AN/Telecom/SMS/1 December 2002

# Introduction

This document aims to assist modem product designers using and understanding Short Message Service (SMS) applications. CML Microcircuits' (CML) integrated circuit devices (CMX85x and CMX86x) could be used to realize and achieve a Caller Line Identification (CLI), SMS or Low Rate Messaging Service (LRMS) data transfer within a wireline system.

CML produces a range of devices that can support CLI or SMS (V.23) in wireline applications. The CML CMX85x and CMX86x series devices support the V.23 protocol, which is essential for CLI or SMS transactions.

SMS has migrated from the GSM domain into the domestic landline market, enabling SMS communications to be established over the following systems:

- Plain Old Telephone Systems (POTS)
- Public Switched Telephone Networks (PSTN)
- Global Systems for Mobile communications (GSM)
- Digital European Cordless Telephone (DECT)
- Wireless Data
- Wireline Telecoms

SMS is a system that allows users to send short text messages (similar to the text messages sent in a GSM mobile phone service), to another user without establishing a full-blown audio duplex GSM or landline connection. This has now given rise to numerous development projects based on SMS in the GSM, PSTN, POTS, DECT, wireless and wireline modem systems.

SMS was an accidental success that took nearly everyone in the mobile industry by surprise. The introduction of pre-pay mobile phone tariffs where people could pay for their airtime in advance and by this means controls their mobile phone expenditure. Billing was the catalyst that accelerated the take up of SMS, which is one of the few services in consumer history that has grown very fast without corresponding decreases in pricing.

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# General SMS Protocol Information

## Send and Receive via the Fixed Network (PSTN)

Sending SMS messages used to be limited to and from mobile phones. Now it is easy to create, send and access SMS messages over the PSTN. A typical terminal consists of an alphanumeric keyboard with a display, which simply connects to a normal telephone line. The growing popularity of SMS, in combination with its low cost and easy access, makes everybody with a telephone line a potential user.

## SMS Compatible Equipment and Applications

SMS is based on an asynchronous Frequency Shift Keyed (FSK) data transfer, which is the same method that CLI uses to display the incoming caller's identification number. CLI and SMS operate in two distinctly different modes, on-hook (type 1) and off-hook (type 2). Type 1 is the most widely used because the SMS is delivered without any user participation. This document covers type 1 SMS transaction. The principles may be extended for some type 2 off-hook services, which will be discussed briefly.

To use SMS, users require the relevant subscriptions and hardware, specifically:

- A terminal phone system that supports SMS data protocol.
- A subscription to a telephone network that supports SMS data transfer (automatic access to CLI and SMS is given by some operators).

- Knowledge of how to send or read a short message using their specific model of phone and phone system.
- A destination to send a short message to, or receive a message from. This is usually another land phone (with a display), mobile phone, fax, Personal Digital Assistant (PDA), Personal Computer (PC), email or Internet site.

SMS is a bi-directional service for short alphanumeric or data messages (up to 160 bytes but extended messages could be supported). Data is transmitted in a store-and-forward fashion. For point-to-point SMS, a message can be sent to another subscriber to the service, and an acknowledgement of receipt can be provided to the sender. SMS can also be used in a cell-broadcast mode, for sending data or messages.

Two possible ways of sending large or multiple short messages are available. SMS concatenation (stringing several short messages together) and SMS compression (getting more than 160 characters of information within a single short message) have been defined in the terminal SMS standards (see Reference section).

SMS also features the confirmation of message delivery, which means that unlike paging, users do not simply send an SMS and hope that it gets delivered. Instead, the sender of the short message can receive a receipt SMS confirming whether the message has been delivered successfully.

## Typical SMS Applications:

- Automatic and manual messaging to and from any of the following – GSM, PSTN, POTS, DECT, wireless and wireline modem systems
- Security Authentication Checking – Credit cards, Personal Identity Number (PIN), Personnel clearance, Electronic Point Of Sales (EPOS)
- Security and commercial location mapping – equipment tracking, vehicle and personnel trackers
- Meter reading and control of domestic utility meters
- Remote sensor monitoring and control – Supervisory Control and Data Acquisition (SCADA) systems, instrumentation monitoring, process control

Whilst the core function of the CML CMX85x and CMX86x are specifically targeted at modem applications, SMS may be a necessary feature of the overall design. SMS may be provided as a ‘value added’ feature to any application design.

The CMX860 is targeted at applications such as low cost and least cost routing. Here SMS can be a useful security feature in cost routers permitting only the authorised caller to provide call table updates using remote access. The CMX850, CMX860, CMX867 and CMX868 all include a Ring Detector, 1200bps FSK Demodulator and a Programmable Tone Pair Detector that can be used to detect and extract the SMS message string.

Figure 1 shows how a terminal PSTN equipment would communicate an SMS to a second terminal PSTN equipment through the current PSTN or Integrated Service

Digital Network (ISDN). This operation must take place through a Short Message Service Centre (SM-SC).

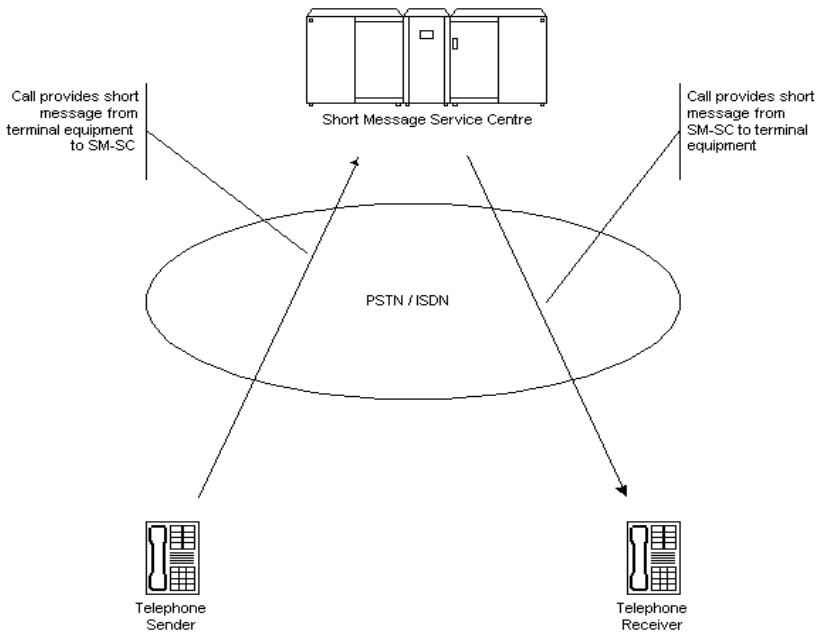



**Figure 1 – SMS Terminals for Fixed Networks (PSTN)**

Figure 2 shows how a GSM and a PSTN/ISDN system would be integrated together to create cross connectivity for SMS to be transferred successfully.

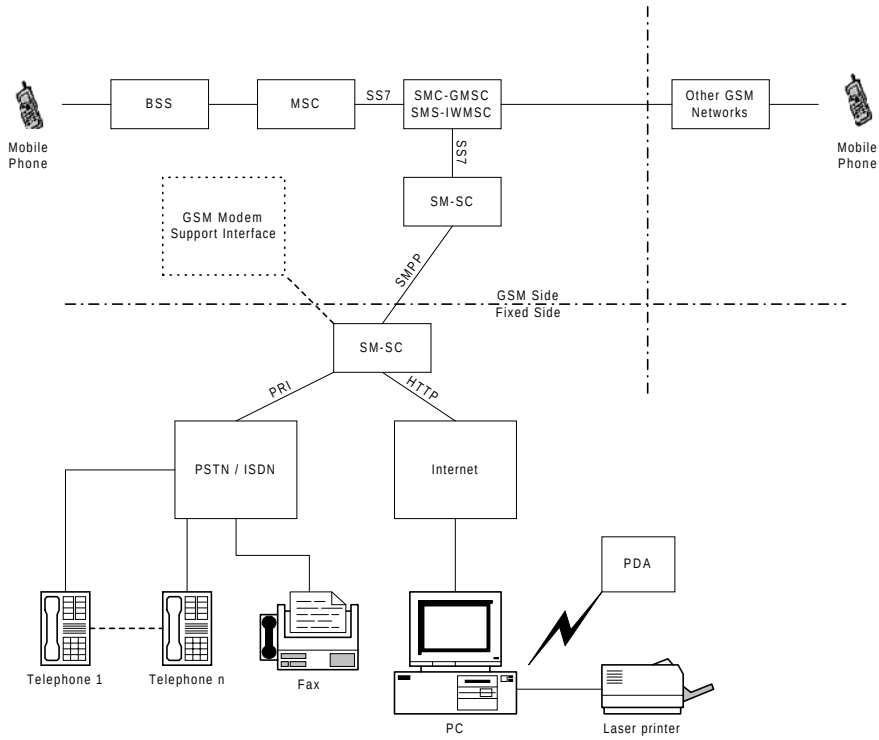



**Figure 2 – SMS Interconnectivity – GSM / PSTN / PDA / FAX / Internet**

## SMS V.23 Protocol

The SMS protocol is specified in the ITU-T Recommendation V.23 [6].
The V.23 [6] protocol is summarised as follows:

- 1200bps Baud Rate
- FSK data transmission:
  - Space = 0 = 2100Hz
  - Mark = 1 = 1300Hz
- 10 bit Octet per character:
  - 1 Start Bit (Space)
  - 8 Data Bits (LSB first)
  - 1 Stop Bit (Mark)

To deliver an SMS the Terminal Equipment (TE) can be connected by analogue access directly to another TE or through an Access Network. The data transmission can be initiated from a source TE or from elsewhere within the network (like the SM-SC) but it is necessary for a transmission path to exist before data transmission can be completed successfully. It is the network operator's responsibility to ensure that a transmission path is established or provide a temporary storage system to ensure the delivery of the SMS data at a later time. Transmission path establishment procedures are outside the scope of this document.

Figure 3 shows a diagrammatic example of the data format of a typical SMS transmission. The requirements imposed on the FSK signaling-based subscriber line protocol deal with data encoding, data transmission requirements and the three layers of the protocol at the network side of the interface:

- Data link layer
- Presentation layer
- Physical layer

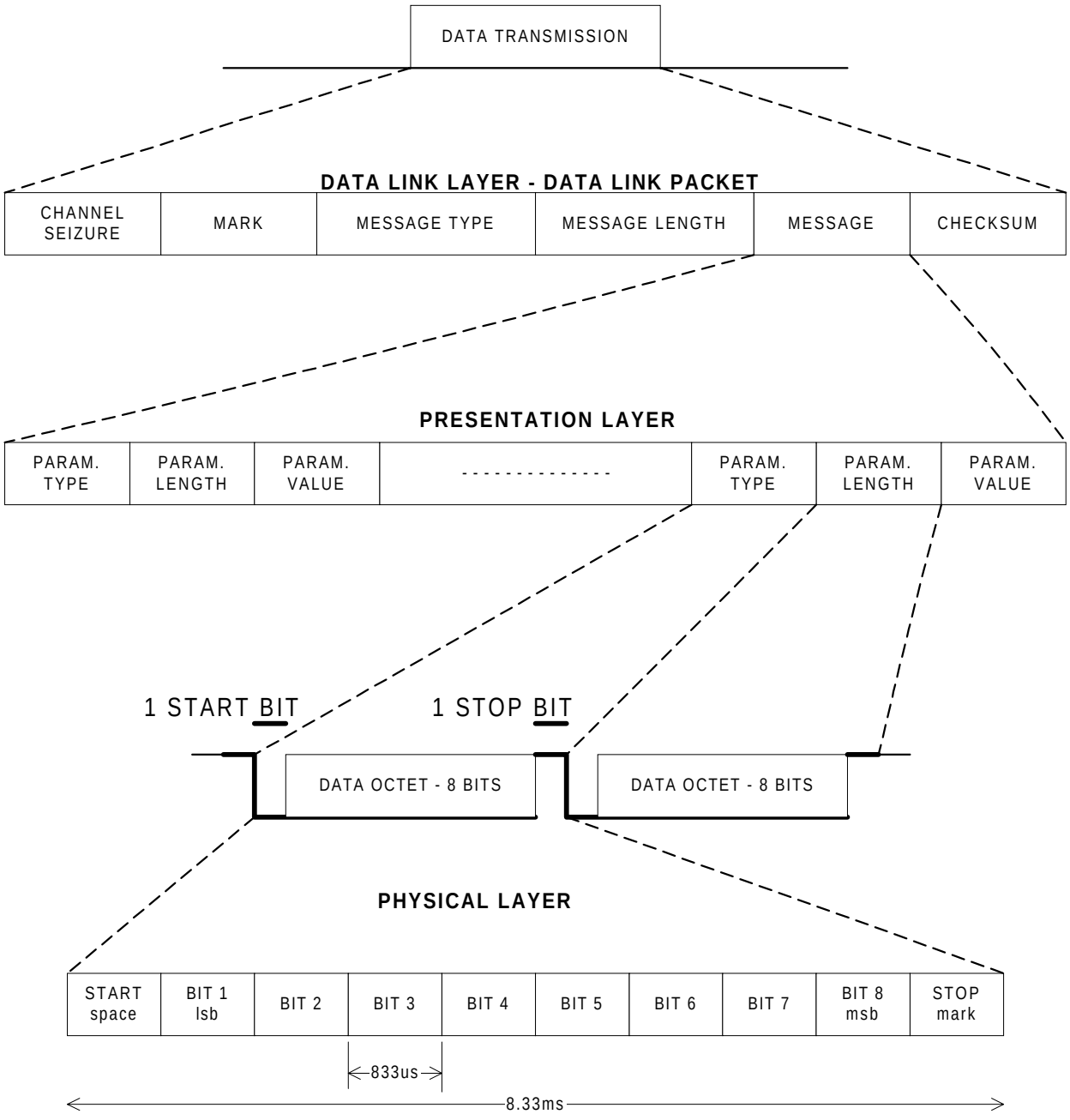



**Figure 3 – SMS Data Transmission Format**

## Messages Between Layers

When handling the transmission of the SMS data over several layers there are associated interactions between the Data Link Layer (DLL), Transfer Layer (TL), Connection Manager (CM) and the Application (APP).

The following table is intended to give the designer some idea of the processes to be included in software coding, processing and receipt handling required to complete an SMS transaction.

The following messages are for information only, and are not the real data message transactions between the layers. These examples have been taken from the ETSI 201 912 document.

### Table 1 - Messages Between Transport Layers

| Message | Description |
|---|---|
| **from SM-AL to SM-TL** | |
| TL_EST_REQ | SME-M_AL request to setup an end-to-end connection. |
| TL_SMS_REQ | SME-M_AL request to send an SM info. |
| TL_REL_REQ | SME-M_AL request to release an end-to-end connection. |
| **from SM-TL to SM-AL** | |
| APP_EST_CFM | SME-M_TL confirmation of the establishment of the end-to-end connection. |
| APP_EST_REJ | SME-M_TL rejection of the establishment of the end-to-end connection. |
| APP_SMS_CFM | SME-M_TL confirmation of the submission/delivery of the SM info to the SME-S_TL. |
| APP_SMS_REJ | SME-M_TL rejection of the submission/delivery of the SM info to the SME-S_TL. |
| APP_SMS_IND | SME-S_TL indication of a received SM Info. |
| **from SM-TL to CM** | |
| CM_CONN_REQ | SME-M_TL request of establishment of a circuit connection. |
| CM_REL_IND | SME_TL indication of not active data link. |
| **from CM to SM-TL** | |
| TL_CONN_CFM | SME-M_CM confirmation of establishment of a circuit connection. |
| TL_CONN_REJ | SME-M_CM rejection of establishment of a circuit connection. |
| TL_CONN_IND | SME-S_CM indication of establishment of a circuit connection. |
| **from SM-TL to SM-DLL** | |
| DLL_EST_REQ | SME-M_TL request of Activate the Data Link. |
| DLL_EST_IND | SME-S_TL indication of Transport Layer Activation. |
| DLL_INFO_REQ | SME-M_TL request of sending any Info. |
| DLL_REL_REQ | SME-M_TL request of release the Data Link. |
| DLL_INFO_CFM | SME-S_TL confirmation of a received Info. |
| DLL_INFO_REJ | SME-S_TL rejection of a received Info. |
| **from SM-DLL to SM-TL** | |
| TL_EST_CFM | SME-M_DLL confirmation of Data Link Activation. |
| TL_EST_REJ | SME-M_DLL rejection of Data Link Activation. |
| TL_INFO_CFM | Confirmation to SME-M_TL of SM submission/delivery to the SME-S_TL. |
| TL_INFO_REJ | Rejection to SME-M_TL of SM submission/delivery to the SME-S_TL. |
| TL_INFO_IND | Indication to SME-S_TL of a received Info. |
| TL_INFO_ABRT | Indication to SME-M_TL of unrecoverable errors occurred during submission/delivery of the SM. |
| TL_REL_CFM | Confirmation to SME-M_TL of the Data Link release. |
| TL_REL_ABRT | Indication to SME_TL of unrecoverable errors during the Data Link release. |
| TL_REL_IND | Indication to SME-S_TL of Data Link Layer deactivation. |

| | | | | | |
|---|---|---|---|---|---|
| AL - | Application Layer | SC - | Service Center | DLL - | Data Link Layer |
| CM - | Call Manager | TL - | Transfer Layer | | |

The various SMS acknowledgement messages over the communication layers are set out very explicitly in the protocol specification documents. With reference to Figure 4 a typical SMS transmission to and from a CMX device has been included.

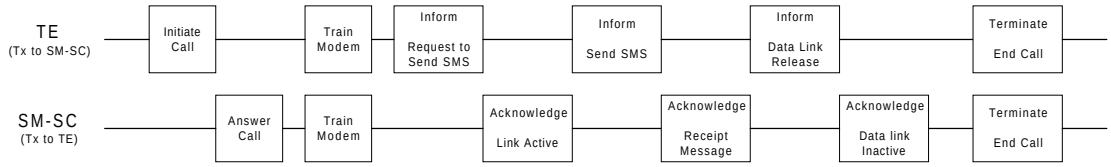



**Figure 4 – TE calling SM-SC Message Transmissions Transfer**

## Basic Communication Flow Chart Examples

The following flowcharts are based on the ETSI 300-659-1, data transfer timing standards and the current British Telecom guidelines. The goal is to deliver a basic understanding and appreciations of the SMS transport protocols and procedures. Software stack, control and timing considerations with reference to the CML CMX85x and CMX86x specific devices will be discussed throughout the flow chart diagrams.

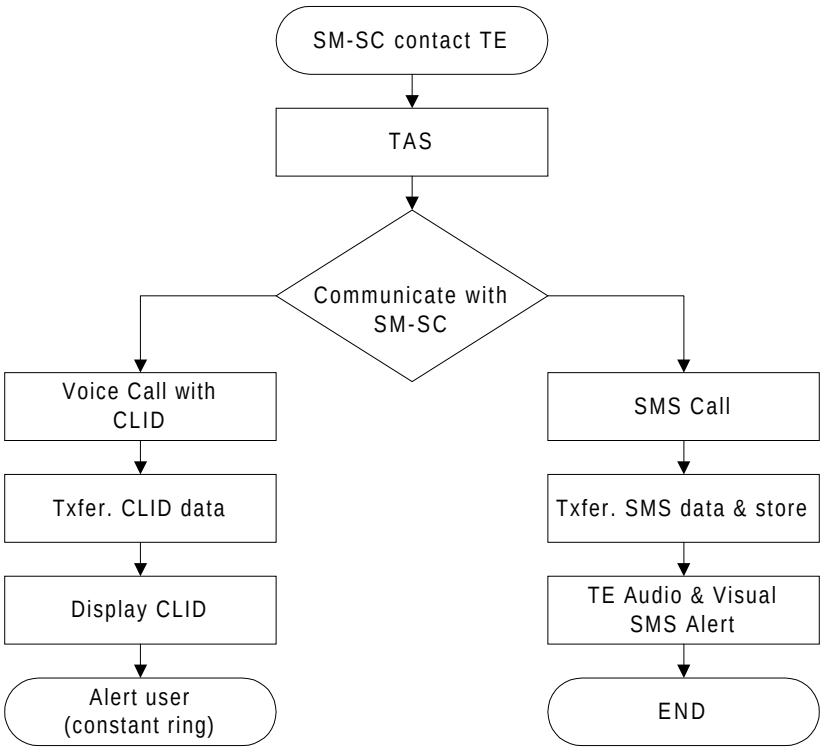



**Figure 5 – Flow chart of a typical SMS communication between the TE and SM-SC**
TAS = Terminal Equipment Alerting Signal

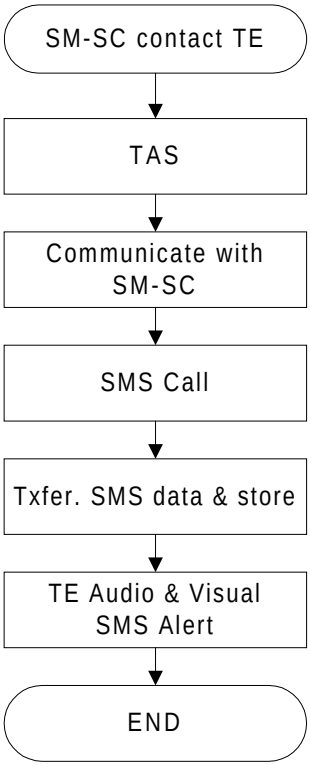



**Figure 6 - The SMSC contacts the TE**

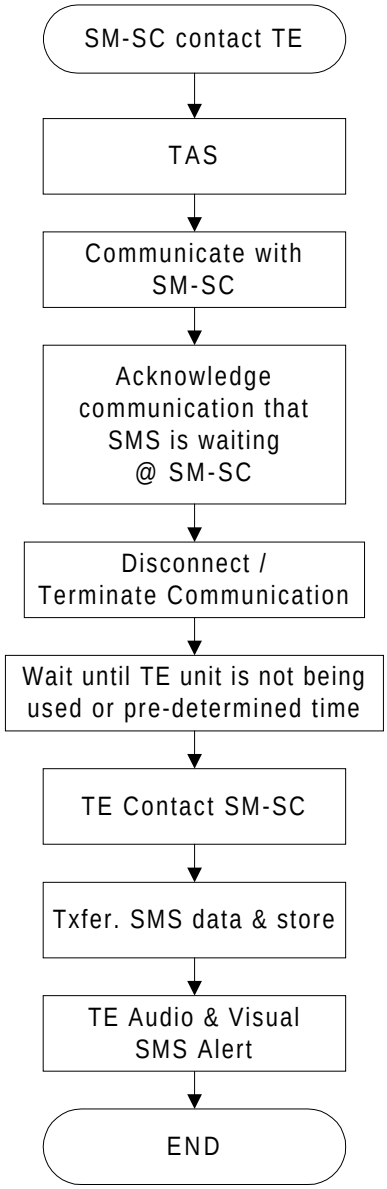



**Figure 7 - The SMSC contacts TE**

Figure 6 shows a data transaction where the SMS data is transferred as and when the SMS message is sent. The TE answers the call thus the Service Centre (SC) will pick up the connection charge.
In Figure 7 the TE acknowledges the call then calls the SM-SC back to collect the SMS. Thus the TE will pick up the connection charges. The SMS data is stored temporarily until the TE is ready to accept the data. This could be implemented when large or numerous SMS transactions are expected and the data transactions are completed during a low charge (off peak) period.

# Receiving SMS

There are several options available for SMS is reception. This is dependant on the Short Message Service Centre, the users contractual agreement and if the phone is on-hook or off-hook. How the call management hardware and software deal with the process is open to discussion.

## Data Transmission During Ringing

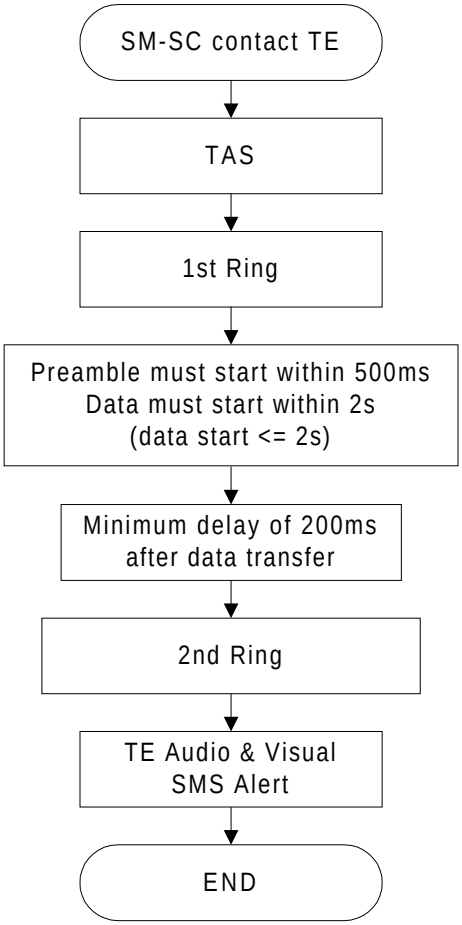



**Figure 8 - Data Transmission Delivered During a Ring Pattern**

In Figure 8 the data transmission for SMS occurs during the 1st long silence between a 1st and 2nd ring pattern.

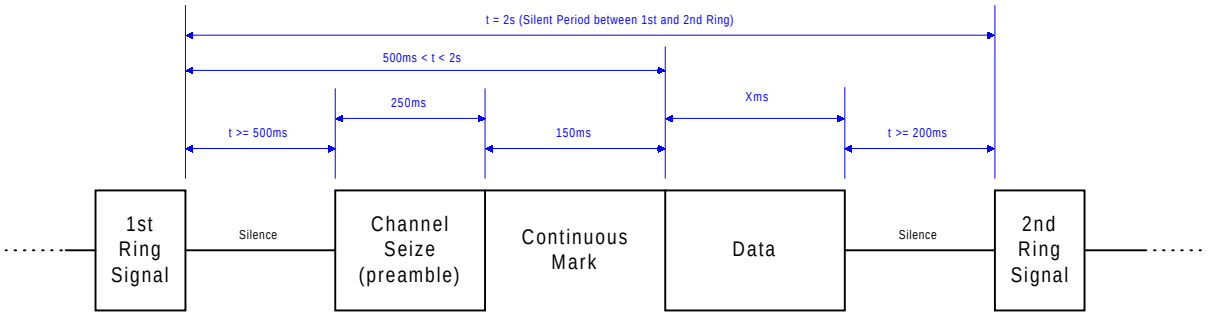



**Figure 9 - Data Transmission Delivered Between a Ring Pattern. Times taken from the ETSI EN-300-659-x document.**

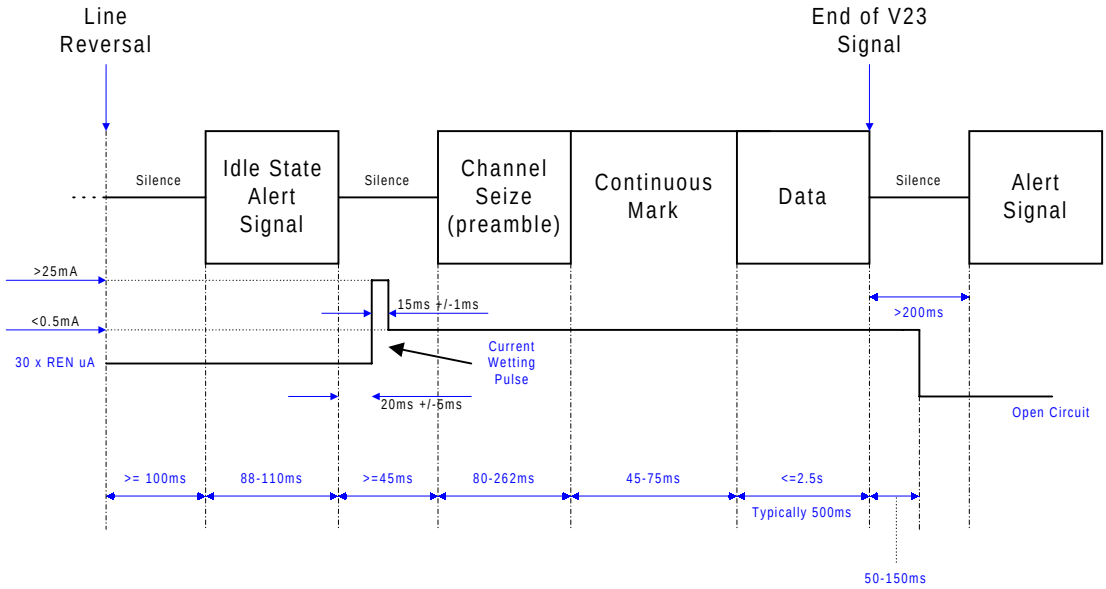
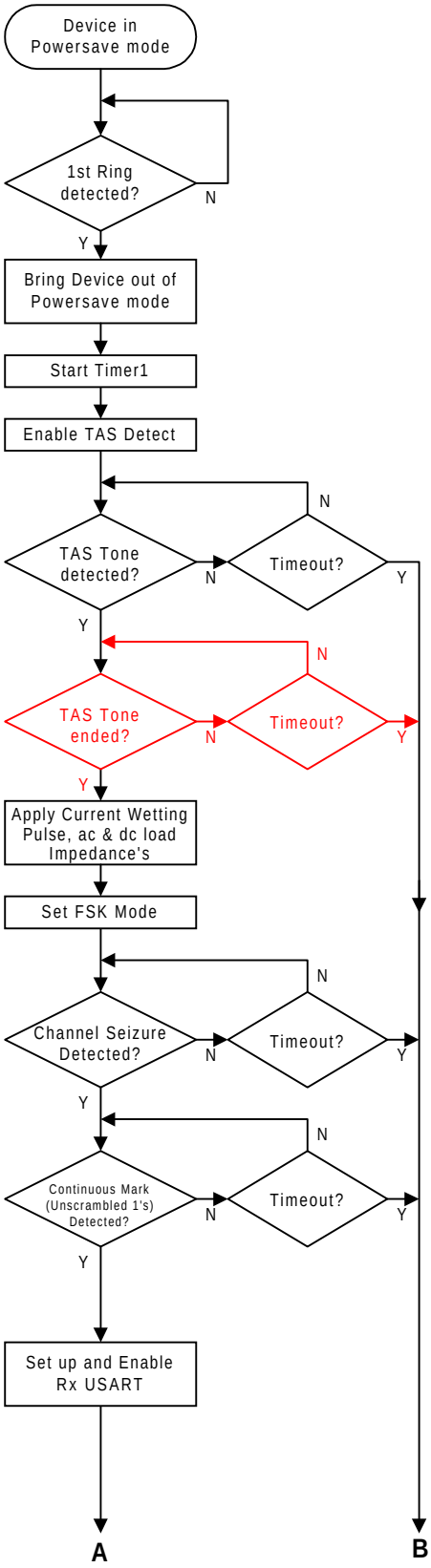
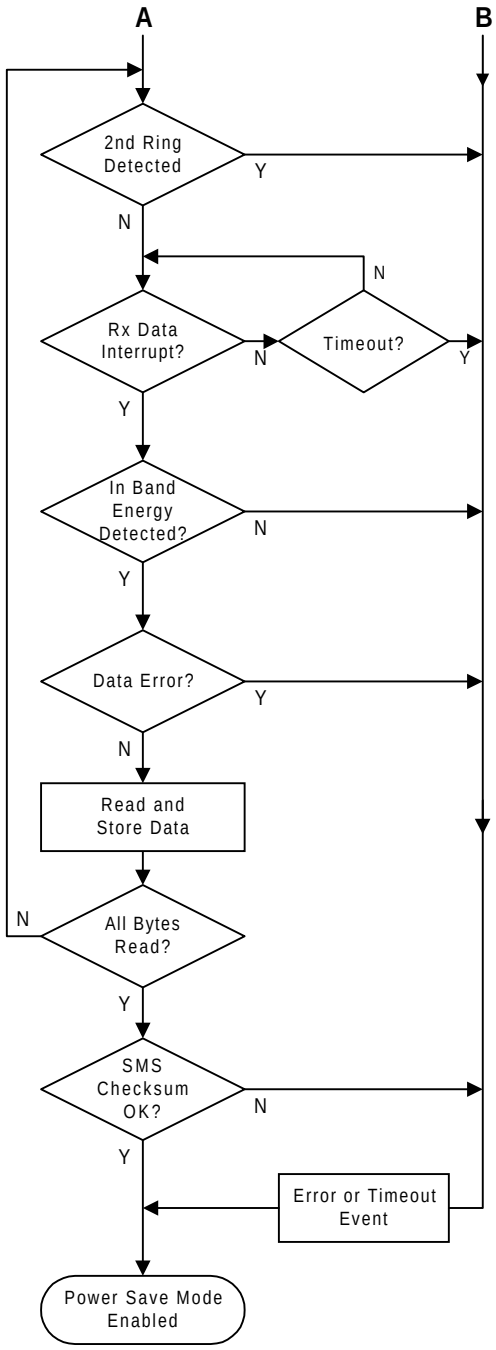



**Figure 10 - Data Transmission Delivered Prior to a Ring Pattern. Times taken from the British Telecom BT SIN242 document.**




| Description | CMX85x & CMX86x Program Flow<br>( ** Red Text = CMX850 CAS Detector) | |
|---|---|---|
| Start | Assume device is in a power saved mode | |
| Ring Detect | Status Register ($E6) Read Only<br>b14=1 | |
| Power Up | General Control Register ($E0)<br>b5=0 (Mask Ring Detect IRQ)<br>b8=1 (Device Powerup Normally)<br>b7=1 (Internal Circuits in a Reset Condition) | |
| | 20ms - Wait / Delay for device and oscillator settling | |
| | General Control Register ($E0)<br>b7=0 (Normal Mode) | |
| Start Clock/Timer | General Purpose Timer / Clock | |
| Enable TAS Detect | General Control Register ($E0)<br>b2=1 (Unmask Both Programmable Tones Detected (IRQ))<br>Receive Mode Register ($E2)<br>b15..b12 = 0001 (Tone Detect Mode)<br>b11..9 = user defined (Rx level adjust)<br>b2..0 = 100 (Select Programmable Tone Pair Detector) | ** CMX85x CAS Detector<br>CAS Detector CASDET ($E9)<br>b7=1 (CAS Enabled)<br>b3..5=user defined tone duration IE_1 ($A9)<br>b0=1 (Enable CAS Det. Interrupt) |
| TAS Detect | Status Register ($E6)<br>b10 = 1 (TAS tone present) | ** CMX85x CAS Detector<br>CAS Detector CASDET ($E9)<br>b0=1 (Tone Pair Present)<br>b1=1 (CAS Interrupt on tone duration) |
| TAS Ended | Status Register ($E6) Read Only<br>b10 = 0 (Monitor until TAS tone disappears) | ** Omit the red flow diagram layer if the CMX850 CAS Detector is used |
| Wetting Current | The TE should respond to the Idle State Tone Alert Signal by drawing a dc Wetting pulse and applying a dc load and an ac load. The dc Wetting Pulse is applied during the silent period following the end of the TAS. The ac Load is applied at the same time as the wetting pulse and is removed at end of the V.23 signals. The dc Load is applied and removed at the same time as the ac load. | |
| Set FSK Mode (CAS Mode Previously) | Receive Mode Register ($E2)<br>b15..12 = 0101 (V.23 1200bps FSK Mode)<br>b11..9 = user defined (Rx Level adjust)<br>b5..3 = 0xx (USART Disabled) | |
| Detect Channel Seizure | General Control Register ($E0)<br>b1 = 1 (Unmask 1010 Pattern Detect IRQ)<br>Status Register ($E6)<br>On interrupt monitor b10 = 1 and b9 = 1<br>(valid 1010 pattern detected for approximately 40ms). | |
| Detect Mark 1's (Unscrambled 1's) | Status Register ($E6) Read Only<br>On interrupt monitor Status Register ($E6) b10 = 1 and b9..8 = 11<br>(valid continuous mark pattern detected). | |
| Set up and Enable Rx USART | Receive Mode Register ($E2)<br>b15..12 = 0101 (V.23 FSK 1200bps - already enabled from Set FSK Mode)<br>b5..3 = 110 (Stop-start mode, no overspeed)<br>b2..0 = 110 (8 data bits, no Parity)<br>General Control ($E0)<br>b0 = 1 (Unmask Rx Data ready and Rx Data Overflow IRQ)<br>b1 = 0 (Mask Continuous Unscrambled 1s Detect IRQ)<br>Status Register ($E6)<br>b10 = 1 (in-band energy detect)<br>b6 = 1 if Rx data is ready<br>b5 = 1 if a data overflow occurs<br>b4 = 1 if a framing error occurs | |

**Figure 11 – Part1/2 - Data Transmission Delivered Between a 1st and 2nd Ring Pattern. CMX85x and CMX86x Software Considerations.**




| Description | CMX85x & CMX86x |
|---|---|
| 2nd Ring Detect | Status Register ($E6) Read Only<br>b14=1 |
| Rx Data IRQ | Status Register ($E6) Read Only<br>b6 = 1 (Rx Data Ready) |
| In Band Energy Detected | * Not Necessary - Check for data presence & quality to prevent false data<br><br>Status Register ($E6)<br>b10 = 1 (in-band energy detect) |
| Data Error | Status Register ($E6) Read Only<br>b5 = 1 if a data overflow occurs<br>b4 = 1 if a framing error occurs |
| Read and Store Data | Read Byte from Rx Data Register<br>Receive Data Register ($E5)<br>b7..0 = (Received Data) |
| All Bytes Read | Check if all bytes have been received |
| Checksum | The last two bytes read are the checksum.<br>Perform a modulo-2 addition of all of the received bytes including the two checksum bytes but ignore any carries.<br>The result should be zero or an error has occurred. |
| Error or Timeout Event | Reset Tx & Rx registers<br>Clear Interrupt Masks / Timers<br>Perform any backout procedures (erasing or clearing data etc.)<br>Go On-Hook |
| Power Save | Status Register ($E6) Read Only<br>b8=0 (Powersave Mode Enabled - all circuits disabled except Ring Detect, RDRVN and C-BUS interface ) |

**Figure 12 – Part 2/2 - Data Transmission Delivered Between a 1st and 2nd Ring Pattern. CMX85x and CMX86x Software Considerations.**

As the SMS and CLI data transfer use a similar protocol and delivery methods, the CMX850 CLI ‘C’ code source file is available for reference purposes.
The “CLI.c” code can be found in the EV8500 Evaluation Kit software zip file “EV8500_w.zip“, which could be downloaded from the Datasheets and Evaluation Kit sections on the CML website.

The folder and file path to the “CLI.c” file is: ...\ev8500_w\fw_11\Firmware\CLI.c

## Data Transmission Not associated with Ringing

In Figure 13 the data transmission will occur after the TAS and no ring will initiate.

The timing diagrams and CML software flow diagrams will be similar to the diagrams from the “Data Transmission Before Ringing” section. The only difference will be that a generic audio and visual indicator on the SMS TE product will be displayed. This will indicate that an SMS has been delivered and is waiting to be read. No ring tones or tone patterns will be initiated to indicate the SMS delivery (This could be a ‘mute’ feature of the TE product).

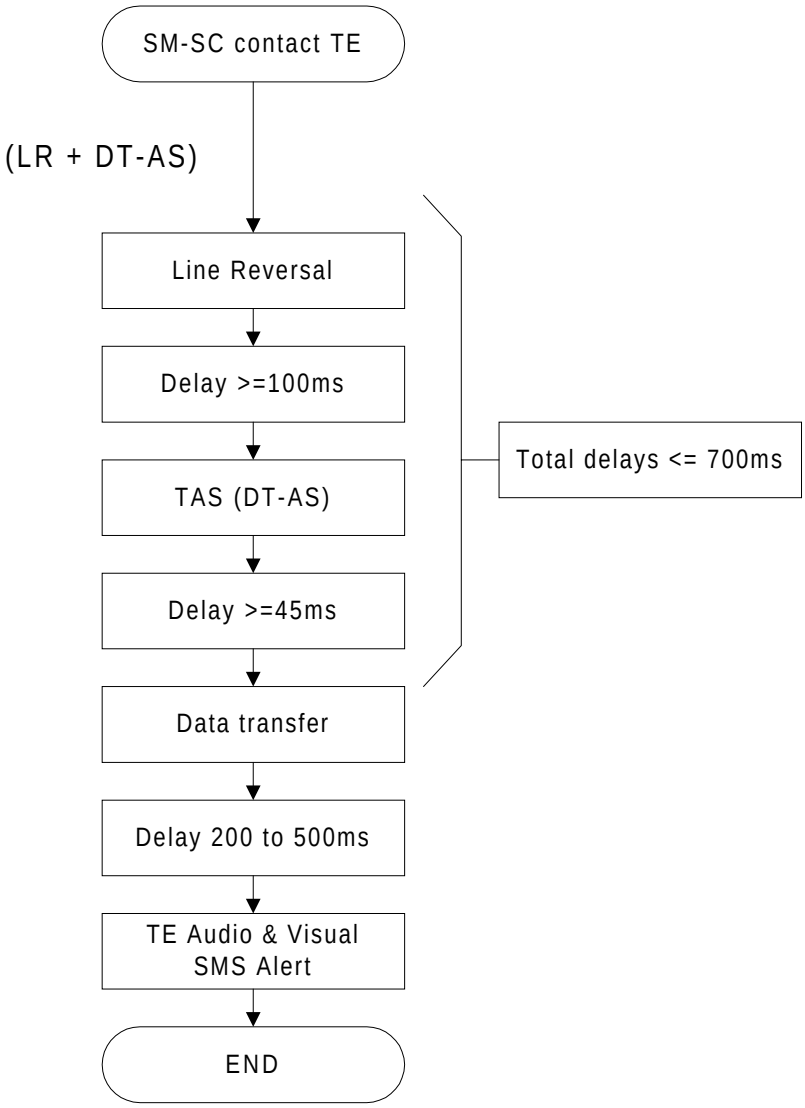



**Figure 13 – Data Transmission Not associated with Ringing**

LR + DT-AS = Line Reversal + Dual Tone Alerting Signal

## Data Transmission Before Ringing

In Figure 14 the TAS signal will be used to signal the TE that a data transmission is expected.

This process may be employed to transfer multiple or longer than normal SMS data transfers. If the FSK data transfer were to take place between the 1st and 2nd ring, the 2 second silence would be affected.

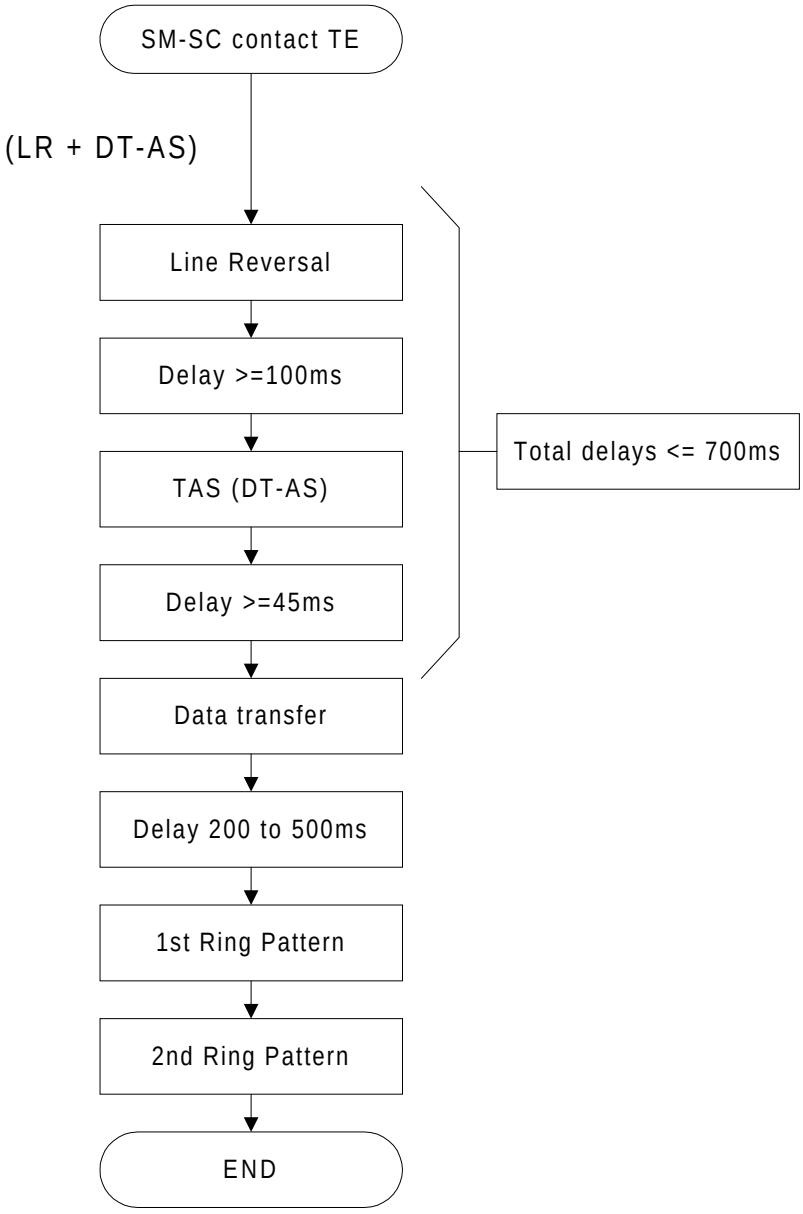



**Figure 14 – Data Transmission Prior to Ringing Start**

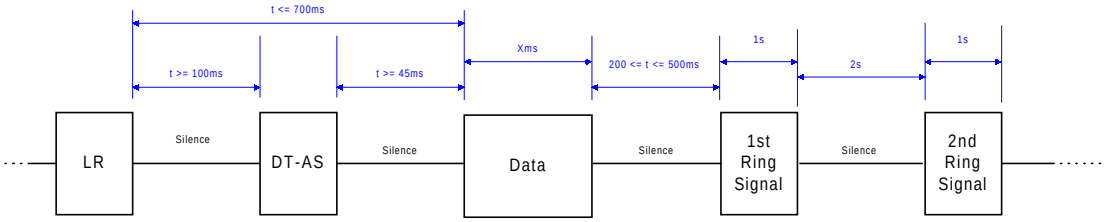



**Figure 15 - Data Transmission Prior to Ringing Start – (LR+DT-AS) Timing Limits**

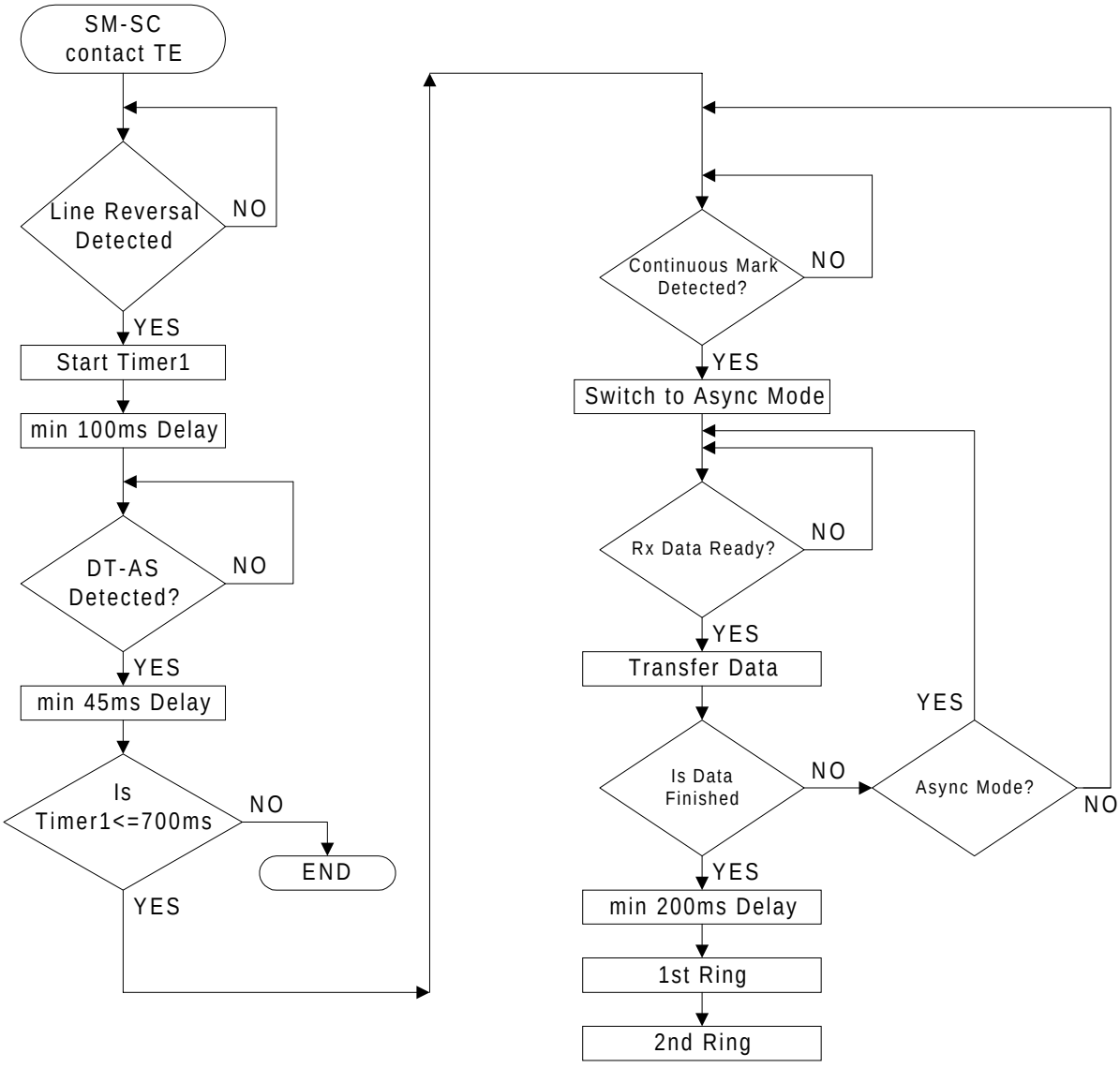



**Figure 16 - Data Transmission Associated to Ringing - CML Software considerations - (LR + DT-AS) Timing Limits**

# Sending SMS

As well as receiving an SMS, SMS transmission can also be established. The process to send an SMS is exactly the same with respect to the call management process and switching between various transmit and receive modes.

To start sending an SMS the TE must establish a circuit-switched connection to the SM-SC. This would start with the TE call manager waking up, seizing the line and dialling the number of the SM-SC. If the TE were connected to a PSTN then it would use the DTMF dialling method. In the case of ISDN access the dialling information would be transmitted to the network via the D-channel messages.

It may be the task of the PSTN to forward the CLID of the terminal device if required or the call manager will facilitate the transmission of the CLID when requested by the SM-SC.

With reference to Figure 17, page 18, this flow diagram gives a simplified example of an SMS being sent from the TE to the SM-SC. In previous flow diagrams illustrate in the “Sending SMS” section, no allowance has been made for acknowledgement of the various receipt messages expected over the communication layers (See Table 1 - Messages Between Transport Layers” page 7 and Figure 4 page 8). When the SC answers and a connection is established, the SMS is ready for data transfer between the TE and the SM-SC. Data transfer is initiated by the SM-SC by sending the appropriate Data Link Layer Message. The Message Sequence Charts and Parameter Formats can be found in the ETSI ES 201 912 document.

Figure 18 and Figure 19; show a more detailed view of the call management software considerations and the steps required by CML85x and CML86x devices to establish an SMS transmission.

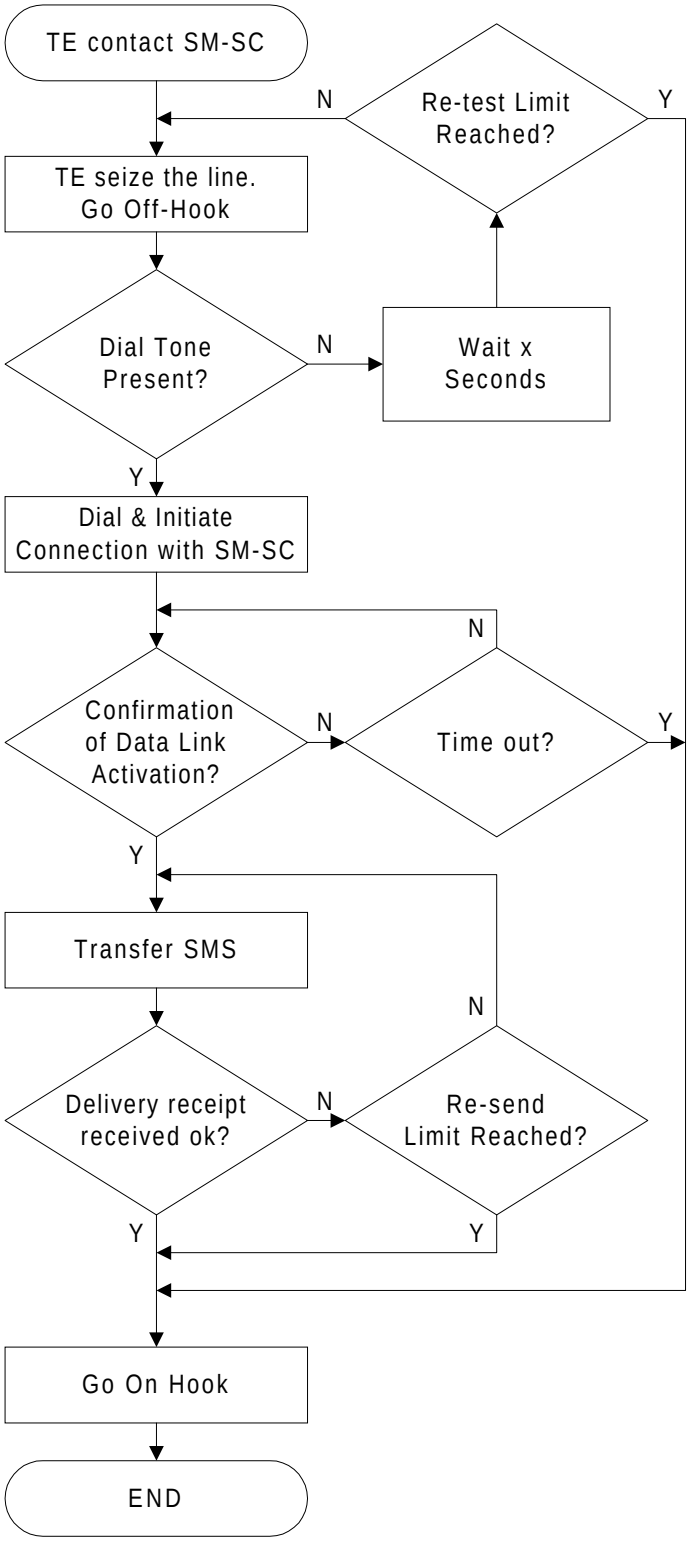
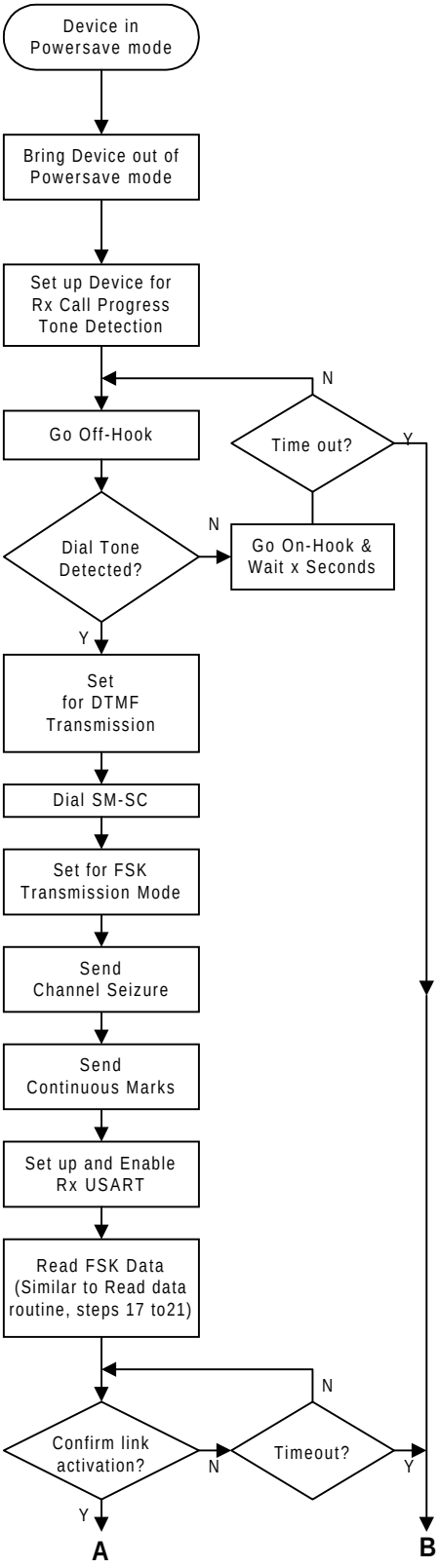
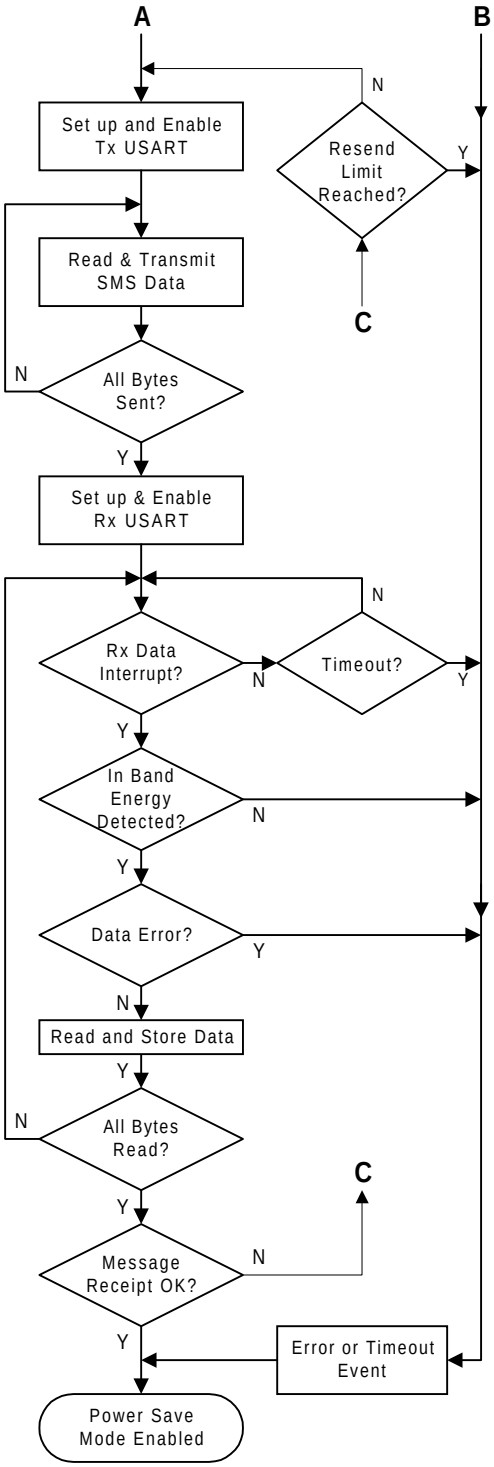



**Figure 17 – Sending an SMS from TE to SM-SC. (Simplified flow diagram)**




| Description | CMX85x & CMX86x Program Flow |
|---|---|
| 1. Start | Assume device is in a power saved mode |
| 2. Power Up | General Control Register ($E0)<br>b5=0 (Mask Ring Detect IRQ)<br>b8=1 (Device powerup normally)<br>b7=1 (Internal circuits in a reset condition) |
| | 20ms - Wait / Delay for device and oscillator settling |
| | General Control Register ($E0)<br>b7=0 (Normal Mode) |
| 3. Set Rx Call Tone Detection | Receive Mode Register ($E2)<br>b15..12 = 0001 (Call Progress Detect)<br>b2..0 = 011 (Call Progress Detect)<br><br>General Control ($E0)<br>b0 = 0 (Mask Rx Data ready and Rx Data overflow IRQ)<br>b1 = 0 (Mask continuous unscrambled 1s Detect IRQ) |
| 4. Go On-Hook or Off-Hook | General Control Register ($E0)<br>b9 = 1 or 0 (Using relay driver RDRVN - pin 98 to go on or off-hook)<br>Note - Before going Off-Hook a test should be performed for Line in use as well as the dial tone detection test performed in the next step. |
| 5. Dial Tone Detected | Status Register ($E6)<br>b10 = 1 (in-band energy detect threshold exceeded) |
| | |
| 6. Set for DTMF Transmission | Transmit Mode Register ($E1)<br>b15..12 = 0001 (DTMF Tones)<br>b4 = 1 (Transmit DTMF tones) |
| 7. Dial Phone Number | Transmit Mode Register ($E1)<br>b3..0 = xxxx (Relative keypad symbol / Phone number) |
| 8. Set Transmit FSK Mode | Transmit Mode Register ($E1)<br>b15..12 = 0101 (V.23 1200bps FSK Mode)<br>b11..9 = user defined (Rx Level adjust)<br>b4..3 = 11 (Synchronous FSK data format mode)<br>b2..0 = 110 (8 data bits, 1 stop bit) |
| 9. Send Channel Seizure | Transmit Mode Register ($E1)<br>b2..0 = 00x (Continuous hand shake pattern) |
| 10. Send Continuous Marks | Transmit Mode Register ($E1)<br>b2..0 = 011 (Continuous '1' pattern) |
| 11. Set-up and Enable Rx USART | Receive Mode Register ($E2)<br>b15..12 = 0101 (V.23 FSK 1200bps - already enabled from Set FSK Mode)<br>b5..3 = 110 (Stop-start mode, no overspeed)<br>b2..0 = 110 (8 data bits, no Parity)<br><br>General Control Register ($E0)<br>b0 = 1 (Unmask Rx Data ready and Rx Data Overflow IRQ)<br>b1 = 0 (Mask Continuous Unscrambled 1s Detect IRQ)<br><br>Status Register ($E6)<br>b10 = 1 (in-band energy detect)<br>b6 = 1 if Rx data is ready<br>b5 = 1 if a data overflow occurs<br>b4 = 1 if a framing error occurs<br><br>Receive Data Register ($E5)<br>b7..0 = (Received Data) |
| 12. Confirm Link Activation | An FSK message from the SM-SC will be sent to the TE to confirm that the link is ok and therefore ok to start transmitting data. |

**Figure 18 – Part 1/2 - Sending an SMS from TE to SM-SC. CMX85x and CMX86x Software Considerations**




| Description | CMX85x & CMX86x |
|---|---|
| 13. Set-up and Enable Tx USART | Transmit Mode Register ($E1)<br>b15..12 = 0101 (V.23 1200bps FSK Mode)<br>b11..9 = user defined (Rx Level adjust)<br>b5..3 = 0xx (USART Disabled) |
| 14. Read & Transmit Data | Read Bytes from µC to Tx Data Register and transmit.<br>Transmit Data Register ($E3)<br>b7..0 = x (Data to be transmitted)<br><br>Note:<br>- The protocol layer messages may have to be sent prior to SMS data.<br>- CLID should be sent from the PSTN |
| 15. All Bytes Transmitted | Check if all bytes of the SMS have been transmitted. |
| 16. Set-up and Enable Rx USART | See Previous Set-Up for Rx USART (step 11) |
| 17. Rx Data IRQ | Status Register ($E6) Read Only<br>b6 = 1 (Rx Data Ready) |
| 18. In Band Energy Detected | * Not Necessary - Check for data presence & quality to prevent false data<br><br>Status Register ($E6)<br>b10 = 1 (in-band energy detect) |
| 19. Data Error | Status Register ($E6) Read Only<br>b5 = 1 if a data overflow occurs<br>b4 = 1 if a framing error occurs |
| 20. Read and Store Data | Read Byte from Rx Data Register<br>Receive Data Register ($E5)<br>b7..0 = (Received Data) |
| 21. All Bytes Read | Check if all bytes have been received |
| 22. Message Receipt | Check to see if SM-SC message delivery receipt is ok. |
| 23. Error or Timeout Event | Reset Tx & Rx registers<br>Clear Interrupt Masks<br>Perform any backout procedures (erasing or clearing data etc.)<br>Go On-Hook |
| 24. Power Save | Status Register ($E6) Read Only<br>b8=0 (Powersave Mode Enabled - all circuits disabled except Ring Detect, RDRVN and C-BUS interface ) |

**Figure 19 – Part 2/2 - Sending an SMS from TE to SM-SC. CMX85x and CMX86x Software Considerations**

# Off-Hook (Type 2) Data Transmissions

This section briefly discuses off-hook data transmission. Type 2, Off-Hook transmissions are not the favoured method of data transfer of an SMS. Due to the period of which an SMS data transfer could take up (taking into account receipt messages and failure retries), it could effectively silence the current in-band audio communication of the near and far end voice on the line while the SMS data is transferred. This would not be acceptable or tolerated by a paying subscriber during a normal telephone conversation.

The best possible way around this muting problem is to use a similar process to “Call Waiting” but referred to as “SMS waiting”. With reference to Figure 21, page 22; when a subscriber is using the phone for a normal telephone conversation and the SM-SC tries to deliver an SMS it will be relayed in the form of a CLI, which is recognised by the TE product call manager. The call manager then flags the product to call the SM-SC at a more appropriate time in the future.

The CMX850 offers a CAS (Customers Premises Equipment (CPE) alerting signal) tone detector. The detector block circuit is driven from the modem’s line input amplifier and provides the ability to detect CAS tones (a burst of simultaneous 2130Hz and 2750Hz signals). Operation is independent from that of the modem circuit. The CAS tone detector operates with low power consumption and with improved performance in the presence of near-end signals, making it particularly suitable for off-hook CLI and SMS detection.

With reference to Figure 20, Figure 21 and the CMX850 data sheet: The CMX850 Call Alert Signal (CAS) Tone Detector is configured through the CASDET Special Function Register (SFR) (address $E9). The Detect bit (bit 0) in the CASDET SFR will be set high while a Tone Alert signal is detected. If the Detect signal stays high for a time within the CAS qualifying time $T_q$CAS, then on the falling edge of the Detect signal the interrupt status bit in the CASDET SFR will go high. This also asserts the Int2 signal to the 8051 µC. The action of writing a 1 to the interrupt clear bit in CASDET generates a short pulse that clears the interrupt status bit. The $T_q$CAS timing is selectable, allowing Detection of up to 135 ms Tone Alert (CAS) signals, but is mainly optimised for detection of 75 to 85ms Tone Alert (CAS) signals used in off-hook applications.

Note that $T_{ton}$ added to $T_q$CAS determines the range of times for which the tones should be present for a CAS interrupt to be generated. The $T_q$CAS time range is selected through the Tone Detect Window Control bits in the CASDET SFR.

The CASDET block uses the VBIAS generator and line input amplifier within the modem, but is otherwise independent of the modem operation. On receipt of a valid CAS Tone Alert, it will be necessary for the 8051 µC to “wake up” the modem for the subsequent data transfer.

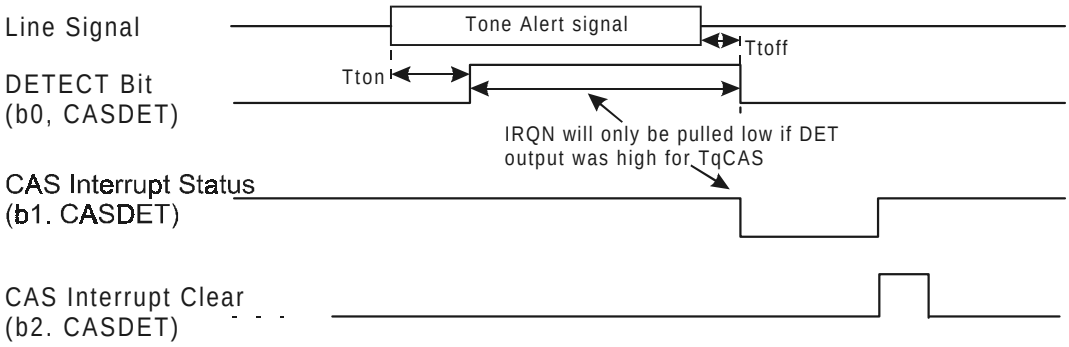



**Figure 20 – CMX850 CAS Tone Alert Detector Operation**

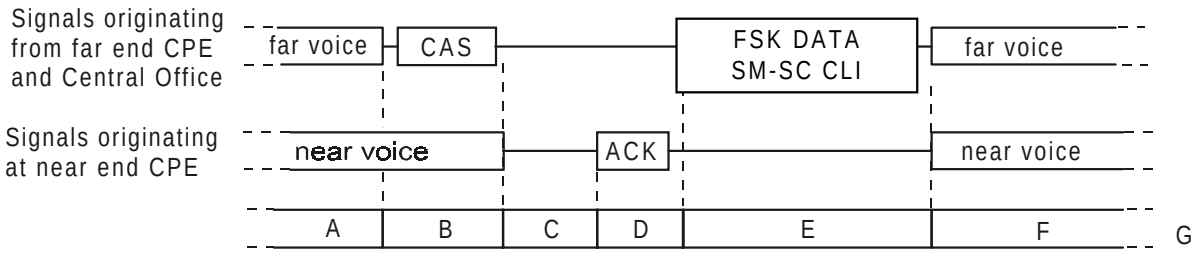



**Figure 21 – CMX850 Typical off-Hook (Type 2) data transaction**

A. Normal conversation with both near and far end voice present.
B. Central Office mutes far end voice, sends CAS and becomes silent.
C. CAS Tone Alert detected and interrupt generated, which causes the CMX850 to mute near end voice, and check that no further CAS tones are detected for 50ms (to minimise falsing).
D. Modem set up to send ACK to Central Office to signal its readiness to receive FSK data.
E. Central Office recognises ACK and sends FSK data. The CMX850 modem, set to FSK receive mode, receives the FSK data. The call manager would recognise the SM-SC CLI and flag the fact that a SMS is waiting.
F. The Transaction is complete. The CMX850 un-mutes the near voice, and reverts back to its original mode, while the central office un-mutes the far end voice, normal conversation returns.
G. At some time in the future when the line is free the TE call manager would initiate a call to the SM-SC to collect the SMS Waiting.

# Conclusion

This document was written with the aim of assisting modem product designers using and understanding Short Message Service (SMS) applications. CML Microcircuits (CML) integrated circuit devices could be used to realize and achieve a CLI, SMS or Low Rate Messaging Service (LRMS) data transfer within a wireline system. This is not a solution for all and any SMS data transfer.

All the processes and flow diagrams discussed can be reproduced in a different way and are open to discussion, creative freedom and application feature requirements.

Limitations and restrictions imposed by the particular telecom providers and SM-SC will also affect any protocol procedures and message transfer handling routines for which the product is being designed for and to be interfaced into.

Although every possibility of software handling of the CML devices has not been covered within this document, there is enough information contained to relate to, to build the desired result.

The following possible scenarios have been discussed:

1. SMS transfer between the 1st and 2nd ring. (Similar to CLI transfer)
2. SMS transfer before the 1st ring. (CM controls and suppresses rings until data is transferred)
3. SMS transfer not associated to a ring. (CM controls and suppresses all audio indicators until data is transferred, then a Visual Warning Message Indicator (VWMI) is flagged)
4. SMS transfer during a normal telephone conversation where the TE calls back the SM-SC

# Appendix

**Abbreviations:**

| | |
|---|---|
| AL | - Application Layer |
| BSS | - Base Station system |
| CAS | - Call Alert Signal |
| CLI | - Caller Line Identification |
| CLIP | - Calling Line Identity Presentation |
| CM | - Call Manager |
| CML | - Consumer Microelectronics Ltd |
| CPE | - Customer Premise(s) Equipment |
| DECT | - Digital European Cordless Telephone |
| DLL | Data Link Layer |
| DT | - Dual Tone |
| DT-AS | - Dual Tone – Alerting Signal |
| EPOS | - Electronic Point of Sale |
| ETSI | - European Telecommunications Standard Institute |
| FSK | : Frequency Shift Keyed |
| GSM | - Global System for Mobile communications |
| HTTP | - Hyper Text Transfer Protocol |
| ISDN | - Integrated Service Digital Network |
| IWMSC | - Inter Working Message Service Centre |
| LR | - Line Reversal |
| LRMS | - Low Rate Messaging Service |
| MSC | - Message Service Centre |
| PC | - Personal Computer |
| PDA | - Personal Digital Assistant |
| PIN | - Personal Identity Number |
| POTS | - Plain Old Telephone System |
| PSTN | - Public Switched Telephone Network |
| RP-AS | - Ring Pulse – Alerting Signal |
| SC | - Service Centre |
| SCADA | - Supervisory Control and Data Acquisition |
| SFR | - Special Function Register |
| SM | - Short Message |
| SM-PP | - Short Message - Passport Protocol |
| SMS | - Short Message Service |
| SM-SC | - Short Message - Service Centre |
| TAS | - TE Alerting Signal |
| TE | - Terminal Equipment |
| TL | - Transfer Layer |
| UBS | - User Based Solution |

**SMS Alpha-Numeric Coding:**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | $b_7$ | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 1 |
| | | $b_6$ | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 1 |
| | | $b_5$ | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 |
| $b_4$ | $b_3$ | $b_2$ | $b_1$ | | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| 0 | 0 | 0 | 0 | 0 | | | SP | 0 | ③ | P | ④ | p |
| 0 | 0 | 0 | 1 | 1 | | | ! | 1 | A | Q | a | q |
| 0 | 0 | 1 | 0 | 2 | | | " | 2 | B | R | b | r |
| 0 | 0 | 1 | 1 | 3 | | | #/£ | 3 | C | S | c | s |
| 0 | 1 | 0 | 0 | 4 | | | ¤/$ | 4 | D | T | d | t |
| 0 | 1 | 0 | 1 | 5 | | | % | 5 | E | U | e | u |
| 0 | 1 | 1 | 0 | 6 | | | & | 6 | F | V | f | v |
| 0 | 1 | 1 | 1 | 7 | | | ' | 7 | G | W | g | w |
| 1 | 0 | 0 | 0 | 8 | | | ( | 8 | H | X | h | x |
| 1 | 0 | 0 | 1 | 9 | | | ) | 9 | I | Y | i | y |
| 1 | 0 | 1 | 0 | 10 | | | * | : | J | Z | j | z |
| 1 | 0 | 1 | 1 | 11 | | | + | ; | K | ② | k | ② |
| 1 | 1 | 0 | 0 | 12 | | | , | < | L | ② | l | ② |
| 1 | 1 | 0 | 1 | 13 | | | - | = | M | ② | m | ② |
| 1 | 1 | 1 | 0 | 14 | | | . | > | N | ② | n | ② |
| 1 | 1 | 1 | 1 | 15 | | | / | ? | O | _ | o | DEL |

**Figure 22 - International reference alphabet - 7-bit basic code table**

# References

## SMS Related ETSI Standards:

There are a number of SMS protocols to which telephone equipment manufacturers must comply.
The first 4 standards listed below are relative to PSTN ETSI standards for SMS applications:

**ETSI ES 201 912** : Access and Terminals (AT); Short Message Service (SMS) for PSTN/ISDN; Short Message Communication between a fixed network Short Message Terminal Equipment and a Short Message Service Centre.

**ETSI EN 300 659-1** : "Access and Terminals (AT); Analogue access to the Public Switched Telephone Network (PSTN); Subscriber line protocol over the local loop for display (and related) services; Part 1: On-hook data transmission".

**ETSI EN 300 659-2** : "Access and Terminals (AT); Analogue access to the Public Switched Telephone Network (PSTN); Subscriber line protocol over the local loop for display (and related) services; Part 2: Off-hook data transmission".

**ETSI EN 300 659-3** (V1.3.1): "Access and Terminals (AT); Analogue access to the Public Switched Telephone Network (PSTN); Subscriber line protocol over the local loop for display (and related) services; Part 3: Data link message and parameter codings".

**BT SIN242** : Calling Line Identification Service.

**ETSI EN 300 757** : Digital Enhanced Cordless Telecommunications (DECT); Low Rate Messaging Service (LRMS) including Short Message Service (SMS)

**ETSI ES 201 912** : Access and Terminals (AT); Short Message Service (SMS) for PSTN/ISDN; Short Message Communication between a fixed network Short Message Terminal Equipment and a Short Message Service Centre

**ETSI TS 100 900** : "Digital cellular telecommunications system (Phase 2+) (GSM); Alphabets and language-specific information (GSM 03.38 version 7.2.0 Release 1998)".

**ETSI TS 100 901** : "Digital cellular telecommunications system (Phase 2+) (GSM); Technical realization of the Short Message Service (SMS)

**ETSI TS 100 942** : "Digital cellular telecommunications system (Phase 2+) (GSM); Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface

**ETSI EN 300 778-2** (V1.2.1): "Access and Terminals (AT); Analogue access to the Public Switched Telephone Network (PSTN); Protocol over the local loop for display and related services; Terminal Equipment requirements; Part 2: Off-hook data transmission".

**ITU-T Recommendation V.25** (1996): "Automatic answering equipment and general procedures for automatic calling equipment on the general switched telephone network including procedures for disabling of echo control devices for both manually and automatically established calls".

**ETSI EN 300 403-1** : "Integrated Services Digital Network (ISDN); Digital Subscriber Signaling System No. one (DSS1) protocol; Signaling network layer for circuit-mode basic call control; Part 1: Protocol specification [ITU-T Recommendation Q.931 (1993), modified]"

**ETSI EN 300 090** : "Integrated Services Digital Network (ISDN); Calling Line Identification Restriction (CLIR) supplementary service; Service description".

**ISO 3166-1**: "Codes for the representation of names of countries and their subdivisions - Part 1: Country codes".

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