ACB SSAC
5	Future massive earthquake	CS barring + PS barring, different barring rates.	No measures available

	Preferred handling of DMB.	
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PS only barring for LTE is needed for heavy congestion.

See the event 1. People might ask why you don't use ACB in the event 1. The answer would be: PS only barring allows subscribers not interested in sending New year's emails to make a normal CS call. ACB would impact on everyone. Such a request comes not only from Japan. S1-131069 by LGE, LGUplus, KT, and SKT tells a need in Korea to treat CS preferably to PS in congested situation, which is addressed by PS only barring, too.

NOTE1: PS only barring for LTE is realized, if ACB applies to LTE and DSAC PS applies to 3G and if 3G CS is used via CSFB when a voice call is attempted. However that mechanism depends on 3G network deployment, which is intended to be reduced.

NOTE2: PS only barring can be alternatively understood CS is allowed while a terminal-wise access barring is applying.

NOTE3: Idle/connected mode: CS only barring needs to be applicable both to idle mode and to connected mode, since network nodes responsible to MMTEL should be protected. PS only barring needs not to be applicable to connected mode; the corresponding server resides outside of EPS, Rel-12 WI UP CON addresses u-plane congestion, and congestion in RACH is considered not serious. "Ongoing communication" is not relevant for ACDC.

PS only barring for LTE and preferred handling of DMB is needed for disaster case.

See the event 5. In the near future, PS barring is needed to avoid network outage in disaster case, too. Smartphone increases signalling caused by frequent preservation return and by usage of applications that might not be suitable in disaster case. If only CS barring was used, there would be no need to take care of DMB. But once PS barring is used, preferred handling of DMB is needed.

NOTE4: PS only barring and preferred handling of DMB can be alternatively understood CS and DMB are allowed while a terminal-wise access barring is applying.

In addition, attention is to be paid to the following aspect.

Avoid new UEs being affected by mechanisms intended to apply to old UEs.

The principle is "each user is fairly treated," while UEs with and without ACDC capability coexist in the network. It is observed in the below table that ACB is used for old UEs in the event 1; ACB and possibly SSAC are used for old UEs in the event 5. That does not necessarily lead to ACB/SSAC to be ignored by new UEs, but leads to roles of ACB/SSAC to be properly positioned in the whole picture of ACDC.

NOTE5: UEs without ACDC capability are forced to rely on 3G network deployment due to their lack of necessary capabilities. The ACDC feature shall not rely on 3G network deployment, which is intended to be reduced.

	Events	Necessary barring measures for LTE	Measures in LTE for each terminal type				
			Data only	CSFB terminal	VoLTE w/o SSAC	VoLTE with SSAC	VoLTE with ACDC (the same as above)
1	New year's Eve	PS only barring	ACB	ACB	ACB+CSFB	ACB+CSFB	No measures available
2	Massive earthquake	CS only barring	N/A	DSAC	DSAC	SSAC	SSAC* (to be enhanced)
3	Local event, e.g. fireworks display	CS/PS barring, the same barring rate	ACB	ACB+DSAC	ACB	ACB	ACB
4	Equipment fault	EPC: CS/PS barring, the same	ACB	ACB	ACB	ACB	ACB

		barring rate IMS: CS only barring	N/A	N/A	N/A	SSAC	SSAC
5	Future massive earthquake	CS barring + PS barring, different barring rates. Preferred handling of DMB.	ACB *DMB is not preferred	ACB+DSAC *DMB is not preferred.	ACB+DSAC *DMB is not preferred.	ACB+DSAC or ACB+SSAC *DMB is not preferred.	No measures available

4.2.2 Pre-conditions

New year's Eve comes close.

Alice is an assistant director of a TV station. She tries to make a call to a person who is waiting for her at a site of today's report. Alice's UE is with ACDC capability of pseudo PS/CS barring.

Bob is an assistant director of another TV station. He tries to make a call to a person who is waiting for him at a site of today's report. Bob's UE is without ACDC capability of pseudo PS/CS barring.

The network does not have sufficient 3G network resources.

4.2.3 Service Flows

The network indicates to ACDC-compliant UEs that the ACDC function is currently activated and that PS barring rate is yy%.

Alice's UE receives this message and activates the ACDC function. Since CS is allowed, the UE decides to initiate the call as usual.

The network indicates to old UEs that ACB is currently activated.

Bob's UE receives this message. Since ACB happens to be effective on the UE, the UE goes to 3G via CSFB and tries to make a call there, but in vain, due to limited resources in 3G network.

4.2.4 Post-conditions

Alice successfully contacts the person and tells a change of today's plan.

Bob fails to contact the person and repeatedly tries to contact the person.

4.2.5 Potential Requirements

The assumptions are:

- This feature is optional.
- This feature shall be applicable to E-UTRAN only.
- This feature shall be applicable to UEs in idle mode (and, in case of MMTEL barring, in connected mode).

The requirements derived from this use case are:

- The network shall be able to activate ACDC control in the UE for (MMTEL barring,) pseudo PS barring, in a specific area dynamically.
- The UE shall be able to avoid being affected by other access barring mechanisms intended to apply to UEs without ACDC capability, subject to operator's policy.

- Upon deactivation of ACDC, the affected areas of the RAN shall return to normal state in a graceful way.

4.3 Use Case 3 - a simplified use case, pseudo PS barring and preferred handling of DMB

4.3.1 Description

See clause 4.2.1.

4.3.2 Pre-conditions

A disaster occurs in a university area and the Disaster Message Board (DMB) service is activated.

Alice is a student who stays at the University while her parents live away at their own home. Alice tries to inform her parents by uploading her status via the DMB service, while her parents are eager to know her status via browsing the DMB. Alice's UE is with ACDC capability of pseudo PS/CS barring and preferred handling of DMB.

Bob is a student who stays at the University while his parents live away at their own home. Bob tries to inform his parents by uploading his status via the DMB service, while his parents are eager to know his status via browsing the DMB. Bob's UE is without ACDC capability.

4.3.3 Service Flows

The network indicates to ACDC-compliant UEs in the disaster area that the ACDC function is currently activated and that CS barring rate is xx%, PS barring rate is yy%, DMB is allowed.

Alice's UE receives this message and activates the ACDC function. Since the DMB service is allowed, the UE decides to initiate the service as usual.

The network indicates to old UEs in the disaster area that ACB is currently activated.

Bob's UE receives this message. Since ACB happens to be effective on the UE, the UE decides not to initiate DMB.

4.3.4 Post-conditions

Alice successfully contacts her families via DMB service to indicate her safety.

Bob fails to contact his family via DMB service to indicate his safety.

Bob repeatedly tries to access to DMB.

4.3.5 Potential Requirements

The assumptions are:

- This feature is optional.
- This feature shall be applicable to E-UTRAN only.
- This feature shall be applicable to UEs in idle mode and, in case of MMTEL barring, in connected mode.

The requirements derived from this use case are:

- The UE shall be able to be configured with an ACDC category to which particular, operator-identified applications, e.g. DMB, are associated in terms of disaster case usage, subject to regional regulations.
- The network shall be able to activate ACDC control in the UE for MMTEL barring, pseudo PS barring, and for preferred handling of the ACDC category, in a specific area dynamically, subject to regional regulations.
- The UE shall be able to avoid being affected by other access barring mechanisms intended to apply to UEs without ACDC capability, subject to operator's policy.

- Upon deactivation of ACDC, the affected areas of the RAN shall return to normal state in a graceful way.

4.4 Use Case 4 – relationship to Access Class 11-15

4.4.1 Description

Access Class 11-15 is allocated to specific high priority users who are supposed to maintain infrastructure, as specified in TS 22.011. The UE with one of those Access Classes shall be treated in a prioritized way.

4.4.2 Pre-conditions

A disaster occurs in a university area and the Disaster Message Board (DMB) service is activated.

Alice is a staff of a public utility. Alice tries to inform the office of the situation of water pipeline being broken down by uploading video data. Alice's UE is with ACDC capability. Access Class 13 is allocated to her.

Bob is a student who stays at the University while his parents live away at their own home. Bob tries to inform his parents by uploading his status via the DMB service and by uploading a video data. Bob's UE is with ACDC capability.

4.4.3 Service Flows

The network indicates to ACDC-compliant UEs in the disaster area that the ACDC function should be activated.

Alice's UE receives this message. Since Access Class 13 is allocated, the UE ignores the message and, not activating ACDC, decides to upload the video data as usual.

Bob's UE receives this message and activates the ACDC function. Since only DMB is allowed, the UE decides not to upload the video data, but to initiate the DMB.

4.4.4 Post-conditions

Alice successfully informs the office of the status of the site with a video.

Bob successfully contacts his families via DMB service to indicate his safety, while he fails to upload a video.

4.4.5 Potential Requirements

The requirement derived from this use case is:

- ACDC shall not apply to Access Classes 11-15.

4.5 Non Roaming Regional (Local) Difference in ACDC Use Case

4.5.1 Description

In this use case, a scenario is described where a subscriber of an operator is moving between 2 states with different allowed ACDC applications. The subscriber is not roaming because the operator's network covers both states and the UE is staying within the same network.

4.5.2 Pre-conditions

Bob is a subscriber to Operator A in a country where nation-wide ACDC is mandated. In addition, discretion is given to the local authorities on what applications are included. Bob lives in State X; his UE is configured to comply with State X's ACDC rules.

The national regulation in that country requires that all domestic subscriber UEs of operator A adhere to the ACDC rules of the local jurisdiction i.e. the locality that the UE is in.

State X and State Y have many similar allowed ACDC applications; they also have different allowed applications e.g. State X's ACDC rules allow video transmission of 15 seconds or shorter while State Y's ACDC rules does not include video transmission regardless of duration.

Bob is visiting State Y, when an earthquake occurs in State Y.

Bob tries to upload a short 15 seconds video to a 3rd Party video application server.

4.5.3 Service flows

As Bob moves into State Y, the network notifies Bob's UE of State Y's ACDC rules.

When the earthquake happens, the network indicates to UEs in the disaster area (State Y) that the ACDC function is activated.

Bob's UE receives this message and activates its ACDC function. Since video applications are not allowed under State Y's ACDC rules, Bob's UE will not initiate the video upload.

4.5.4 Post-conditions

Bob is unable to upload his video during the period when ACDC is activated thus alleviating RAN congestion.

When the ACDC status is deactivated in State Y or when Bob moves back into State X (or away from State Y), the video upload will be initiated.

4.5.5 Potential requirements

- The system shall support regional differences in allowed ACDC applications within the same network
- The network shall be able to indicate changes of the applicable ACDC rules if any, as the UE moves between different regional jurisdictions

4.6 Roaming Regional (Local) Difference in ACDC Use Case

4.6.1 Description

The roaming scenario describes how ACDC controls affect the a roaming UE.

4.6.2. Pre-conditions

Operator X operates its network exclusively in Country A; Operator Y operates its network exclusively in Country B.

Operators X and Y have roaming agreements that allow their respective subscribers to access each other's network when roaming away from their respective HPLMN.

Although Countries A and B have many similar applications on their ACDC controls; they also have some differences on applications that may or may not be initiated by the UE.

Table illustrating the International differences in ACDC controls:

	Country A	Country B
Allowed ACDC Applications	Operator X	Operator Y
Disaster Message Board (DMB)	Yes	Yes
Instant Messaging	Yes	No

Bob, who lives in Country A, is a subscriber of Operator X. His UE is configured to comply with Operator X's ACDC controls, subject to Country A's regulations.

4.6.3 Service flows

Bob is visiting his cousin in Country B. When Bob roams into Operator Y's network, the VPLMN notifies Bob's UE of its ACDC controls.

An earthquake occurred in County B and Operator Y activated ACDC.

Bob sends a message to the DMB to inform his family that he is safe. In addition, he also attempts to initiate an instant message to his friend, John.

4.6.4 Post-conditions

Bob's UE is able to successfully send his status update to the DMB. He is however, unable to initiate sending the instant message because of Operator Y's ACDC controls

4.6.5 Potential requirements

- The network shall be able to notify all UEs in the affected service area about the ACDC controls that currently apply
- The network shall be able to indicate changes of ACDC controls to the UE
- When ACDC is activated by the network, the UE shall allow network communication, by applications, based on the available and applicable ACDC controls.

4.7 Categories in ACDC

4.7.1 Description

In this use case, the initiations of different ACDC applications by the UE are allowed according to the activated ACDC categories as determined by regulatory and operators during emergency or RAN congestion situations.

4.7.2 Pre-conditions

Bob is a subscriber of Operator X.

Bob's UE is pre-configured with Operator X's allowed and prioritized categories of applications that may be triggered by the UEs. For example, the allowed ACDC applications on Bob's UE may be categorised as follows:

Allowed ACDC Applications	ACDC Category 1	ACDC Category 2	ACDC Category 3
Emergency Services	Yes	Yes	Yes
Instant Messaging Services	No	Yes	Yes
Video Services	No	No	Yes

If ACDC Category 1 is activated - only emergency service applications are allowed.

If ACDC Category 2 is activated - both emergency and messaging applications are allowed.

If ACDC Category 3 is activated – emergency, messaging and videos services) are allowed.

An earthquake occurs. As a precaution and prudent measure, Operator X decides to activates ACDC category 2 initially to ensure that the network is able to handle the traffic load.

4.7.3 Service flows

Bob initiates a status update to the DMB to inform his family that he is safe. After he has completed his DMB status update, he attempts to initiate an instant message with his friend, John and also attempts to upload a video to 3rd Party Video Application Server.

4.7.4 Post-conditions

Bob's UE is also able to send his DMB status update because it is also an emergency service (allowed under ACDC category 2 activation). He is also able to send the instant message to John because messaging service is a category 2 application.

Bob's UE is however unable to initiate the transmission of the video to the 3rd Party Video Application Server because video service applications that are not allowed under the present time.

NOTE: When network congestion condition improves and Operator X activates ACDC Condition 3 Bob's UE will be able to initiate the video upload. In addition, all condition 1 and 2 applications i.e. DMB and Instant Messaging are also allowed.

4.7.5 Potential requirements

- The System shall be able to support different categories of ACDC applications. The selection and activation of categories can be according to the level of urgency and needs and can be subject to national and regional regulations and operator's policy.

5 Analysis

6 Potential Requirements

7 Conclusion

Annex A: Key issues for consideration

A.1 Applicability

The scope of ACDC (Application specific congestion control for data communication) is to study ways to control initiation of data communication (i.e., before any signalling or user data plane packets start flowing) at times of heavy traffic load in the UTRAN and EUTRAN.

A.2 Control and Triggering

A key issue in ACDC control and triggering in the network is whether ACDC applies only in “disaster” situations, or in any situation where for whatever reason, the network is congested to the point that other techniques are not deemed sufficient? The scope of ACDC includes a broad range of causes regardless of whether it is triggered by a disaster, declared or not, or other causes.

A.3 Effects on On-going Communication

A key issue is whether ACDC affect on-going communication, e.g., an application that has already been launched prior to “activation” of ACDC. Per the ACDC WID, only application initiation is in scope, not effects of on-going communication.

A.4 Control Range and Proportionality

A key issue to be studied is whether there should be a range of controls from open access to blocking of access, which is a function of severity of load condition and the need to gradually transition from open access to barred access and vice versa.

A.5 Interaction with other Forms of Access Control

Interaction of ACDC with previously standardized other forms of access control, including ACB, EAB, and SSAC, is to be studied in the ACDC TR.

Annex B: Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2012-12	S1-60	S1-124272	-	-	Draft received by MCC		0.2.0
2013-08	S1-63	S1-134167	-	-	Draft received by MCC	0.2.0	0.3.0