

1 Introduction

Wireless local loops provide a simple means of interfacing existing POTS devices, like telephones or fax machines, to cellular networks. To achieve this simple connection, a wireless local loop must regenerate a POTS line locally: the short local loop. This application note looks at the basic signalling required to implement a low-cost, short local loop using the CMX605 Digital to Analogue Signalling Interface to provide the POTS signalling and calling party identity, CLI or caller-ID, regeneration.

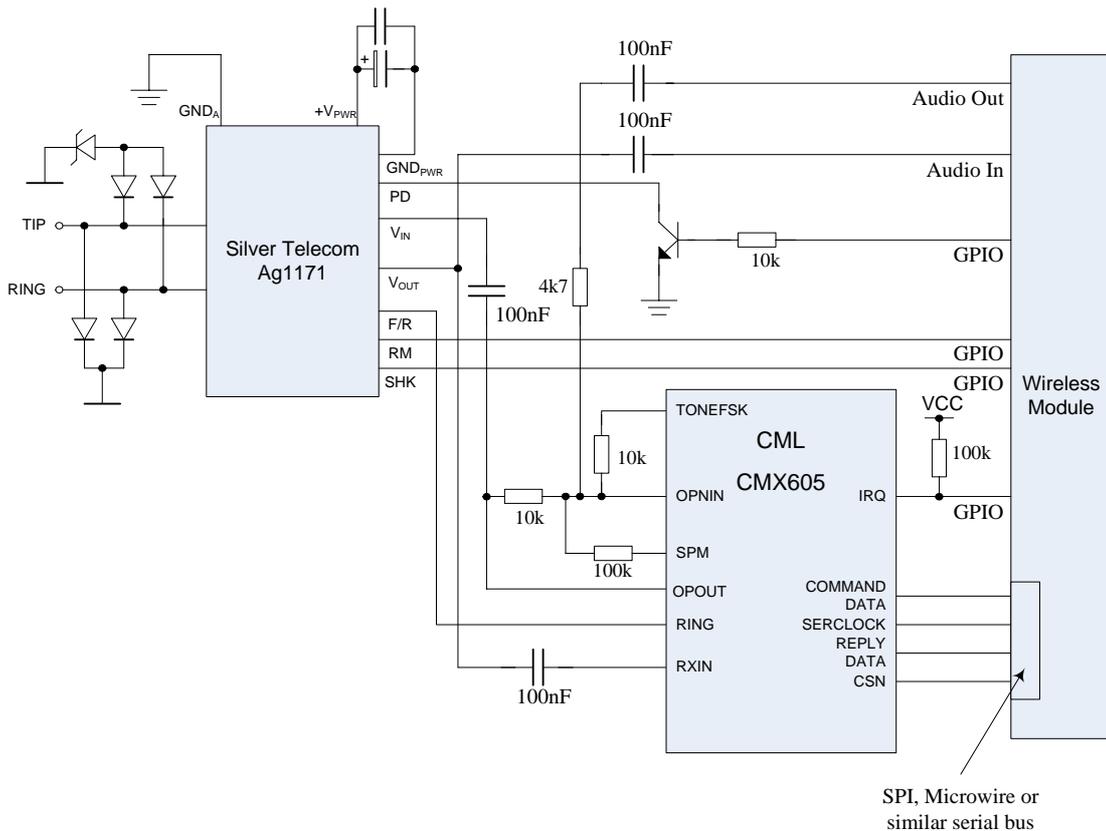


Figure 1. Typical wireless local loop application

2 Bellcore and BT caller-ID formats

Figures 1 and 2 illustrate the line signalling and data formats for both Bellcore and BT systems, upon which most caller-ID applications are based.

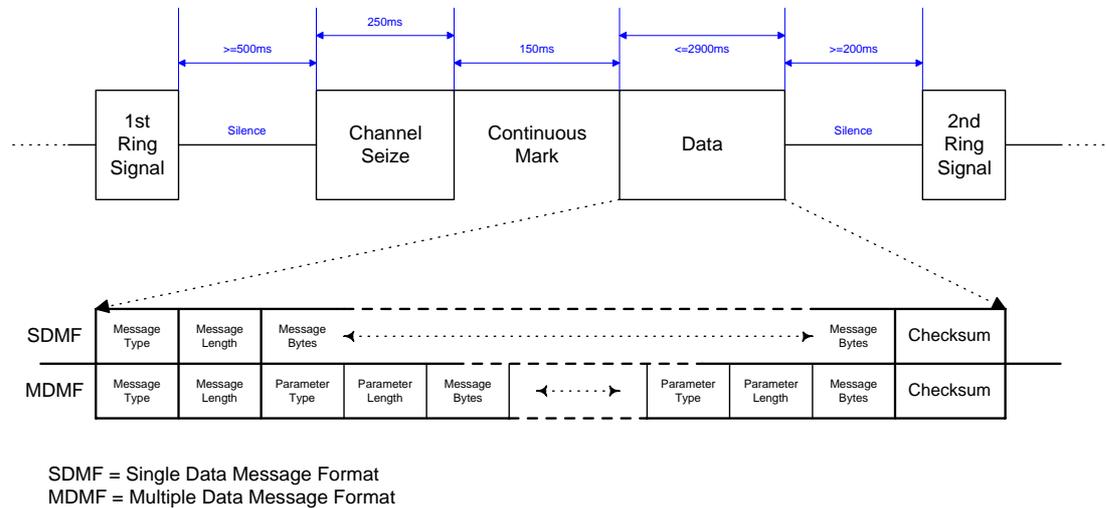


Figure 2. Bellcore On-hook System Signals and Data Format

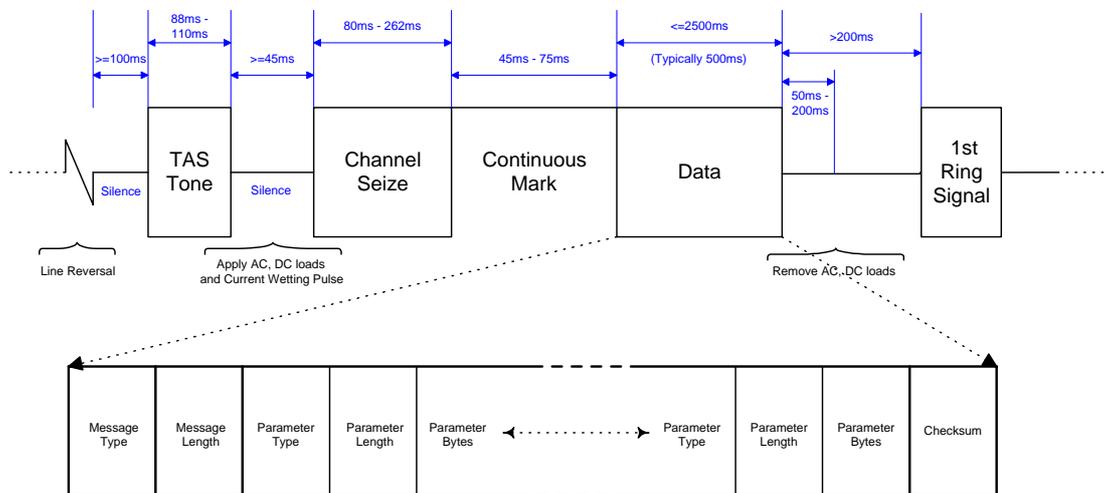


Figure 3. BT On-hook System Signals and Data Format

Notes:

1. In the Bellcore scheme the CLI is preceded by a ringing signal that is likely to exceed 40V. The BT scheme is signalled by a line reversal where the potential between the two wires will be greater than 15V. The SLIC, the AG1171, will provide the ringing signal, the cadence of which is controlled by the host processor.

2. If no CLI is present on a Bellcore system then the silence period between ringing signals may extend for 4 seconds (nominal)
3. For some applications the Channel Seizure on BT systems may be delayed by up to 5 seconds. Either or both silent periods may be extended in this case.

3 General Information

- 1 Interface details, line level specifications and other technical requirements are not covered because these are dependent on the application and the intended country of operation. For this information please contact your local PTT or refer to the relevant specifications.
- 2 The following syntax is used to describe the CMX605 C-BUS registers.
 - a *Setup* (\$D0) - The register name is italicized followed by the hexadecimal address of the register in brackets.
 - b b2 = 1 - The register bit, bit 2, is set to a 1.
 - c b5..b2 = 1001 - The register bits, bit 5 through bit 2, are set to 1001 respectively.
- 3 Figures 4 and 7 both assume that the CMX605 is powered up and a General Reset Command, C-BUS address \$01 (no data), has been issued. The CMX605 will, therefore, be in powersave mode.
- 4 CMX605 registers are either write or read -only and not bit addressable. It is suggested that a shadow (working copy) of each register is maintained in the host so that bit settings can be changed by a read-shadow, mask and write operation. A shadow of the Status register should be maintained in the host so that status bits are not unexpectedly lost because they are cleared following the read.
- 5 Additional timers and error handling may be required.
- 6 For illustration, the following ¹tones are assumed:
 - a Dial tone is 350 + 440 Hz continuous.
 - b ²"Error tone" is 350 + 440 Hz cadenced.
 - c Ring tone is 400 + 450 Hz cadenced.
 - d ³Ringing signal is 17.1Hz.
- 7 The Caller-ID packet format is assumed to be Bell SDMF format.
- 8 It is assumed that interrupts or polling will start some processes. For clarity, links between these have been left out.
- 9 Bit changes are given when the remainder of the register may need to be preserved.

¹ The names of the various signalling tones used in networks vary by country and network. The tone names used in this document are in accordance with the ITU.

² For clarity, a single "error tone" is used in this document to indicate busy, congestion or similar network tones, or as an internal tone to signal a 'problem' within the wireless local loop. It is anticipated that the designer will replace this tone with ones appropriate to the network in which the equipment will be used.

³ The AG1171 uses a logic input to generate ringing signals. This input causes line reversals that emulate a ringing signal but this means that true additive and multiplicative signals cannot be used. In short local loop applications this will not be a problem and only the low modulating frequency should be used.

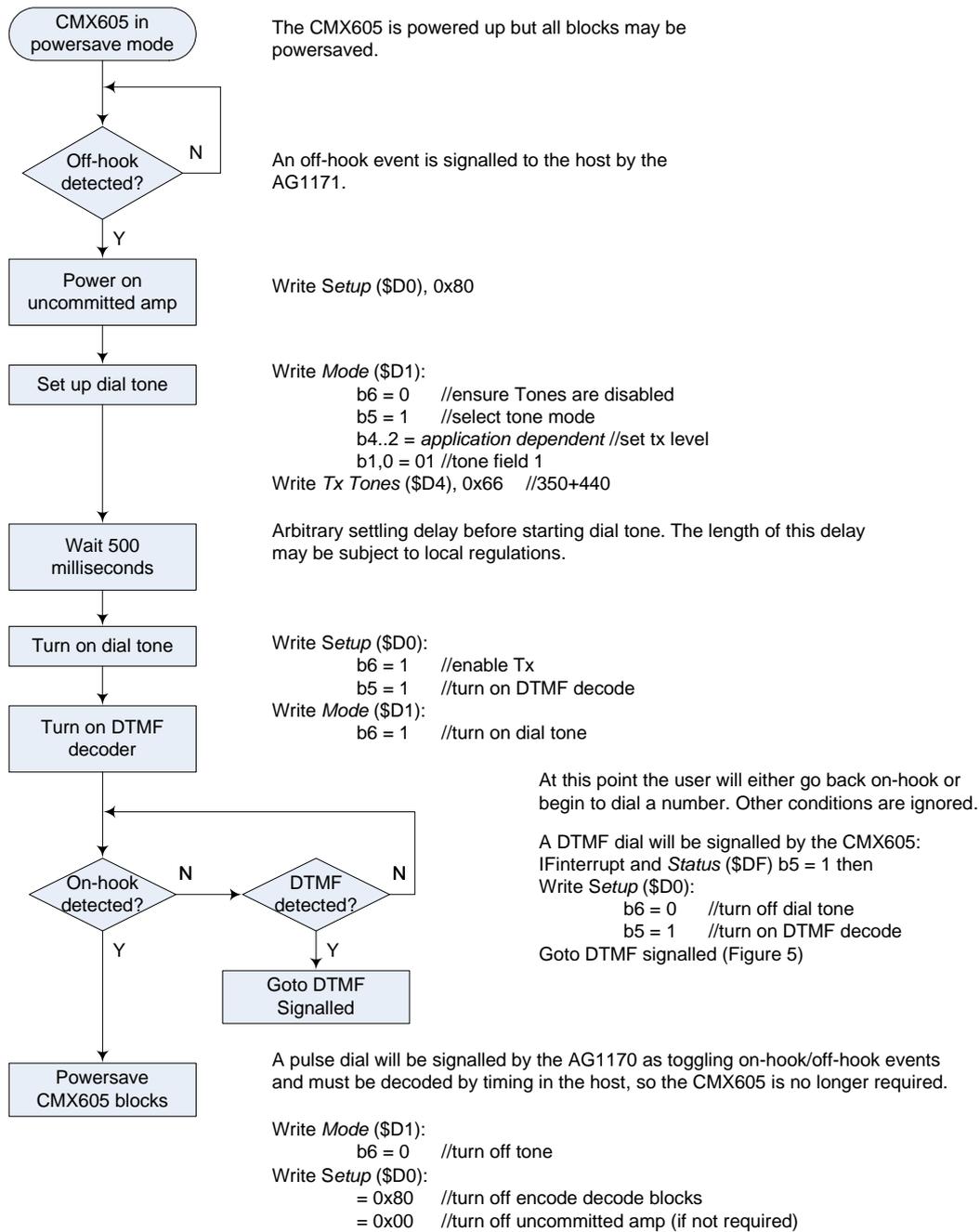


Figure 4. On-hook to off-hook detected

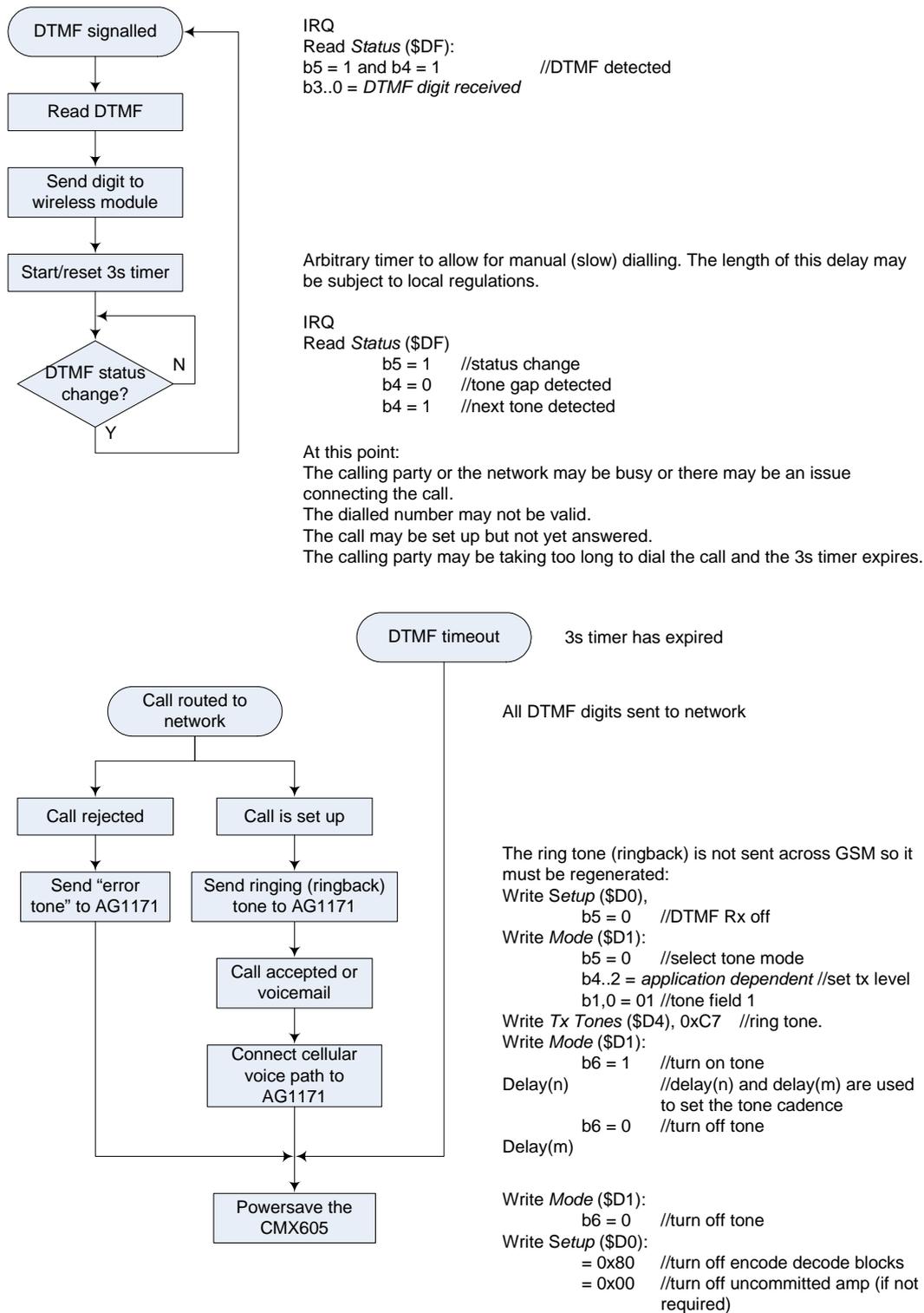
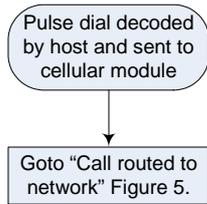
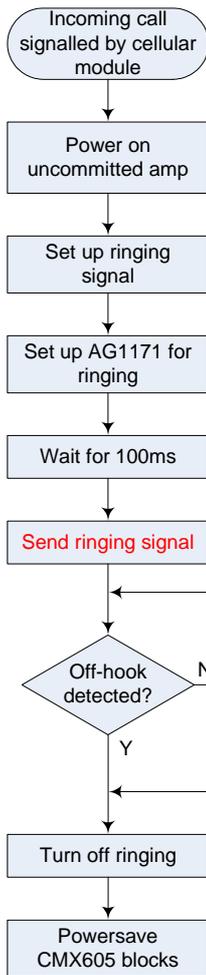


Figure 5. DTMF received from POTS line



At this point the cellular network will signal an error if the pulse dial is not valid or The pulse dial is valid so the cellular module will enable a voice call. A timeout is recommended to prevent the system blocking if pulse dialled digits are not completed.

Figure 6. Pulse dialling



The CMX605 is powered up but all blocks may be powersaved.

Write *Setup* (\$D0), 0xC0 //uncommitted amp and Tx enabled

Write *Mode* (\$D1):
 b6 = 0 //ensure tone is disabled
 b5 = 0 //select tone mode
 b4..2 = *application dependent* //set tx level
 b1,0 = 00 //tone field 0
 Write *Tx Tones* (\$D4), 0x01 //17.1Hz via ring output

Arbitrary settling delay before starting ringing signal. The length of this delay may be subject to local regulations.

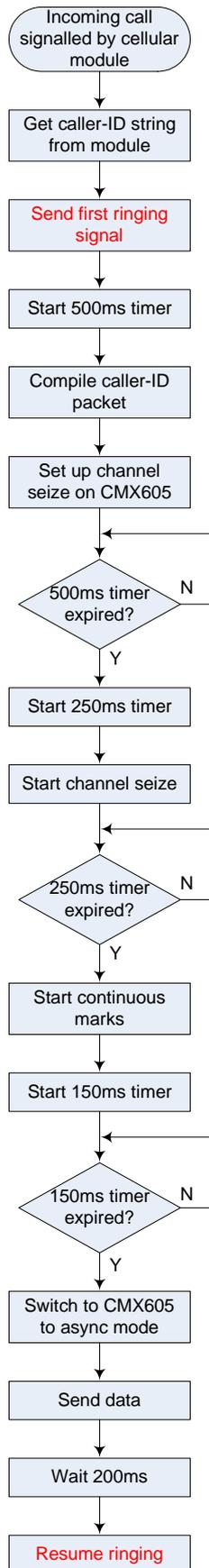
Write *Mode* (\$D1):
 b6 = 1 //turn on ringing signal
 Delay(n) //delay(m/n) sets cadence
 b6 = 0 //turn off ringing signal
 Delay(m)

A POTS phone answers the call or the network sends a disconnect. The disconnect will be because the caller has hung-up or because the cellular network has diverted the call – call divert or answerphone.

Write *Mode* (\$D1):
 b6 = 0 //turn off tone

Write *Setup* (\$D0):
 = 0x80 //powersaved except uncommitted amp
 = 0x00 //turn off uncommitted amp (if required)

Figure 7. Handling an incoming call



A caller-ID packet can be regenerated from the caller-ID string received from the cellular module. It can be sent over the POTS line before, or between, ringing cycles.

The 'Incoming call' process (Figure 7) is followed until 'send ringing signal' is reached. This process is then followed.

The minimum silence period before the caller-ID message is sent is 500ms. During the silence period, the caller-ID packet can be compiled (reconstructed) using caller-ID string received from the cellular module. See 'CID packet reconstruction'. The channel seize pattern is also set-up during the silence period.

Write *Setup* (\$D0), 0xC1 //power on uncommitted amp, Tx Enable, FSK mode=sync, Bell202.

Write *Mode* (\$D1):
 b6 = 0 //ensure Tone/FSK is disabled
 b5 = 1 //select FSK mode
 b4..2 = application dependent //set tx level
 Write *Tx Data* (\$D3), 0xAA //1010... Pattern

Following the silence period is channel seize (1010...) for 250ms. This is to allow the receiving modem to train.

Write *Setup* (\$D0), b6 = 1 //turn on channel seize

Interrupts will signal when the Tx Data register is available, but in synchronous mode the CMX605 will continually loop the register so the interrupts can be ignored. There is no need to reload the data register.

After the channel seize is a continuous mark for 250ms. This is to allow the receiving modem's UART to synchronise on the asynchronous data that follows.

Write *Tx Data* (\$D3), 0xFF //equal to marks
 Write *Setup* (\$D0):
 b1 = 1 //FSK mode=async

There is no need to stop the modem before writing 0xFF to the data register. In asynchronous mode, the CMX605 UART sends stop flags (=0xFF) continuously when there is no data to send. The data does not have to be reloaded and interrupts can be ignored. Any spurious errors that result from the switch from synchronous to asynchronous mode will not be a problem at the receiving end.

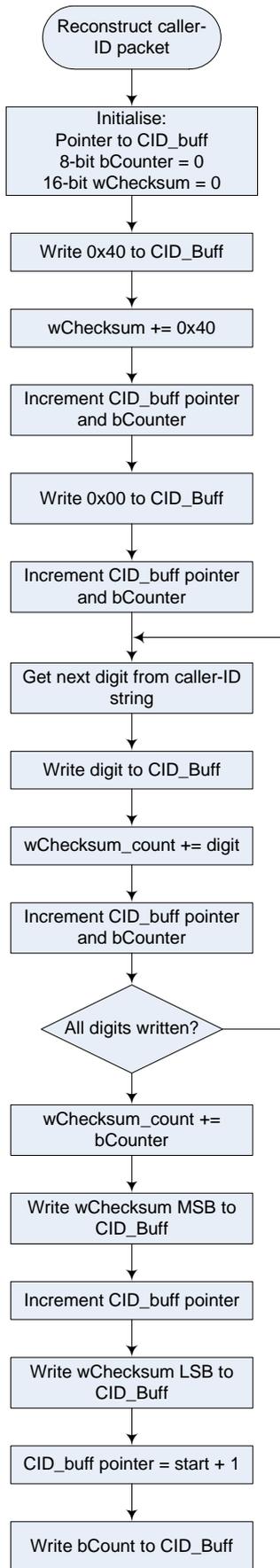
After the continuous mark is the caller-ID packet.. This is sent asynchronously so the receiving modem's UART should synchronise on the first start bit (1 to 0 transition).

Write *Tx Data* (\$D3) = data byte 1
 Read *Status* (\$DF) //dummy read to clear IRQN output if interrupts are being used

On IRQ – Read *Status* (\$DF):
 If bit b6 = 1 then load next data byte
 Loop until all data is sent.

Wait 200ms before resuming 'send ringing signal' in 'Incoming call' process (Figure 7).

Figure 8. Generating Bellcore caller-ID



This process assumes that the caller-ID string will be fetched from the cellular module in 1 byte pieces, MSB first. I.e. The leading digit of the country code or area code will be the first digit received. Special messages like “unavailable” or “withheld” can be used in the message format.

Lead byte that identifies the message as SDMF – single data message format.

Checksum calculated on fly.

Point to next location in the message buffer and increment a counter for the number of byte in the packet.

Insert a dummy byte for the ‘message length’ parameter. This is counted on the fly and will be inserted later.

Insert the Caller-ID information one byte at a time. Calculate the checksum and keep a count of the message length.

All done so add the actual counter value to the checksum.

Append the checksum to the end of the message.

Move the pointer to the 2nd byte in the message buffer.

Replace the dummy byte with the actual message length.

Figure 9. Caller ID packet reconstruction

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