Global Handset Requirements for CDMA - Data Session Throttling

CDG Document 160

Version 1.1

August 2010

CDMA Development Group
575 Anton Boulevard, Suite 560
Costa Mesa, California 92626
PHONE +1 888 800-CDMA
+1 714 545-5211
FAX +1 714 545-4601
http://www.cdg.org
cdg@cdg.org

Contents

Tables

Revision History

Date	Version	Description
August 2010	1.1	Updated per CRs approved in July 2010 GHRC San Diego meeting: ConnectionDeny and SO Reject on Traffic Channel.
March 2008	1.0	Initial Publication

1. Introduction

1.1 Scope of Document

1.2 Organization

1.3 Reference Documents

3GPP2 reference documents can be found at http://www.3gpp2.org/Public_html/specs/index.cfm.

CDG reference documents can be found at http://www.cdg.org.

CCF reference documents can be found at http://www.globalccf.org.

The following Normative Reference specifies the high level behavior of CDMA terminals.

[1] Global Handset Requirements for CDMA. (September 28, 2007). *CDMA2000 Voice, SMS and Data, version 2.2, Reference Document #90.* CDMA Development Group.

[2] Global Handset Requirements for CDMA. (March 15, 2007). Recommended System Selection Requirements for 1X and 1xEV-DO-Capable Terminals, version 1.0, Reference Document #143. CDMA Development Group.

[3] Global Handset Requirements for CDMA. (December 22, 2007). CDMA Device Requirements – CDMA2000 1xEV-DO Release 0 & Revision A, version 1.5, Reference # 148. CDMA Development Group.

[4] Global Handset Requirements for CDMA. (To Be Published in early 2008). *CDMA Handset Requirements – CDMA2000 Wireless IP, Reference # 155.* CDMA Development Group.

[5] TSC-G. (February 2003). C.S0017-0 Data Service Options for Spread Spectrum Systems, version 5.0. Third Generation Partnership Project 2.

[6] TSG-C. (February 2005). C.S0011-C, Recommended Minimum Performance Standards for cdma2000 Spread Spectrum Mobile Stations, version 1.0. Third Generation Partnership Project 2.

[7] TSG-C. (October 2005). C.S0001-D, Introduction to cdma2000 Standards for Spread spectrum Systems, version 2.0. Third Generation Partnership Project 2.

[8] Network Working Group. (June 2007). Verizon Wireless Dynamic Mobile IP Key Update for cdma2000 ® Networks, Network Working Group Request for Comments: 4784. Internet Engineering Task Force.

1.4 Acronyms and Abbreviations

Table 1-1: Acronyms and Abbreviations

Acronym / Abbreviation	Description
1xRTT	Third generation wireless technology that offers enhanced voice and data capacity and higher data rates than previous, second generation wireless technologies.
1xEV-DO	1xEVolution Data Optimized is part of a family of CDMA2000 1x digital wireless standards.
API	Application Programming Interface
DMU	Dynamic Mobile IP Key Update
MIP	Mobile Internet Protocol
NAI	Network Access Identifier
NDIS	Network Driver Interface Specification
PPP	Point to Point Protocol
RF	Radio Frequency
SIP	Simple Internet Protocol

1.5 Terms and Definitions

Table 1-2: Terms and Definitions

Term	Definition
Access Attempt	Terminal initiates a data call, 1xRTT or 1xEV-DO, in order to establish a data session. An access attempt consist of a mobile station origination attempt and a network acknowledgement
Applications	See section 2.3 of this document.
Call Stack	See section 2.3 of this document.
Data Stack	See section 2.3 of this document.
Modem Hardware/Physical Layer	See section 2.3 of this document.

Term	Definition
Relay Mode	This term is generally used in the industry to mean the term "Relay Layer Rm Interface Protocol Option" as defined in Reference [5]. This document uses the term "Relay Mode."
Sockets API	A specific type of API defined by MicroSoft.
System	A CDMA2000 network. The system may use either the 1xRTT or 1xEV-DO protocols. See Reference [7] for the appropriate standards.
Terminal	A wireless device that is used on a CDMA2000 network. This term includes voice-centric handsets, data cards and data modules and any other device that can be used on a CDMA2000 network.
Tethered Laptop	A combination of a Laptop and a wireless terminal where the laptop uses the terminal as a modem to connect to a CDMA2000 network.

This document uses the following verbal forms: "Shall" and "shall not" identify actions to be followed strictly to conform to this process and from which no deviation is permitted. "Should" indicates that one of several possibilities is recommended as particularly suitable, without mentioning or excluding others; "should not" indicates a certain possibility or course of action that is discouraged but not prohibited. "May" and "need not" indicate a course of action permissible within the limits of the process. "Can" and "cannot" are used for statements of possibility and capability, whether material, physical or causal. "Will" and "will not" refer to actions that the GHRC takes and are considered a statement outlining responsibilities of the GHRC. (This paragraph is taken almost verbatim from Note 2 of Reference [6].)

1.6 Categories of Requirements

Four categories of requirements are established:

(M) Mandatory	The handset **shall** support that characteristic in order to achieve approval.
(HD) Highly Desirable	It is highly desirable and recommended that the handset supports this characteristic. This feature may become Mandatory in subsequent versions of the document. Supporting this characteristic will be valued in the commercial promotion of the terminal.
(O) Optional	It is left up to the manufacturer whether or not the terminal supports this characteristic. The handset **may** support this characteristic.
(D) Discard	The manufacturer **shall not** support this feature or function.

1.7 How to Use This Document

In this document, each section starts with a description of the concept of the requirement(s) for that section and finishes with a table of numbered requirements. Terminals are required to meet the numbered requirements; the descriptions are provided for context and to explain complex concepts.

2. Data Session Throttling Requirements

This section describes the desired behavior of mobile terminals when they encounter certain error conditions as they attempt to access the data network. A major motivation for specifying this retry logic is to prevent terminals from overwhelming the network with ineffective origination attempts. To prevent overly disruptive behavior, the terminals shall sometimes be required to throttle or disable access attempts. These requirements specify the throttling algorithms and the conditions which instigate throttling.

In the following sections, the authors describe the throttling mechanism implying certain aspects of the detailed design of the terminals (e.g., naming timers). This document does not require that the implementation be as described, rather the requirements are on the outward observable behavior of the terminal under the conditions described. The GHRC will not force design decisions on the terminal manufacturers; these requirements are for the behavior of the terminal. Design details are presented in order to illustrate the intent of the requirements.

2.1 Terminal Applicability

The requirements in this section are applicable to any terminal supporting CDMA2000 1xRTT or 1xEV-DO air interfaces including handsets, modules, modems, data cards notebooks and other terminals.

2.2 Bearer Service Applicability

The requirements in this section are applicable to data services in systems of 1xRTT and 1xEVDO air interface standards. For 1xRTT systems, the requirements in this section are applicable to all packet-switched and circuit-switched data service options including, but not limited to, Service Options 12 and 33.

2.3 Logical Architecture

For the purposes of this discussion, Figure 2-1 shows the logical architecture of the terminal.

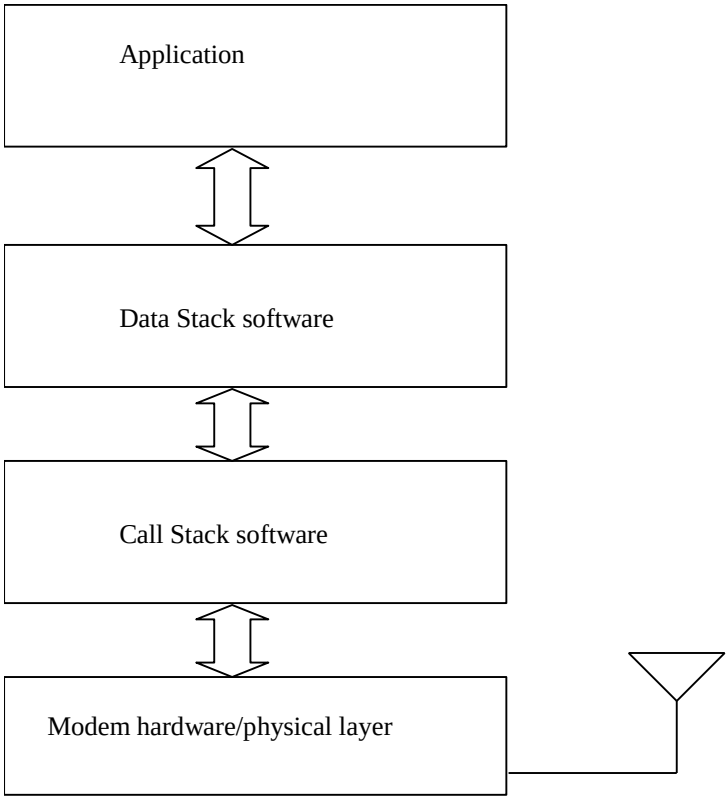


Figure 2-1: Logical Architecture Of The Terminal

Modem hardware/physical layer: this is the part of the terminal that controls the air interface between the terminal and the base station.

Call Stack: this is the software that manages connections with the wireless networks. For 1xRTT systems, this software manages data calls (e.g., Service Option 33 calls). For 1xEVDO systems, this software manages the 1xEV-DO session and opens and closes connections. For the purposes of this discussion, the Call Stack includes the system determination function and hybrid mode operation.

Data Stack: this is software that manages data connections. Functions of this software include maintenance of PPP sessions, Mobile IP and Simple IP functionality, etc. The Data Stack also includes a DNS resolver.

Applications: in this document, an "application" is defined as any software above the Data Stack that requests a wireless data session. Applications can be embedded applications that request wireless data sessions over a sockets Application Programming Interface (API). They can also be software that runs on a laptop and communicates with the terminal over a tethered connection or via Windows NDIS or software that runs on a separate application processor. For terminals that run an advanced operating system, the advanced OS and all applications that run on it are all considered to be part of the application layer in this document since this software exists above the modem's Data Stack. Any application that does not request a data session via

a sockets API (e.g., tethered laptop, PC cards, modules, modems, advanced terminals on which the applications run on a separate application processor, remote terminals, etc) are considered to fall under the general category of “tethered data sessions” for this document. Any software that causes a data call to occur, no matter what the physical or logical interface, is considered to be an application in this document.

In this document, the authors use the terms “Data Stack/Call Stack”, “Data Stack” and “Call Stack” illustratively to refer to the base terminal. The intent is not to force a specific implementation within the terminal itself, merely to explicitly state that the behavior specified is part of the base terminal and not part of any application.

2.4 Details of the Throttling Algorithm

All terminals are required to implement the throttling of data calls as per the following requirements.

2.4.1 “Per System” and “Per NAI” Throttling

The terminal shall maintain throttling behavior on a per-system basis where a “system” is defined by a SID/PZID pair on a 1xRTT network and sub-net on a 1xEVDO network. Throttling parameters (e.g., timers and counters) shall be maintained for each system even after moving to a more favorable system. For example: consider the case in which the current system is system “A” and the Throttling Counter for system “A” is set to a value of six and a 15 minute Throttling Timer is running. The terminal transitions to system “B” for 20 seconds and then comes back to system “A”. The Throttling Timer for system “A” shall continue running while the terminal is monitoring system “B” and shall still be running when the terminal returns to system “A”. The Throttling Counter shall, similarly, still be six when the terminal returns to system “A” from system “B”. The terminal shall maintain parameters for a minimum of ten systems, including both 1xRTT and 1xEV-DO systems.

In addition to the per system basis, the terminal should maintain the throttling parameters on a per NAI basis if the terminal is capable of supporting multiple NAI’s. The terminal shall maintain these parameters for each NAI on each system.

Req. #	Requirement	Category	Remarks	References	Related Requirements
2.4.1.1	Maintain throttling parameters and timers on a per system basis for a minimum of ten systems.	M	A separate set of parameters shall be kept for each system. Includes both 1xRTT and 1xEV-DO systems.		

Req. #	Requirement	Category	Remarks	References	Related Requirements
2.4.1.2	Maintain throttling counter settings when changing systems	M	Each system's throttling counters shall be maintained separately, irrespective of which system the terminal is active on.		
2.4.1.3	Keep throttling timers active when changing systems	M	Each system's throttling timers shall be maintained separately, irrespective of which system the terminal is active on.		
2.4.1.4	Maintain throttling counter settings for each NAI.	HD	Each NAI's counters shall be maintained for each system, irrespective of which NAI the terminal is using.		

2.4.2 Throttling Algorithm Requirements

The purpose of the Throttling Algorithm is to prevent the terminal from continuously attempting to initiate a data session when there are recent failed attempts. To prevent the terminal from repeated attempts to initiate a data session, the Data Stack shall keep a "Throttling Counter" and "Throttling Timer". If the Throttling Timer is active, then the Data Stack shall not attempt to initiate the requested data session and shall return an error to the application. The terminal shall keep the Throttling Counter and Throttling Timer separately for each system that it attempts to initiate a data session on.

1. The data throttling behavior shall be implemented in the Data Stack/Call Stack portion of the terminal and shall, therefore, be independent of the type of application requesting the data session as well as the type of terminal.
2. All failures to connect a data session shall result in the Data Stack returning an error message to the application. The Data Stack shall not attempt, on its own, any further attempts to reconnect for any network failure except those listed below.
    - Data Stack may attempt additional originations as per the MIP Registration Failure parameters. The Data Stack shall report the failure after the number of attempts has reached the value permitted by the parameters.
    - When the terminal is set to MIP Preferred mode, the failure shall be reported to the application only after both MIP and SIP fail.
    - When the error causes Silent Redial as specified in Reference 2, the error is only reported once if all attempts fail.

3. When an application requests the Data Stack to initiate a data session and the Throttling Timer is not running, the Data Stack shall attempt to initiate the session without delay. If the attempt fails, the Data Stack shall return an error to the application. If the attempt succeeds, the Data Stack shall clear the Throttling Counter.
4. If the first attempt (the Throttling Counter is equal to zero) fails for any of the designated reasons (see Requirement 2.4.2.3 for the list), the Data Stack shall set the Throttling Counter to one and not start the Throttling Timer.
5. If the second attempt (the Throttling Counter is equal to one) fails for any of the designated reasons (see Requirement 2.4.2.3 for the list), the Data Stack shall set the Throttling Counter to two and not start the Throttling Timer.
6. If the third attempt (the Throttling Counter is equal to two) fails for any of the designated reasons (see Requirement 2.4.2.3 for the list), the Data Stack shall set the Throttling Counter to three and set the Throttling Timer to one minute plus a Random Value, which is described below.
7. If the fourth attempt (the Throttling Counter is equal to three) fails for any of the designated reasons (see Requirement 2.4.2.3 for the list), the Data Stack shall set the Throttling Counter to four and set the Throttling Timer to two minutes plus a Random Value, which is described below.
8. If the fifth attempt (the Throttling Counter is equal to four) fails for any of the designated reasons (see Requirement 2.4.2.3 for the list), the Data Stack shall set the Throttling Counter to five and set the Throttling Timer to eight minutes plus a Random Value, which is described below.
9. If the sixth attempt (the Throttling Counter is equal to five) fails for any of the designated reasons (see Requirement 2.4.2.3 for the list), the Data Stack shall set the Throttling Counter to six and set the Throttling Timer to 15 minutes plus a Random Value, which is described below.
10. If any subsequent attempts (the Throttling Counter is equal to six), the Data Stack shall set the Throttling Timer to 15 minutes plus a Random value, which is described below.
11. DRS=0 originations on 1xRTT systems shall not be throttled. These originations are used to alert the network when the terminal with an active PPP session crosses a system boundary and must not be suppressed. This does not reset the Throttling Counters or Throttling Timers.
12. The terminal shall respond to network-initiated data sessions regardless of the state of throttling i.e., if the terminal receives a data Page message from either a 1xRTT or 1xEVDO system while the Throttling Timer is running for that system, the terminal shall respond to the Page; in addition, it shall reset the Throttling Timer and Throttling Counter to zero for that system. However, if the terminal encounters one of the failures specified in section 2.4.3 while responding to a Page, the Data Stack shall start throttling again as described in step 4 above.
13. If a 1xEV-DO Access Authentication attempt fails, the Data Stack shall not implement the Data Throttling mechanism. As a practical matter, this means that the Data Stack shall not increment the Throttling Counter. The terminal shall follow the requirements of CDG 143 (Reference 2) in that case.

14. RF related failures such as Forward Link RF loss or a maximum access probes failure for access attempts may result in an error being returned to the application but shall not impact the throttling parameters. For example, if a terminal attempts to originate a data session on a 1xRTT system and experiences a maximum access probes failure, the Data Stack shall send a failure indication to the application but it shall not increment the Throttling Counter. In addition, if the terminal sends multiple access probes before the network acknowledges the access attempt, the terminal shall not increment its Throttling Counter.

When the terminal operates in “Relay Mode” call failures due to a PPP/LCP/IPCP failure or timeout will not increase the Throttling Counter.

In several of the following requirements, the timers shall be set to a specified value plus a Random Value. The GHRC does not specify the type of Random Value to be used, nor does it specify any parameters for the Random Value, except that it shall be a minimum of 0 seconds to a maximum of 60 seconds. It is suggested that the Overload Class of the terminal be used in the calculation of the Random Value in order to help randomize the wait in the situation where a large number of terminals have failures in a specific system.

Req. #	Requirement	Category	Remarks	References	Related Requirements
2.4.2.1	General Data Throttling Requirements				
2.4.2.1-1	Implement the Data Throttling mechanism in the Data Stack so it is equally available to all applications.	M			
2.4.2.1-2	Except where noted otherwise, the Data Stack shall not attempt any retry on its own.	M			
2.4.2.2	Data Stack error reporting				
2.4.2.2-1	Data Stack shall return an error to the application when the connection fails for any reason, except for the following three conditions.	M			

Req. #	Requirement	Category	Remarks	References	Related Requirements
2.4.2.2-1.1	When the error causes a Silent Redial as specified in Reference [2], the Data Stack shall report the error only once if and after all attempts fail.	M	See Reference [2].		
2.4.2.2-1.2	Data Stack may attempt additional originations as per the MIP Registration Failure parameters before reporting one error to the application.	M			
2.4.2.2-1.3	Data Stack shall report an error when terminal is set to MIP Preferred mode after both MIP and SIP fail.	M			
2.4.2.3	Data Stack management of the Throttling Counter				
2.4.2.3-1	Data Stack shall increment the Throttling Counter for each failure as specified in the following ten cases.				
2.4.2.3-1.1	On receipt of an Intercept Order on a 1xRTT system	M			
2.4.2.3-1.2	On receipt of a Release Order (SO Rejected) message on a 1xRTT system.	M	Either on the Paging Channel or the Traffic Channel		
2.4.2.3-1.3	On receipt of a Connection Deny message on a 1xEV-DO system with the reasons General, Network Busy or Authentication and Billing Failure.	M			

Req. #	Requirement	Category	Remarks	References	Related Requirements
2.4.2.3-1.4	Any Authentication Failure that occurs when setting up any Simple IP PPP session with the exception of a tethered data session operating in “Relay Mode.”	M	Relay Mode defined in IS-707.		
2.4.2.3-1.5	LCP setup failure during PPP negotiation for any system with the exception of a tethered data session operating in “Relay Mode.”	M	Relay mode defined in IS-707.		
2.4.2.3-1.6	IPCP (or any other NCP) setup failure for any system with the exception of a tethered data session when operating in “Relay Mode.”	M	Relay mode defined in IS-707.		
2.4.2.3-1.7	PPP setup failure due to an option mismatch for any system with the exception of a tethered data session when operating in “Relay Mode.”	M	Relay mode defined in IS-707.		
2.4.2.3-1.8	MIP Agent Solicitation failure	M			
2.4.2.3-1.9	Mobile IP Registration Request failure after all required retires failed.	M			
2.4.2.3-1.10	Any Mobile IP failure indicated by a non-zero error code except for a failure indicating that a DMU update is needed in the Mobile IP registration Response when the DMU is not initialized.	M	If the DMU is not initialized, the Data Stack shall increment the Throttling Counter	See Reference [8]	

Req. #	Requirement	Category	Remarks	References	Related Requirements
2.4.2.3-2	When any failure other than those listed in 2.4.2.3-1 occurs, the Data Stack shall not increment the Throttling Counter.	M			
2.4.2.4	The Data Stack management of the Throttling Timer				
2.4.2.4-1	When the Throttling Counter is equal to “1”, the Data Stack shall not set the Throttling Timer.	M			
2.4.2.4-2	When the Throttling Counter is equal to “2”, the Data Stack shall not set the Throttling Timer.	M			
2.4.2.4-3	When the Throttling Counter is equal to “3”, the Data Stack shall set the Throttling Timer to one minute plus a Random Value.	M			
2.4.2.4-4	When the Throttling Counter is equal to “4”, the Data Stack shall set the Throttling Timer to two minutes plus a Random Value.	M			
2.4.2.4-5	When the Throttling Counter is equal to “5”, the Data Stack shall set the Throttling Timer to eight minutes plus a Random Value.	M			

Req. #	Requirement	Category	Remarks	References	Related Requirements
2.4.2.4-6	When the Throttling Counter is greater than or equal to “6”, the Data Stack shall set the Throttling Timer to 15 minutes plus a Random Value.	M	All subsequent failures are treated the same. See Requirement 2.4.2.3-3.		
2.4.2.5	Access Attempts based on the Throttling Timer				
2.4.2.5-1	The Data Stack shall not attempt to connect to the Data Network while the Throttling Timer is active	M			
2.4.2.5-2	The Data Stack shall always allow DRS=0 originations on 1xRTT systems.	M			
2.4.2.6	The Terminal shall maintain the timer as it counts down to zero independent of any requests to connect from an application	M			

2.4.3 Clearing the Throttling Behavior

The following events shall clear the throttling behavior (i.e., clear the Throttling Counter to an integer zero and clear the Throttling Timer to zero seconds) for a particular system.

Req. #	Requirement	Category	Remarks	References	Related Requirements
2.4.3.1	The Data Stack shall clear both the Throttling Counter and Throttling Timer for a particular system after these events:		The Throttling Timer and Throttling Counter are cleared for the active system immediately preceding the event unless otherwise noted.		
2.4.3.1-1	A power cycle of the terminal.	M			

Req. #	Requirement	Category	Remarks	References	Related Requirements
2.4.3.1-2	A software reset of the terminal	M			
2.4.3.1-3	A successful data session is established on that system. Success is defined in the following two requirements.				
2.4.3.1-3.1	When the terminal progresses past the IPCP phase of PPP and is assigned an IP address for Simple IP sessions	M			
2.4.3.1-3.2	When the terminal receives a Mobile IP Registration Response with an error code of zero for Mobile IP sessions.	M	Note that an IP address is assigned with the IP Registration Response.		
2.4.3.1-4	The terminal successfully completes an OTASP (Over the Air Service Provisioning) session. This causes the terminal to clear both the Throttling Timer and the Throttling Counter for all systems.	M	A successful session is specified as one in which the terminal receives a “Commit Request” from the network and responds with a “Commit Response” in which the result code is “0x00 Accepted – Operation Successful.”		
2.4.3.1-5	The terminal successfully completes an OTAPA (Over the Air Parameter Administration) session. This causes the terminal to clear both the Throttling Timer and the Throttling Counter for all systems.	M	A successful session is specified as one in which the terminal receives a “Commit Request” from the network and responds with a “Commit Response” in which the result code is “0x00 Accepted – Operation Successful.”		

Req. #	Requirement	Category	Remarks	References	Related Requirements
2.4.3.1-6	The terminal receives an incoming data call.	M			
2.4.3.1-7	The terminal's identification information is changed as specified in the following three requirements		Changed by any means, including Keypad Programming		
2.4.3.1-7.1	IMSI	M			
2.4.3.1-7.2	MIN	M			
2.4.3.1-7.3	MDN	M			

2.4.4 1xEV-DO Hybrid Mode Terminal Behavior

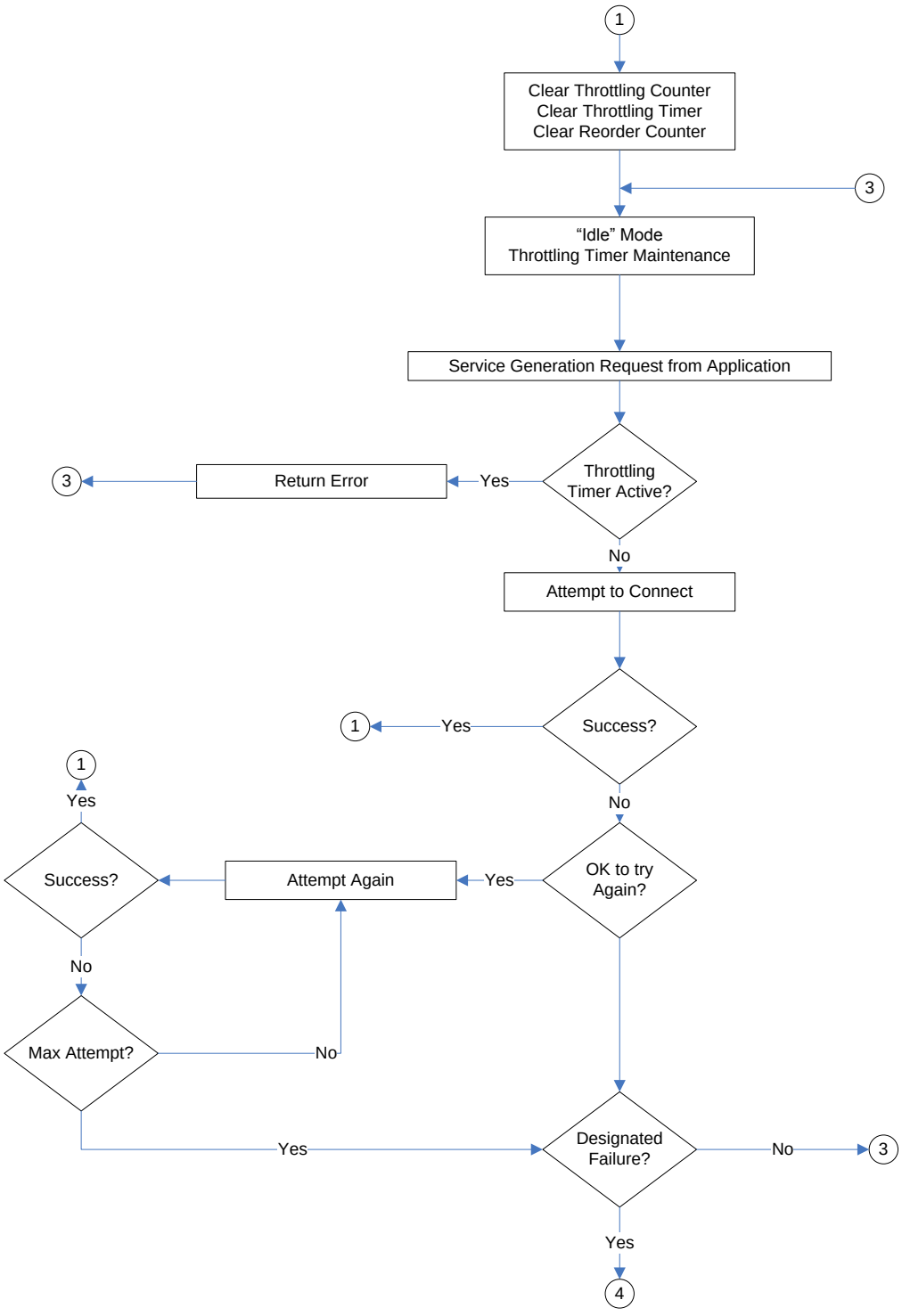
If an 1xEV-DO-capable terminal is monitoring both 1xEV-DO and 1xRTT systems and a Throttling Timer is running for the 1xEV-DO system when an application requests a data connection, the terminal shall attempt to connect the data session on the 1xRTT system. If both systems have active Throttling Timers, the Data Stack does not attempt to originate a data session with the network.

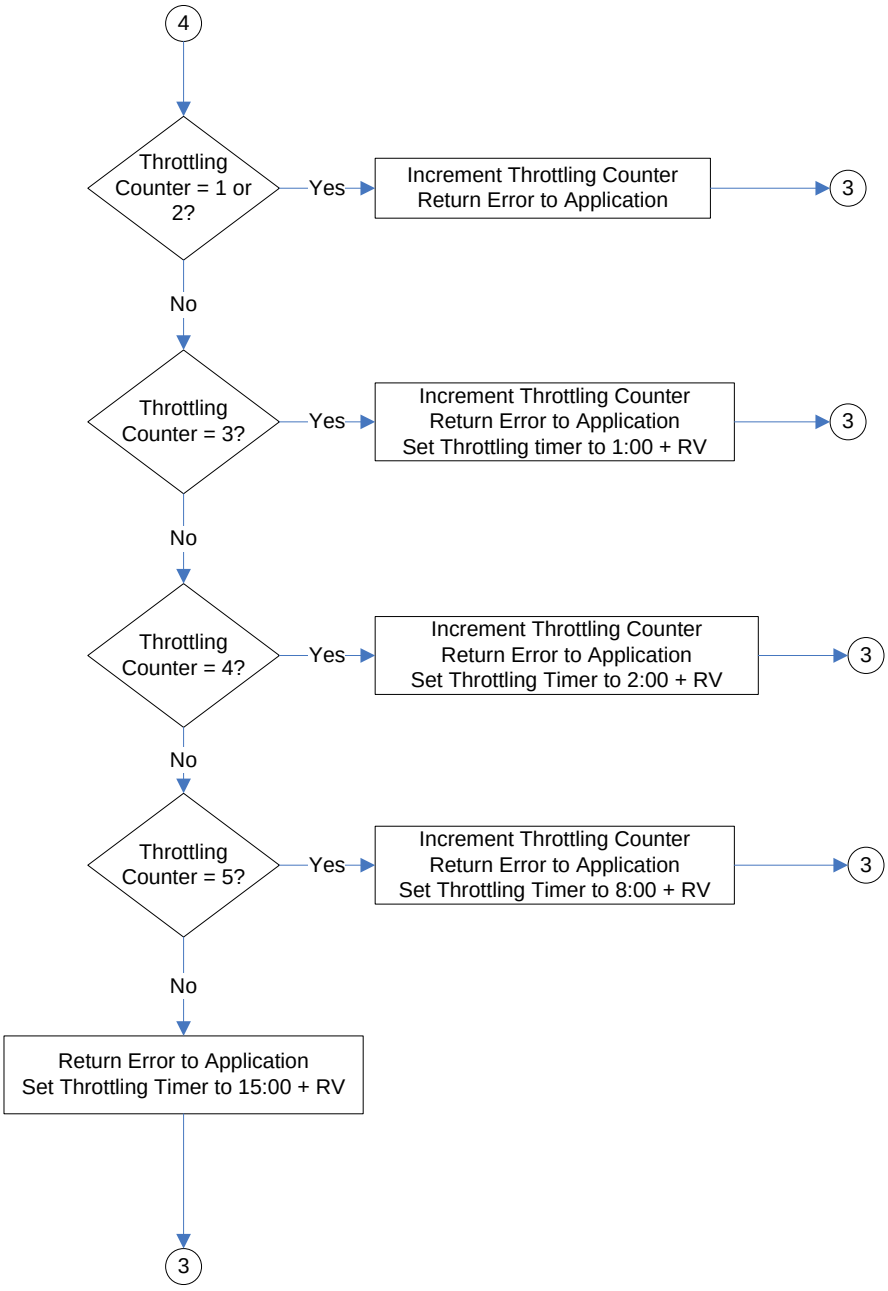
Req. #	Requirement	Category	Remarks	References	Related Requirements
2.4.4.1	The next two requirements apply only to terminals monitoring both 1xEV-DO and 1xRTT systems.				
2.4.4.1-1	When the Throttling Timer for the EV-DO system is active, the Data Stack shall only attempt to connect a requested data session on the 1xRTT system.	M			

Req. #	Requirement	Category	Remarks	References	Related Requirements
2.4.4.1-2	When the Throttling Timers for both the 1xRTT and 1xEV-DO systems are active, the Data Stack shall not attempt an access on either network.	M			

Appendix A – Data Retry Algorithm Flowchart

This Appendix contains a flowchart of the Data Retry Algorithm.




4
Throttling Counter = 1 or 2?
Yes
Increment Throttling Counter
Return Error to Application
3
No
Throttling Counter = 3?
Yes
Increment Throttling Counter
Return Error to Application
Set Throttling timer to 1:00 + RV
3
No
Throttling Counter = 4?
Yes
Increment Throttling Counter
Return Error to Application
Set Throttling Timer to 2:00 + RV
3
No
Throttling Counter = 5?
Yes
Increment Throttling Counter
Return Error to Application
Set Throttling Timer to 8:00 + RV
3
No
Return Error to Application
Set Throttling Timer to 15:00 + RV
3