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NETWORK CONNECTION SPECIFICATION FOR CONNECTION OF CUSTOMER PREMISES EQUIPMENT (CPE) TO THE PUBLIC TELECOMMUNICATIONS NETWORK (PTN) IN HONG KONG OVER DIGITAL TRUNK AT 1544 kbit/s USING DTMF SIGNALLING

TELECOMMUNICATIONS AUTHORITY
HONG KONG

FOREWORD

1. This specification is issued pursuant to Section 32D of the Telecommunications Ordinance (Cap. 106). This specification sets out the technical requirements for connection of multi-line customer premises equipment (CPE) to the Public Telecommunicaitons Networks (PTN) in Hong Kong over digital trunk at 1544 kbit/s using DTMF signnalling.

2. Digital trunks at 1544 kbit/s may be provided by any one of the Fixed Telecommunications Network Services (FTNS) operators in Hong Kong. CPE should comply with this specification for connection to the digital trunk at 1544 kbit/s using DTMF signalling provided by the FTNS operators. The general technical characteristics of the FTNS networks are given in HKTA 2201. Supplementary information on network characteristics and services of the FTNS networks may be obtained direct from the operators. Contact information of the FTNS operators can be found in the information note OFTA I 412.

3. At present, the Office of the Telecommunications Authority (OFTA) operates a **H**ong **K**ong **T**elecommunications Equipment **E**valuation and **C**ertification ("HKTEC") scheme. Details of the scheme can be found in the information note OFTA I 421. Under the scheme, suppliers or manufacturers may apply for certification of their customer premises equipment against this specification. The application procedures for certification of customer premises equipment can be found in the information note OFTA I 412. A label prescribed by the Telecommunications Authority (TA) may be affixed to the certified equipment. Details of the labelling arrangement can be found in the Standardisation Guide HKTA 3211.

4. The TA may amend any part of this specification as and when he deems necessary.

5. In case of doubt about the interpretation of this specification, the methods of carrying out the test and the validity of statements made by the manufacturers of the equipment, the decision of the TA shall be final.

6. The TA accepts no responsibility for the satisfactory performance of the CPE connected to the public telecommunications networks. The CPE is not normally evaluated against performance, reliability or quality-of-service parameters.

7. The HKTA specifications and information notes issued by the TA can be downloaded from OFTA's website at http://www.ofta.gov.hk. Enquiries about this specification may be directed to -

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AMENDMENT TABLE

Item	Issue No.	Paragraph	Descriptions
1.	Issue 2	Foreword Para. 3-4	Update contact information for FTNS operators. Add information for HKTEC Scheme and classify the CPE under CCS Cat. I.
2.	Issue 2	Para. 2.2	Rewrite para. 2.2 to refer to HKTA 2001 on electrical safety requirement.
3.	Issue 2	Para.5.6.1	Recorded announcement is also accepted before the establishment of the answer condition.
4.	Issue 2	Para.5.6.2 & 5.6.3	Add para. 5.6.2 and 5.6.3 to refer to HKTA 2201 on the application and characteristics of supervisory tones.
5.	Issue 3	Foreword	Certification and labelling arrangements are updated.
6.	Issue 4	Foreword	Update information on certification and labelling as a result of the accreditation of Certification Bodies (CBs).
7.	Issue 4	Para. 2.2 & 11	The title of HKTA 2001 is updated.
8.	Issue 4	Para. 4	Update the technical requirements based on the current ITU-T Rec. G.703, Edition 2001.
9.	Issue 4	Para. 4.4	The technical requirements of the cable pairs connecting the CPE to the interconnect point is moved from para. 4.4 to the new para. 3.4.
10.	Issue 4	Para. 8	Update the name of the Fixed Carrier.

CONTENT

1. SCOPE

This Network Connection Specification covers the technical requirements for connection of multi-line customer premises equipment (CPE) with digital interface to the Public Telecommunications Networks (PTN) in Hong Kong over digital trunks using DTMF signalling at the transmission rate of 1544 kbit/s.

2. ELECTRICAL SAFETY

2.1 PRINCIPLE OF PROTECTION

In order to safeguard operating personnel, users and plant, it is essential to prevent the transmission of excessive voltages from the CPE into the PTN in Hong Kong.

2.2 SAFETY REQUIREMENTS

The CPE shall comply with specification HKTA 2001 titled “Compliance Test Specification – Safety and Electrical Protection Requirements for Subscriber Telecommunications Equipment” issued by the Telecommunications Authority (TA).

3. INTERCONNECT POINT (IP)

3.1 Interconnection with the digital trunk using DTMF signalling at 1544 kbit/s will require the installation of the Fixed Telecommunications Network Services (FTNS) operators' equipment and internal cabling in customer premises. A normal office air-conditional environment is required together with a maintained power supply. Either a mains power supply at 220 Vrms ± 10% taken from the same point in the building distribution as the CPE or a suitable power supply at -48 Vdc ± 10% should be provided by the customer.

3.2 The interconnect point marks the division of responsibility between the network operator and the customer (please see Figure 1 below).

3.3 The network operator will provide socket for connection, disconnection or re-connection of the equipment to the IP. The customer will be responsible for connection and disconnection of CPE at the interconnect point. Either a 15-pin D-type connector per each 1544 kbit/s circuit or Krone strips / terminating frame will be used as the IP depending on the number of circuits.

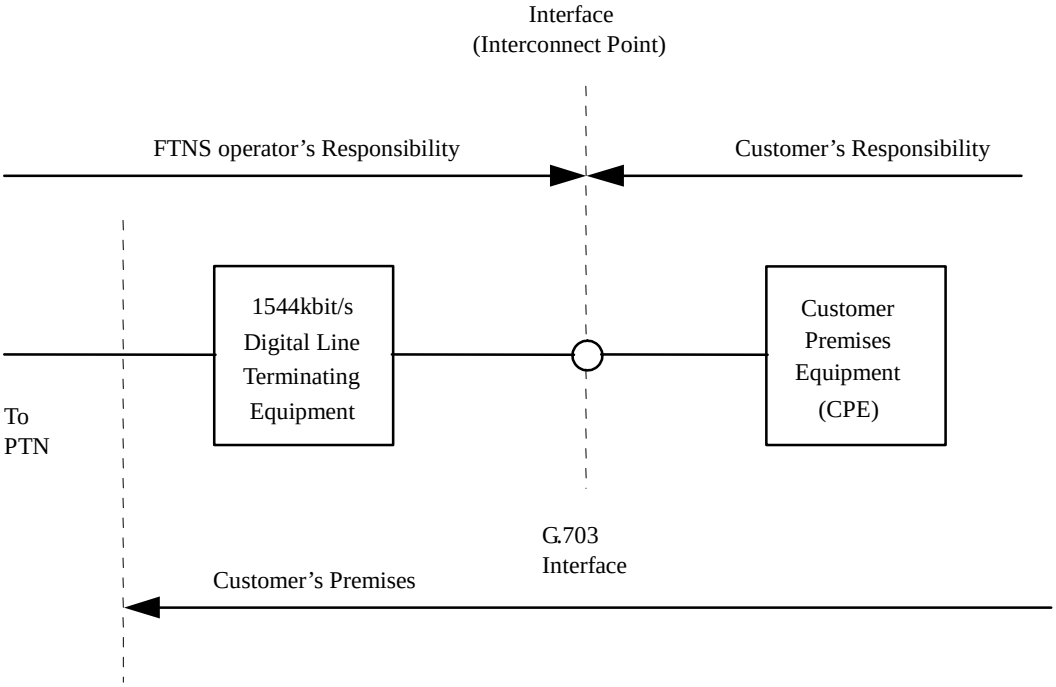


Figure 1 Interconnection of CPE with 1544 kbit/s digital interface to FTNS operator's PTN at the Interconnect Point

3.4 The cable pairs connecting the CPE to the Interconnect Point shall have the following characteristics -

(a) One screened, twisted symmetrical pair shall be used for each direction of transmission.

(b) Cable gauge : 0.5 mm in diameter (i.e. AWG 24/SWG 25)

(c) Attenuation : Not greater than 0.02 dB/m at 772 kHz

(d) Characteristic impedance : 100 ohms nominal at 772 kHz

(e) The screen of the symmetrical pair shall be connected to earth at the output port and left open-circuit at the input port, on the CPE side of the Interconnect Point (Figure 2 refers).

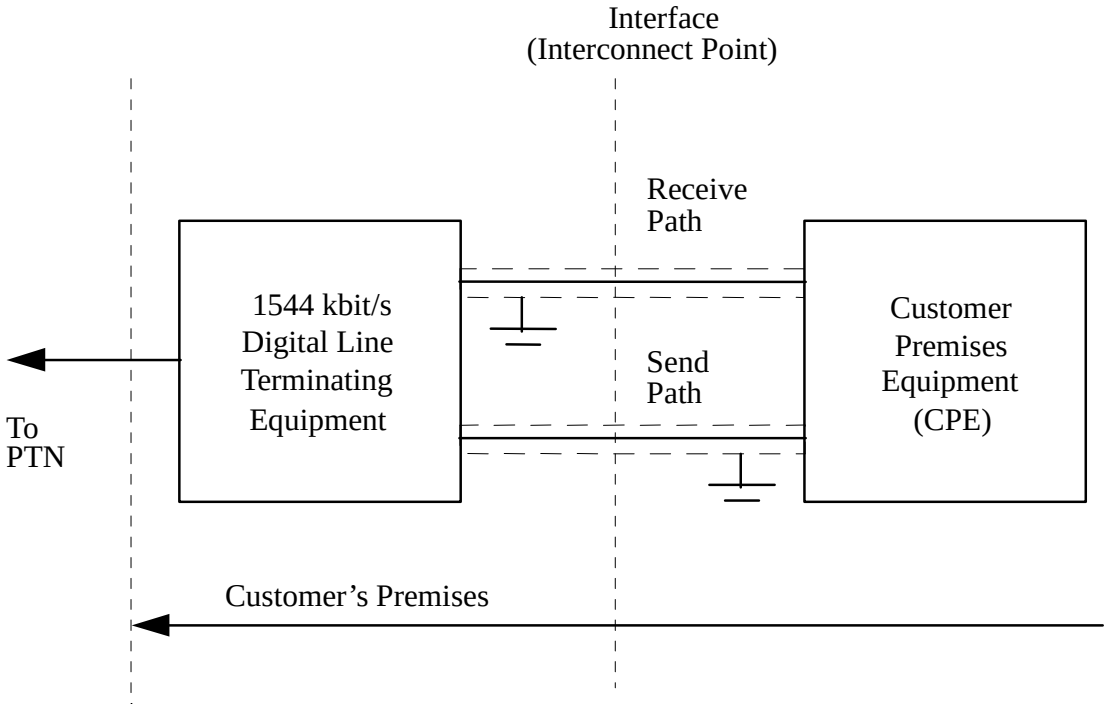


Figure 2 Earthing of Screened Pair at Output Port

4. INTERFACE ELECTRICAL REQUIREMENTS

4.1 GENERAL

The digital interface of the CPE shall conform to ITU-T Recommendations G.703 and G.824 referring to a digital interface operating at a nominal bit rate of 1544 kbit/s, as specified below.

Note 1: The voltage specifications below are given for isolated pulses, while power levels below are specified for all-ones signal.

4.2 BIT RATE ACCURACY

The CPE shall have a bit rate accuracy of ±32 parts per million (ppm) or better.

Note 2: The bit-error-ratio of the 1544 kbit/s digital links provided by the network at the interface is less than 1 in 10^6.

4.3 LINE CODE

The CPE shall support either B8ZS or AMI (bipolar) code.

Note : B8ZS code is the default option used by the network. AMI code can be supported by the network if it is specified by the equipment manufacturer/supplier.

4.4 TEST LOAD IMPEDANCE

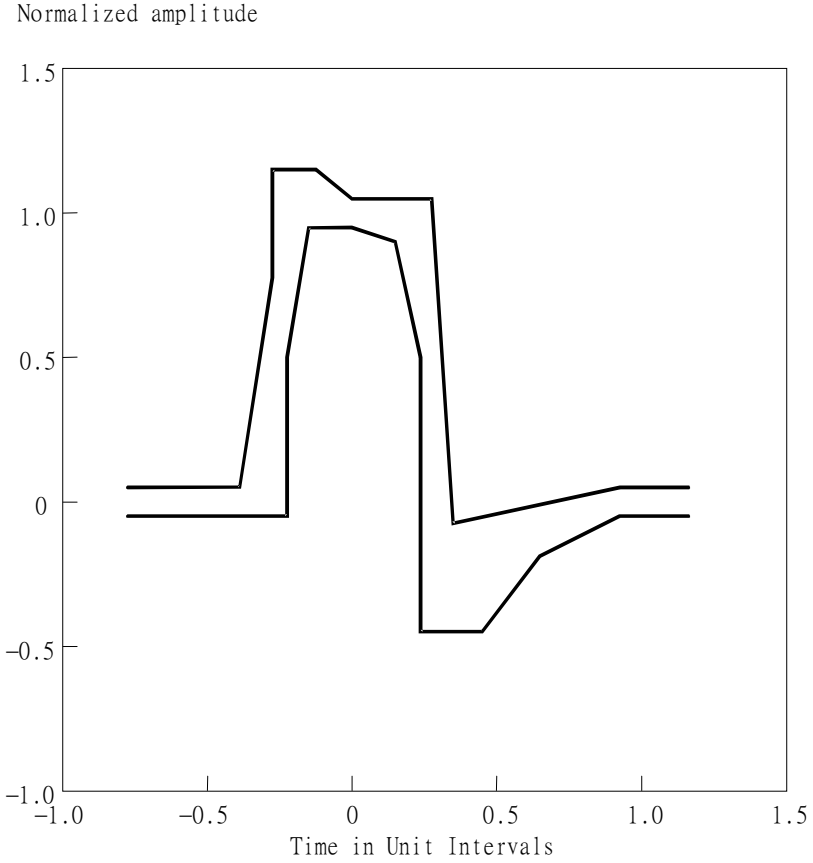
The test load impedance shall be 100 ohms ± 5% resistive.

4.5 PULSE AMPLITUDE

The amplitude of an isolated pulse shall be between 2.4 V and 3.6 V.

4.6 PULSE SHAPE

The shape of every pulse that approximates an isolated pulse (is preceded by four zeros and followed by one or more zeros) shall conform to the mask as shown in Figure 3 below.



Minimum curve		Maximum curve	
Time	Normalized amplitude	Time	Normalized amplitude
− 0.77	− 0.05	−0.77	0.05
− 0.23	−0.05	−0.39	0.05
− 0.23	0.5	−0.27	0.8
− 0.15	0.95	−0.27	1.15
0.0	0.95	−0.12	1.15
0.15	0.9	0.0	1.05
0.23	0.5	0.27	1.05
0.23	−0.45	0.35	−0.07
0.46	−0.45	0.93	0.05
0.66	−0.2	1.16	0.05
0.93	−0.05		
1.16	−0.05		

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Figure 3 1544 kbit/s Interface Isolated Pulse Mask

4.7 POWER LEVEL

For an all-one signal, the power in a 3 kHz ± 1 kHz band centred at 772 kHz shall be between 12.6 dBm to 17.9 dBm. The power in a 3 kHz ± 1 kHz band centred at 1544 kHz shall be at least 29 dB below that at 772 kHz.

4.8 PULSE IMBALANCE

In any window of 17 consecutive bits, the maximum variation in pulse amplitudes shall be less than 200 mV, and the maximum variation in pulse widths (half amplitude) shall be less than 20 ns.

4.9 DC POWER

There shall be no DC power applied at the interface.

4.10 VERIFICATION ACCESS

Access to the signal at the interface shall be provided for verification of the signal specifications as stipulated above.

4.11 JITTER AND WANDER

The control of jitter and wander shall conform to ITU-T Recommendation G.824.

Suitable test apparatus is described in ITU-T Recommendation O.171. Testing will be conducted if loop-back facility is provided by the CPE.

5. SIGNALLING REQUIREMENTS

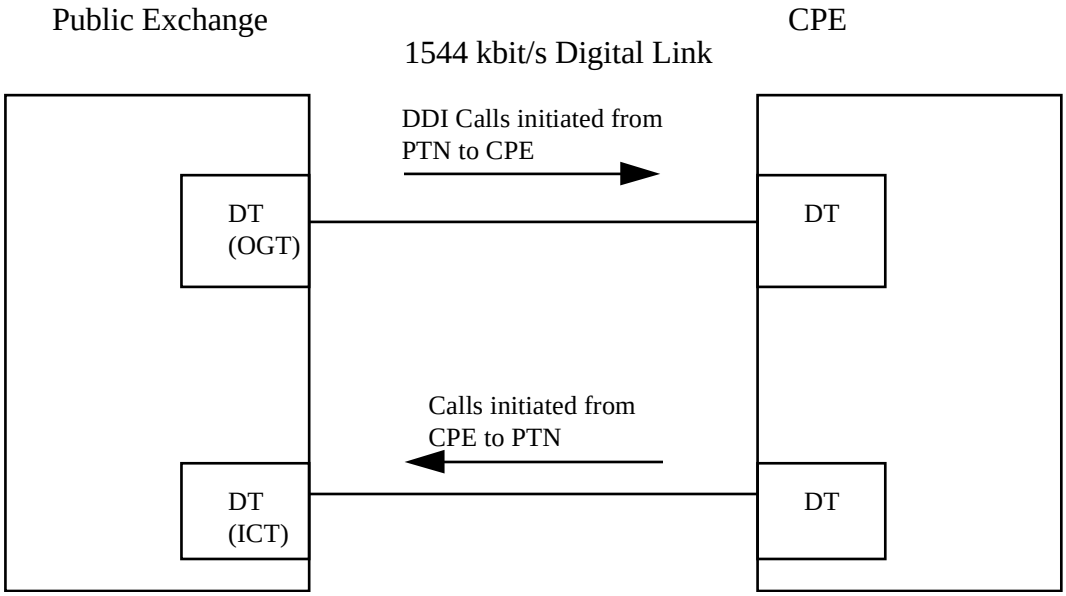
5.1 GENERAL

DTMF signalling is employed as the register signalling (dialling) method for both calling directions, i.e. calls initiated from PTN to CPE [direct-dial-in (DDI)] and calls initiated from CPE to PTN, as shown in Figure 4 below.

Notes : (a) Both incoming and outgoing calls should be supported by the 1544 kbit/s digital link. A separate 1544 kbit/s digital link may be required for each direction of calling subject to the individual FTNS operator's practice.

(b) The interface (Interconnect Point) is assigned as a 0 dBr point.

(c) Both Immediate Start method and Delay Dial method are supported by the public exchange for incoming and outgoing trunks. The signalling method shall be specified by the equipment manufacturer/supplier.



DT : Digital Terminal / Digital Trunk
OGT : Exchange Outgoing Trunk
IGT : Exchange Incoming Trunk

Figure 4 Digital Link at 1544 kbit/s for each direction call between public exchange and CPE

5.2 PCM LINE SIGNALLING FOR DDI CALLS

5.2.1 Signalling Protocol

Table 1 shows the PCM line signalling protocol for DDI calls initiated from PTN to CPE.

Signal	Signal Direction (Notes)	PCM Signalling Bit (Notes)								Remark
		"Pulse-On-Busy" Option				"Pulse-On-Idle" Option				
		Forward		Backward		Forward		Backward		
		Af	Bf	Ab	Bb	Af	Bf	Ab	Bb	
Idle	←→	0	0	0	0	1	1	1	1	
Seizure	→	1	1	0	0	0	0	1	1	
Delay Dial	←	1	1	1	1	0	0	0	0	Applicable to Delay Dial method only
Start Dialling	←	1	1	0	0	0	0	1	1	
Answer	←	1	1	1	1	0	0	0	0	
Holding	→	1	1	1	1	0	0	0	0	
Clear-Backward	←	1	1	0	0	0	0	1	1	
Clear-Forward	→	0	0	0	0	1	1	1	1	Clear-forward After clear-backward
				1 ↓ 0	1 ↓ 0			0 ↓ 1	0 ↓ 1	Clear-forward Before clear-backward
Remote-Blocking	←	0	0	1	1	1	1	0	0	

Notes : (a) → indicate forward (from PTN to CPE) signalling state changes.
(b) ← indicate backward (from CPE to PTN) signalling state changes.
(c) The option of the signalling protocol to be used ("Pulse-On-Busy" or "Pulse-On-Idle") shall be specified by the equipment agent/supplier.
(d) Please refer to paragraph 6 for the framing format of the signalling bits.

Table 1 PCM Line Signalling for DDI Calls Initiated from PTN to CPE

5.2.2 Description of PCM Line Signals (Pulse-On-Busy Option)

(a) Idle Signal (Sent in the Forward and Backward Directions)

In idle condition, the A-bit and B-bit in both the forward and backward signalling channels shall be all “0”.

(b) Seizure Signal (Sent in the Forward Direction)

To initiate a call, the public exchange will seize the digital trunk by setting the A-bit and B-bit in the forward signalling channel to “1”.

(c) Delay Dial Signal (Sent in the Backward Direction, Applicable to Delay Dial Option Only)

After detecting the seizure signal from the public exchange, the CPE provides a delay dial signal by setting the A-bit and B-bit in the backward signalling channel from “0” to “1”.

(d) Start Dialling Signal (Sent in the Backward Direction, Applicable to Delay Dial Option Only)

The start dialling signal is actually the termination of delay dial signal and is sent from the CPE to the public exchange to indicate that digits can be sent. The CPE shall restore the A-bit and B-bit in the backward signalling channel from “1” to “0”.

(e) Answer Signal (Sent in the Backward Direction)

The answer signal is sent from the CPE to the public exchange to indicate that the called party has answered. It shall be the change of the A-bit and B-bit in the backward signalling channel from “0” to “1”. The condition shall be maintained throughout the answer/hold state.

(f) Holding Signal (Sent in the Forward Direction)

After detecting the answer signal from the CPE, the A-bit and B-bit in the forward signalling channel will be maintained as “1” by the public exchange.

(g) Clear-Backward Signal (Sent in the Backward Direction)

The clear-backward signal is sent from the CPE to the public exchange to indicate that the called party has cleared. It shall restore the A-bit and B-bit in the backward signalling channel from “1” to “0”.

(h) Clear-Forward Signal (Sent in the Forward Direction)

The clear-forward signal is sent from the public exchange to the CPE to indicate that the calling party has cleared. It will be "0" in the A-bit and B-bit in the forward signalling channel.

(i) Remote Blocking Signal (Sent in the Backward Direction)

The remote blocking (backward guard) signal can be initiated by the CPE by setting the A-bit and B-bit in the backward signalling channel to "1". The signal shall be maintained until remote blocking is released by the CPE. The blocking may be initiated during idle state or conversation state with either the calling party or the called party clears first. Figure 6 shows the details.

Note 1 : The polarity of the A and B bits described above is based on "Pulse-On-Busy" protocol option. If "Pulse-On-Idle" protocol option is used instead, the "0" and "1" for the A and B bits described above should be reversed.

Note 2 : Items (c) & (d) above are applicable to Delay Dial method only.

5.2.3 Signalling Timing Diagram of Delay Dial Method

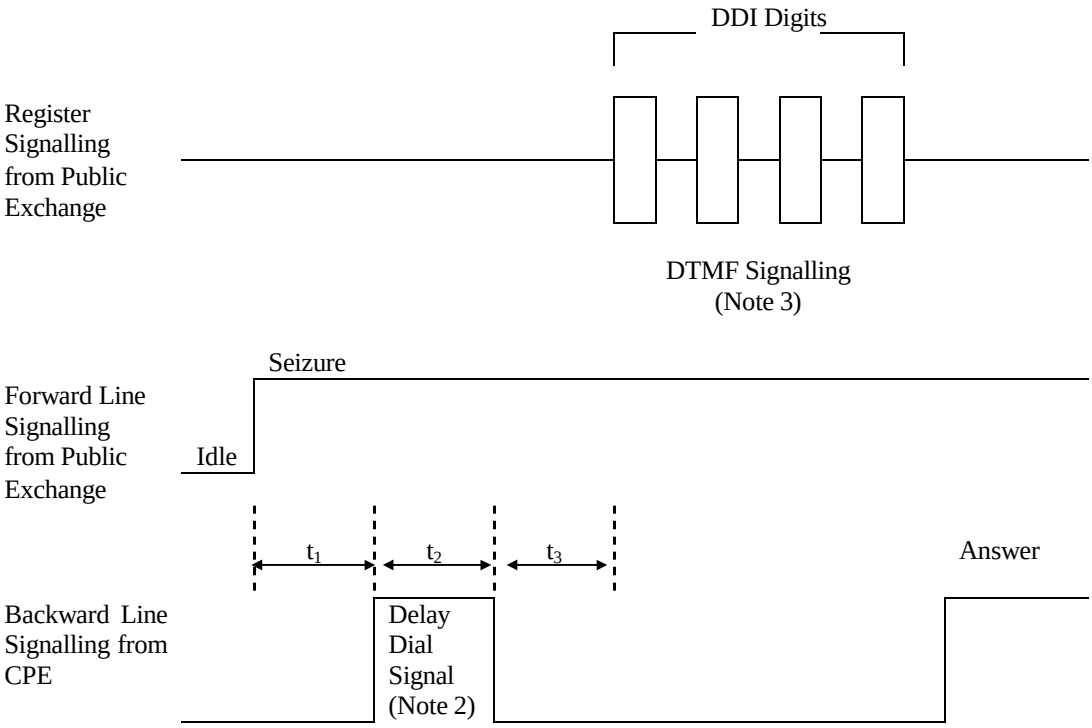


Figure 5 Timing Diagram of Delay Dial Method by DTMF Signalling for DDI call

Timing	Description	Limit
t_1	Duration between the beginning of seizure and the beginning of delay dial signal	4 s maximum (Note 1)
t_2	Duration of the delay dial signal	140 ms minimum 4 s maximum
t_3	Duration between the end of delay dial signal and the first DDI digit	80 ms - 300 ms

Table 2 Delay Dial Method Timing Requirement of DTMF Signalling for DDI Calls

Note 1 : There is no minimum limit for t_1 and the CPE can return the delay dial signal as soon as the seizure signal from the public exchange is detected.

Note 2 : The delay dial signal is a momentary reversal of the polarity of the A and B bits transmitted from the CPE.

Note 3 : Please refer to paragraph 5.4 for details of DTMF signals sent from the public exchange.

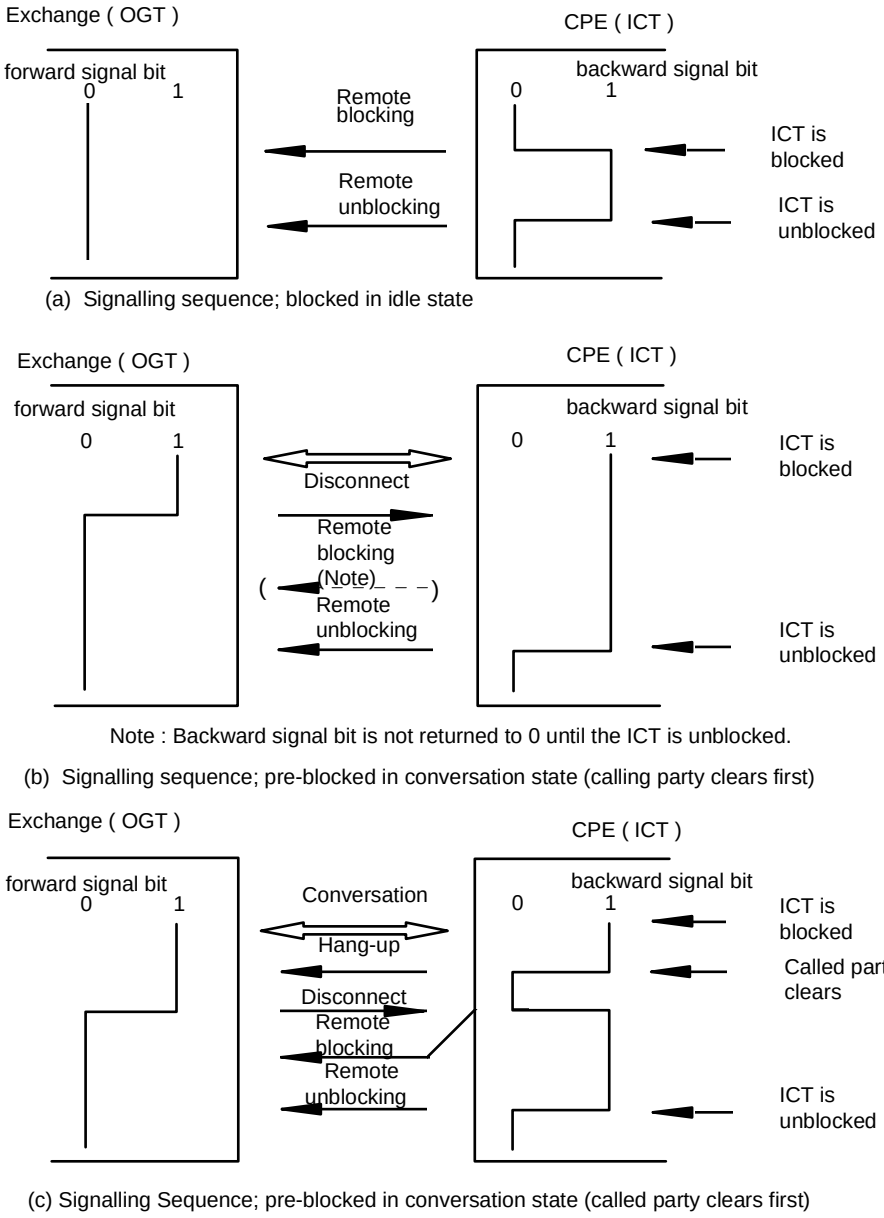


Figure 6 Signalling Sequences for Remote Blocking on DDI Calls Initiated from PTN to CPE (“Pulse-On-Busy” Protocol Option)

5.3 PCM LINE SIGNALLING FOR CPE OUTGOING CALLS

5.3.1 Signalling Protocol

Table 3 shows the PCM line signalling protocol for calls initiated from CPE to PTN.

Signal	Signal Direction (Notes)	PCM Signalling Bit (Notes)								Remark
		"Pulse-On-Busy" Option				"Pulse-On-Idle" Option				
		Forward		Backward		Forward		Backward		
		Af	Bf	Ab	Bb	Af	Bf	Ab	Bb	
Idle	←→	0	0	0	0	1	1	1	1	
Seizure	→	1	1	0	0	0	0	1	1	
Delay Dial	←	1	1	1	1	0	0	0	0	Applicable to Delay Dial method only
Start Dialling	←	1	1	0	0	0	0	1	1	
Answer	←	1	1	1	1	0	0	0	0	
Holding	→	1	1	1	1	0	0	0	0	
Clear-Backward	←	1	1	0	0	0	0	1	1	
Clear-Forward	→	0	0	0	0	1	1	1	1	Clear-forward after clear-backward
				1 ↓ 0	1 ↓ 0			0 ↓ 1	0 ↓ 1	Clear-forward before clear-backward
Remote-Blocking	←	0	0	1	1	1	1	0	0	

Notes : (a) → indicate forward (from CPE to PTN) signalling state changes.
(b) ← indicate backward (from PTN to CPE) signalling state changes.
(c) The option of the signalling protocol to be used ("Pulse-On-Busy" or "Pulse-On-Idle") shall be specified by the equipment agent/supplier.
(d) Please refer to paragraph 6 for the framing format of the signalling bits.
(e) For calls initiated from CPE to PTN, the answer signal from public exchange may not be provided when the call is made to certain special services numbers such as 1081/1083 (Directory Enquiry) and 999 (Emergency Services) etc.
(e) Either one or both of the Immediate Start and Delay Dial Methods will be supported by the network operators for calls from CPE to PTN.

Table 3 PCM Line Signalling for Calls Initiated from CPE to PTN

5.3.2 Description of PCM Line Signals (Pulse-On-Busy Option)

(a) Idle Signal (Sent in the Forward and Backward Directions)

In idle condition, the A-bit and B-bit in both the forward and backward signalling channels shall be all “0”.

(b) Seizure Signal (Sent in the Forward Direction)

To initiate a call, the CPE shall send a seizure signal to the public exchange by setting the A-bit and B-bit in the forward signalling channel to “1”.

(c) Delay Dial Signal (Sent in the Backward Direction, Applicable to Delay Dial Option Only)

After detecting the seizure signal from the CPE, the public exchange will provide a delay dial signal by setting the A-bit and B-bit in the backward signalling channel from “0” to “1”.

(d) Start Dialling Signal (Sent in the Backward Direction, Applicable to Delay Dial Option Only)

The start dialling signal is actually the termination of delay dial signal and is sent from the public exchange to the CPE to indicate that digits can be sent. The public exchange will restore the A-bit and B-bit in the backward signalling channel from “1” to “0”.

(e) Answer Signal (Sent in the Backward Direction)

The answer signal is sent from the public exchange to the CPE to indicate that the called party has answered. It will be the change of the A-bit and B-bit in the backward signalling channel from “0” to “1”. The condition will be maintained throughout the answer/hold state.

(f) Holding Signal (Sent in the Forward Direction)

After detecting the answer signal from the public exchange, the A-bit and B-bit in the forward signalling channel shall be maintained as “1” by the CPE.

(g) Clear-Backward Signal (Sent in the Backward Direction)

The clear-backward signal is sent from the public exchange to the CPE to indicate that the called party has cleared. It will restore the A-bit and B-bit in the backward signalling channel from “1” to “0”.

(h) Clear-Forward Signal (Sent in the Forward Direction)

The clear-forward signal is sent from the CPE to the public exchange to indicate that the calling party has cleared. It shall be "0" in the A-bit and B-bit in the forward signalling channel.

(i) Remote Blocking Signal (Sent in the Backward Direction)

The remote blocking signal may be initiated by the public exchange by setting the A-bit and B-bit in the backward signalling channel to "1". The signal will be maintained until remote blocking is released by the public exchange. The blocking may be initiated during idle state or conversation state with either the calling party or the called party clears first. Figure 8 shows the details.

Note 1 : The polarity of the A and B bits described above is based on "Pulse-On-Busy" protocol option. If "Pulse-On-Idle" protocol option is used instead, the "0" and "1" for the A and B bits described above should be reversed.

Note 2 : Items (c) & (d) above are applicable to Delay Dial method only.

5.3.3 Signalling Timing Diagram of Delay Dial Method

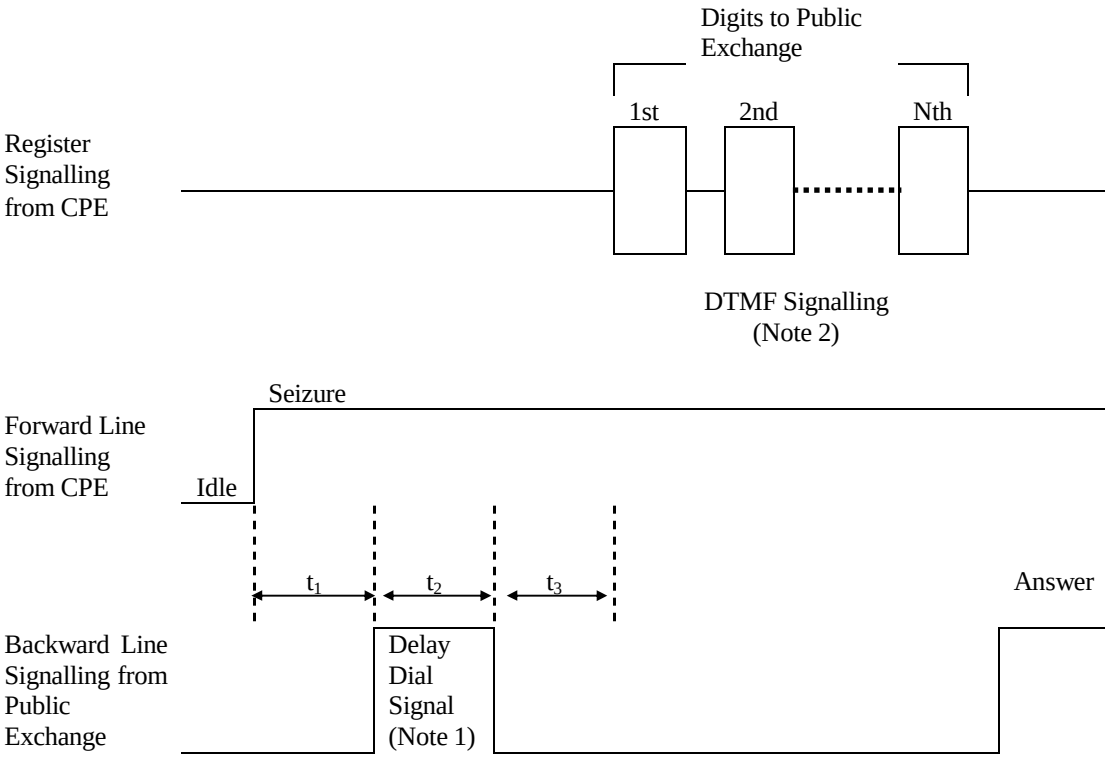


Figure 7 Timing Diagram of Delay Dial Method by DTMF Signalling for CPE outgoing calls

Timing	Description	Limit
t_1	Duration between the beginning of seizure and the beginning of delay dial signal	100 ms minimum 166 ms maximum
t_2	Duration of the delay dial signal	128 ms minimum 160 ms maximum
t_3	Duration between the end of delay dial signal and the first digit sent from CPE	70 ms minimum (Note 3)

Table 4 Delay Dial Method Timing Requirement of DTMF signalling for CPE outgoing calls

Note 1 : The delay dial signal is a momentary reversal of the polarity of the A and B bits transmitted from the incoming trunk of public exchange.

Note 2 : Please refer to paragraph 5.5 for details of DTMF signalling sent from the CPE.

Note 3 : Time-out will occur if digit is not received by exchange within 10 seconds from the end of the delay dial signal.

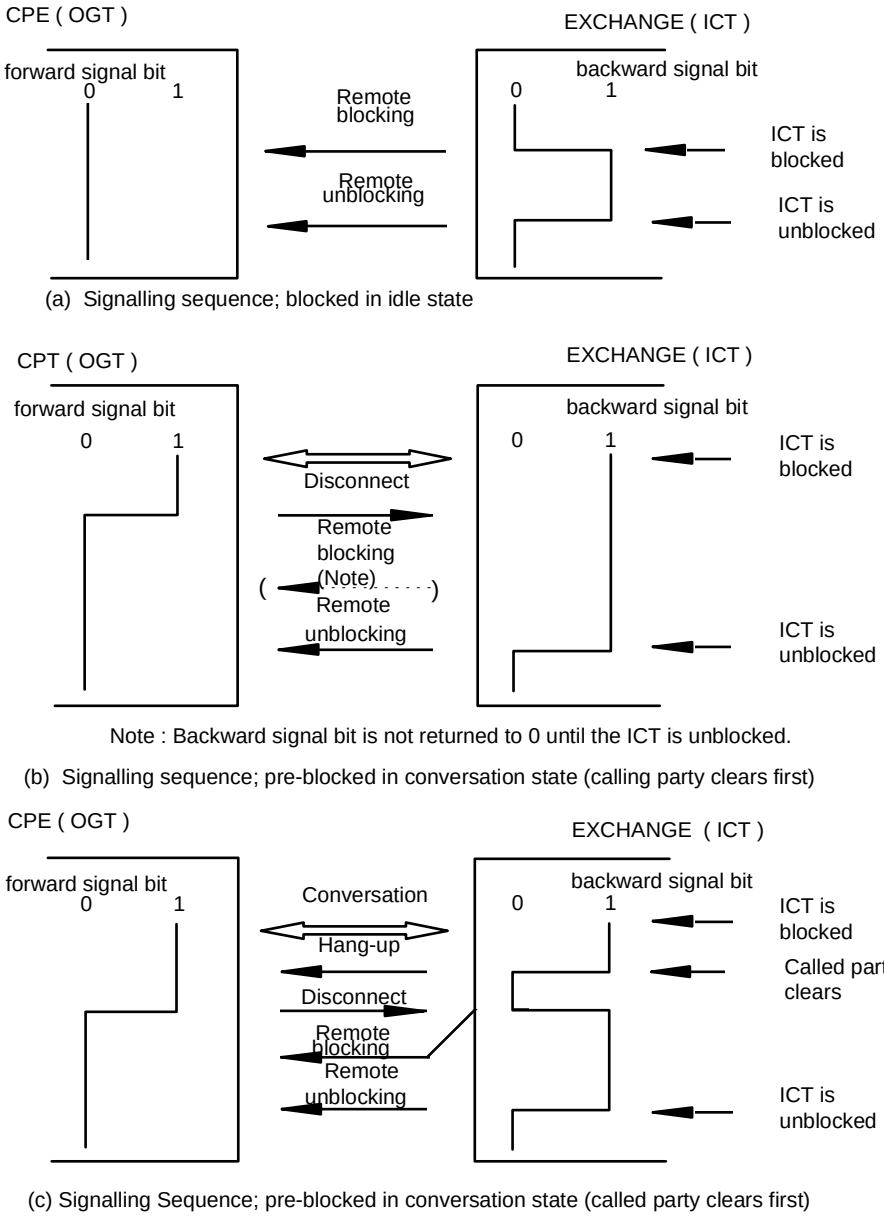


Figure 8 Signalling Sequences for Remote Blocking on Calls Initiated from CPE to PTN ("Pulse-On-Busy" Protocol option)

5.4 REGISTER (DTMF) SIGNALS SENT FROM PUBLIC EXCHANGE TO CPE FOR DDI CALLS

5.4.1 For Immediate Start method, the public exchange will start to send DTMF dialling signals when a minimum of 600 ms has elapsed after the seizure of the digital trunk by the public exchange. The number of digits sent from the public exchange will be used for identification of a DDI number.

5.4.2 For Delay Dial method, please refer to paragraph 5.2.3 for the timing requirements.

5.4.3 The DTMF signal frequencies will be in accordance with ITU-T Recommendation Q.23, as shown in Table 5.

	Low Frequency Group (Hz)				High Frequency Group (Hz)			
	697	770	852	941	1209	1336	1477	1633
Digit 1	X				X			
Digit 2	X					X		
Digit 3	X						X	
Digit 4		X			X			
Digit 5		X				X		
Digit 6		X					X	
Digit 7			X		X			
Digit 8			X			X		
Digit 9			X				X	
Digit 0				X		X		
*				X	X			
#				X			X	

Note : 1633 Hz code is not used.

Table 5 DTMF Signal Frequencies

5.4.4 The frequency tolerance of DTMF signals will be contained within ±1.5%.

5.4.5 The duration of steady-state DTMF signal representing each digit will be within the range 61 to 75 ms.

5.4.6 The interdigital pause will be within the range 61 to 75 ms.

5.4.7 The power level of each frequency component of the high and low frequency groups will be within the range -6 to -10 dBm0, when measured at the Interconnect Point by using a calibrated codec in compliance with ITU-T Recommendation G.711.

5.4.8 The total power of all unwanted frequency components will be less than -27 dBm0, and the power level of any individual unwanted frequency component will be less than -33 dBm0, when measured at the Interconnect Point by using a calibrated codec in compliance with ITU-T Recommendation G.711.

5.5 REGISTER (DTMF) SIGNALS SENT FROM CPE TO PUBLIC EXCHANGE FOR CPE OUTGOING CALLS

5.5.1 For Immediate Start method, the CPE may start to send DTMF dialling signals as soon as 300 ms has elapsed after seizure of the public exchange trunk by the CPE. Time-out will occur if digit is not received by exchange within 10 seconds from seizure.

Note : Dial tone upon seizure is normally not provided for digital trunks. However, this facility will be made available upon request.

5.5.2 For Delay Dial method, please refer to paragraph 5.3.3 for the timing specifications.

5.5.3 The DTMF signal frequencies shall be in accordance with ITU-T Recommendation Q.23, as shown in Table 6.

	Low Frequency Group (Hz)				High Frequency Group (Hz)			
	697	770	852	941	1209	1336	1477	1633
Digit 1	X				X			
Digit 2	X					X		
Digit 3	X						X	
Digit 4		X			X			
Digit 5		X				X		
Digit 6		X					X	
Digit 7			X		X			
Digit 8			X			X		
Digit 9			X				X	
Digit 0				X		X		
*				X	X			
#				X			X	

Note : 1633 Hz code is not used.

Table 6 DTMF Signal Frequencies

5.5.4 The frequency tolerance of DTMF signals shall be contained within ±1.5%

5.5.5 The duration of steady-state DTMF signal representing each digit shall be within the limits of 50 to 200 ms.

5.5.6 The interdigital pause shall be within the limits of 50 ms to 4 seconds.

5.5.7 The power level of each frequency component of the high and low frequency groups shall be within the limits of -3 to -24 dBm0, when measured at the Interconnect Point using a calibrated codec in compliance with ITU-T Recommendation G.711.

5.5.8 The twist (differential) level of the signal power of the high and low frequency groups shall be contained within ±4 dB.

5.5.9 The total power of all unwanted frequency components shall be at least 20 dB below the lowest power level of the DTMF signal and less than -30 dBm0, and the power level of any individual unwanted frequency component shall be less than -35 dBm0, when measured at the Interconnect Point using a calibrated codec in compliance with ITU-T Recommendation G.711.

5.6 SUPERVISORY TONES RETURNED FROM CPE TO PTN FOR DDI CONNECTION

5.6.1 General

Call progress indication in the form of supervisory tone shall be transmitted from the CPE to the PTN within 6 seconds upon receipt of the final DDI digit. In some occasions, recorded announcements can be transmitted to the calling party through the public exchange before the establishment of the answer condition.

5.6.2 Application of Supervisory Tones

Application of supervisory tones shall be in accordance with Clause 5.2 of the HKTA 2201 titled “General Technical Characteristics of Fixed Telecommunications Networks in Hong Kong”.

5.6.3 Characteristics of Supervisory Tones

Supervisory tones transmitted from the CPE shall conform to Clause 5.3 of the HKTA 2201.

5.7 RELEASE CONDITION

5.7.1 DDI Calls Initiated from PTN to CPE

(a) When Calling Party Releases First

When the calling party restores to on-hook, the public exchange will send a clear-forward signal to the CPE.

Upon receipt of the clear-forward signal from the public exchange, a clear-backward signal shall be returned from the CPE. The exchange circuit will then be released after expiry of a release guard timing (0.7 to 2.0 s).

(b) When Called Party Releases First

When the called party restores to on-hook, a clear-backward signal shall be sent from the CPE to the public exchange.

For calls within Hong Kong, upon detection of the clear-backward signal from CPE, a re-answer supervision timing will normally commence at the public exchange. ‡

If re-answer from the CPE is detected by the public exchange before expiry, the supervision timing will be cancelled and the call connection will be maintained.

When the re-answer supervision timing expires or as soon as clear-forward signal from the calling party is received during the supervisory timing, the public exchange will send a clear-forward signal to the CPE and the exchange circuit will be released after expiry of a release guard timing (0.7 to 2.0 s).

5.7.2 Calls Initiated from CPE to PTN

(a) When Calling Party Releases First

When the calling party restores to on-hook, the CPE shall send a clear-forward signal to the public exchange.

Upon receipt of the clear-forward signal from CPE, a clear-backward signal will be returned from the public exchange and the call will be released. A guard time of about 2 seconds is required before the exchange circuit is ready for a new seizure again.

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‡ This re-answer supervision timing may not be provided by individual network operators in Hong Kong.

(b) When Called Party Releases First

When clear-backward signal from the called party is received by the public exchange while the calling party (the CPE) remains in the off-hook condition, a clear-backward signal will be sent from the public exchange to the CPE.

For calls within Hong Kong, a re-answer supervision timing will normally commence. ‡

If re-answer signal from the called party is detected, the supervision timing will be cancelled and the call connection will be maintained.

If the CPE returns a clear-forward signal to the public exchange upon detection of the exchange clear-backward signal, the call will be released and both the calling and the called lines will be restored to idle. Otherwise, upon expiry of the re-answer supervision timing, the called subscriber line will be restored to idle and a busy tone will be sent to the CPE from the public exchange; a clear-forward signal shall be returned from the CPE to the public exchange to release the connection.

6. FRAME STRUCTURES AND ALARM INDICATION

6.1 GENERAL

The requirements in this paragraph are based on relevant sections of ITU-T Recommendations G.704 and G.706, and shall apply to both the input and the output ports of the CPE.

6.2 FRAME

Each frame contains 193 bits, numbered 1 to 193. The nominal bit rate is 1544 kbit/s and the frame repetition rate is 8000 Hz.

The first bit of a frame is designated as framing bit (F-bit), and is used for such purposes as frame alignment, data link provision and performance monitoring. The remaining 192 bits are partitioned into 24 eight-bit time slots (24 channels).

6.3 SUPERFRAME (12-FRAME MULTIFRAME)

A superframe is formed by combining 12 consecutive frames. Table 7 shows the allocations of F-bits, information coding bits and signalling bits.

Note : Extended superframe (24-Frame Multiframe) format for digital trunk service is not supported.

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‡ This re-answer supervision timing may not be provided by individual network operators in Hong Kong.

Frame Number	F-Bit		Bit Number(s) In Each Channel Time Slot		Signalling Channel Designation
	Frame Alignment Signal	Multiframe Alignment Signal (S-Bit)	Information Coding Bits (For Character Signal)	Signalling Bits (For Signalling)	
1	1	-	1 to 8	-	
2	-	0	1 to 8	-	
3	0	-	1 to 8	-	
4	-	0	1 to 8	-	
5	1	-	1 to 8	-	
6	-	1	1 to 7	8	A
7	0	-	1 to 8	-	
8	-	1	1 to 8	-	
9	1	-	1 to 8	-	
10	-	1	1 to 8	-	
11	0	-	1 to 8	-	
12	-	0	1 to 7	8	B

Note : To generate Remote Alarm Indication (RAI), either the S-bit in frame 12 shall be modified from state “0” to “1” or bit 2 in every channel time slot shall be forced to the value of “0”.

Table 7 Superframe (12-Frame Multiframe) Format

6.4 PCM-ENCODED VOICEBAND SIGNAL IN CHANNEL TIME SLOTS

Bits 2 to 193 in the basic frame carry 24 octet interleaved 64 kbit/s channel time slots, numbered 1 to 24. Each 64 kbit/s channel time slot can accommodate a PCM-encoded voiceband signal conforming to ITU-T Recommendation G.711 "Pulse Code Modulation (PCM) of Voice Frequencies" - Tables 2a and 2b, i.e. "μ– Law".

6.5 SIGNALLING FRAMES AND BITS

Channel associated signalling is used. The allocation of signalling bits for different 12-frame multiframes is as shown in Table 7 . Frames 6 and 12 are designated as signalling frames, and the 8th bits of Frame 6 (A-bit) and Frame 12 (B-bit) in each channel time slot are robbed as signalling bits associated with that channel.

6.6 FRAME ALIGNMENT

The frame alignment procedures shall be in accordance with Section 2 of ITU-T Recommendation G.706. The loss of frame alignment shall be declared when the received framing bits are in error in the range 2 out of 4 to 2 out of 5.

6.7 ALARM CONDITIONS

6.7.1 Remote Alarm Indication (RAI)

The CPE shall generate an alarm indication in the "send" path upon detection of any of the following conditions.

(a) Loss of incoming 1544 kbit/s signal.
(b) Loss of frame alignment.
(c) Excessive bit error ratio (1 in 10^3 or higher) on the frame alignment signal.

The CPE shall either modify the S-bit in frame 12 from state "0" to "1" or force bit 2 in every channel time slot to the value of "0". The RAI method to be used shall be agreed between the network operator and the equipment agent/supplier.

6.7.2 Blocking 1544 kbit/s Interface

The CPE should preferably block the 1544 kbit/s interface when an alarm indication is generated from the public exchange.

The public exchange may generate RAI either by modifying the S-bit in frame 12 from state "0" to "1" or by forcing bit 2 in every channel time slot to the value of "0". It will be aligned with the RAI method used by the CPE.

7. NETWORK SYNCHRONIZATION

7.1 GENERAL

Network synchronisation is required in a digital network in order to ensure that the octet slip rate performance is in accordance with ITU-T Recommendation G.822, "Controlled Slip Rate Objectives on an International Digital Connection". Slip is defined as the gain or the loss of a digit position or a set of consecutive digit positions, resulting from an aberration of timing processes associated with transmission or switching of digital signal.

7.2 OCTET SLIP RATE PERFORMANCE OBJECTIVE

Performance Category	Mean Slip Rate	Proportion of Time (Note)
a	≤ 1 slip in 12 hrs	> 98.9%
b	> 1 slip in 12 hrs and ≤ 1 slip in 5 mins	< 1.0%
c	> 1 slip in 5 mins	< 0.1%

Note : Total time is not less than 1 year.

Table 8 Slip Rate Performance

7.3 CPE CLOCK

(a) Stability

Short-term stability : ≤ $\pm 3.7 \times 10^{-7}$ per day

Long-term stability : ≤ $\pm 3.2 \times 10^{-5}$ per 20 years

(b) Pull-in Range

≥ $\pm 6.4 \times 10^{-5}$

(c) Free Run Accuracy

≤ $\pm 3.2 \times 10^{-5}$

7.4 SYNCHRONIZATION METHOD

Network synchronization is required in a digital network. Reliable synchronization of CPE clocks (treated as stratum 4 entities) depends entirely on receiving a time reference that is phase-locked to an equal or higher quality clock. To increase the availability of a timing reference, the CPE clocks should be capable of accepting more than a single synchronization reference source (e.g., one primary and one or more secondaries). An automatic means is desirable to switch over from a facility carrying the primary reference source to another facility carrying the secondary reference (Figure 9 refers).

The CPE shall be able to synchronize (as a slave) with the public exchange using master-slave synchronisation method.

7.5 MAINTAINABILITY OF CPE SYNCHRONIZATION DEVICE

The CPE synchronisation device shall be able to detect, isolate and rectify timing failures on the synchronisation link.

7.6 DUPLICATION ARRANGEMENT OF CPE SYNCHRONIZATION DEVICE

It is preferred that the CPE synchronisation device is duplicated so that a single failure will not cause the CPE to become free-run.

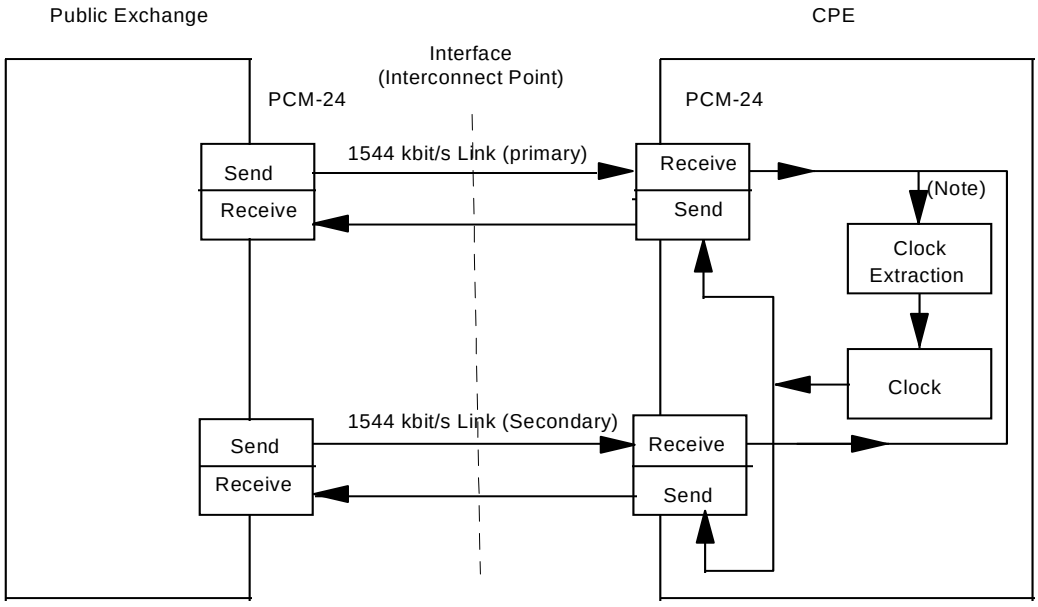

Figure 9 Preferred Synchronization Method between Pubic Exchange and CPE

8. TRANSMISSION REQUIREMENTS

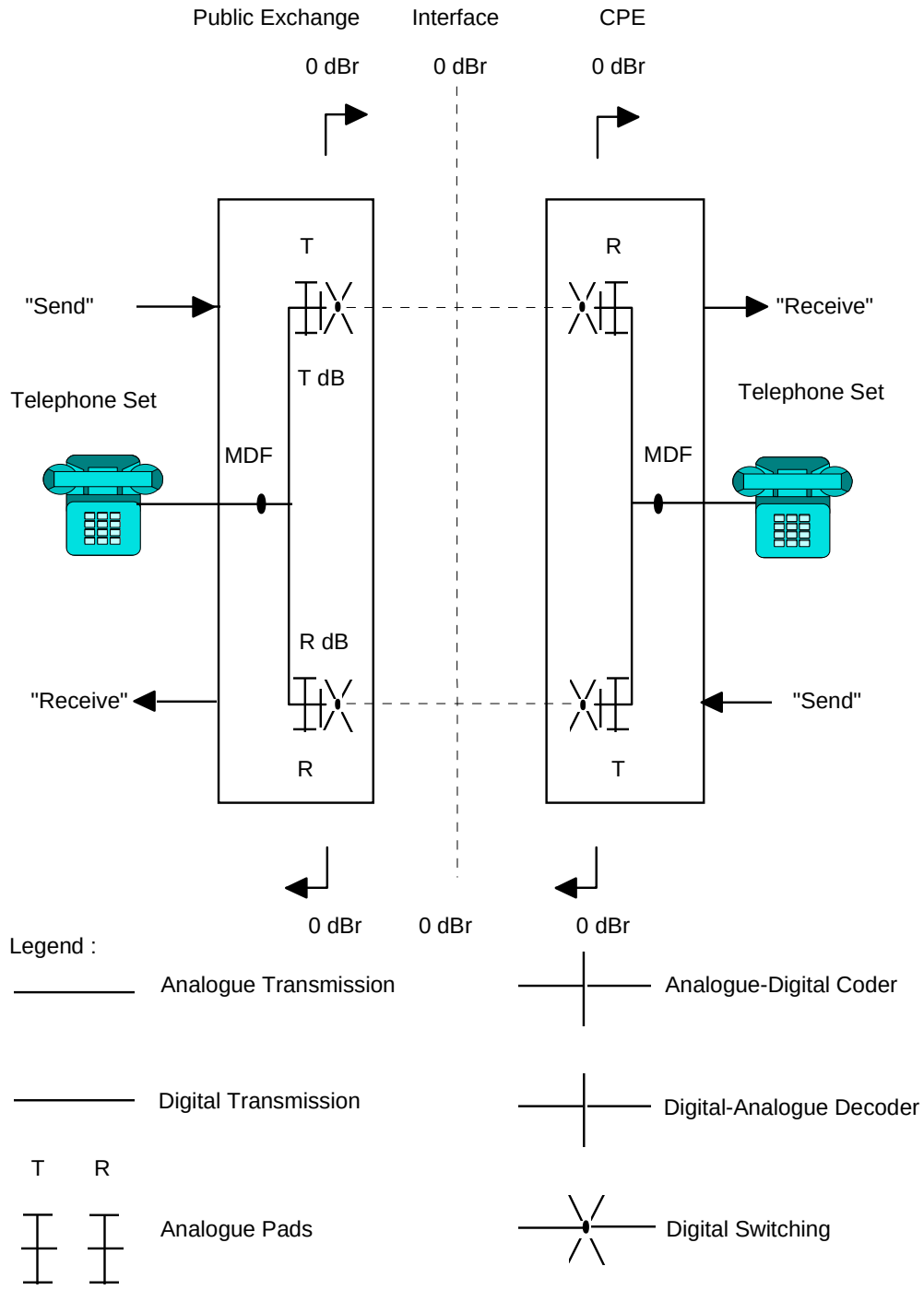

Figure 10 Pad Settings for Transmission Paths

Figure 10 shows the pad settings T and R for the “send” path and the “receive” path respectively between the public exchange side and the CPE side. As a general principle, it is required that the ITU-T Recommendations concerning loudness ratings (G.121) and stability & echo (G.122) be followed.

For convenience sake, the followings are listed/stated for quick reference:

a) The individual values for T and R in conjunction with the nominal CPE loudness rating performance shall be able to meet the long term objectives for loudness rating requirements referred to the Virtual International Connecting Points (VICP) as specified in G.121, i.e.

Send Loudness Rating (SLR) = 7 to 9 dB;
Receive Loudness Rating (RLR) = 1 to 3 dB

b) The nominal value of the differential loss (R-T) is recommended to be 6 dB; in all cases (R-T) should be in the range of 3 to 9 dB.

c) The nominal values of the T and R pads set by the FTNS Operators in Hong Kong are as follows:

	T / R	
PCCW	0 / 6	dB
NWT	0 / 6	dB
HGC	0 / 7	dB
WT&T	2 / 8	dB

9. AUTOMATIC OPERATION

9.1 AUTOMATIC INITIATION OF OUTGOING CALLS

9.1.1 Commencement of Dialling

For Immediate Start method, the CPE may start to send DTMF dialling signals as soon as 300 ms has elapsed after seizure of the public exchange trunk by the CPE. Time-out will occur if digit is not received by exchange within 10 seconds from seizure. For Delay Dial method, please refer to paragraph 5.3.3 for the timing specifications.

Note : Dial tone upon seizure is normally not provided for digital trunks. However, this facility will be made available upon request.

9.1.2 Automatic Repeated Dialling

Not more than 10 repeated attempts of outgoing call to the same telephone number shall be made automatically by the CPE after the initial call attempt to that number.

9.2 AUTOMATIC ANSWERING OF INCOMING CALLS

9.2.1 For automatic operation, upon answering of an incoming call by returning an answer signal (reversal of the polarity of the A and B bits) to the PTN, verbal announcement or appropriate handshake/identification signals shall be provided by the CPE.

9.2.2 Tone signals provided by the CPE after answering shall be distinct and audibly dissimilar from the PTN supervisory tones.

Note : In cases where the CPE answers a call automatically and then provides a tone to the calling person (e.g. an interactive voice response system answers a call and then provides a tone to prompt the calling party to enter commands), it is preferred that a verbal announcement should be provided before sending the tone, in order to avoid misleading the calling party into thinking that the call has not been answered.

9.3 AUTOMATIC CALL RELEASE

9.3.1 For DDI operation, CPE with automatic answering or trunk-to-trunk connection features shall automatically release the line (restore to idle) immediately upon detection of clear-forward signal from the PTN.

9.3.2 For outgoing call operation, CPE with automatic calling or trunk-to-trunk connection features shall automatically release the line (restore to idle) in accordance with both of the following conditions :

(i) The CPE shall release the line upon detection of clear-backward signal from the PTN.

(ii) In addition, the CPE shall also release the line automatically by means of at least one of the following :

- When the off-hook duration of the CPE exceeds a preset limit of not more than 3 minutes.

- Within one minute when genuine signals are not present on the line.

- Immediately upon detection of appropriate network supervisory tone from the PTN.

Note : In order to avoid false holding of exchange equipment as well as the CPE itself, it is preferred that all CPE with automatic operation should incorporate a time-out call release mechanism independent of the status of the far-end party.

10. TONE RECEIVER SENSITIVITY OF CPE

Where the CPE's operation involves the detection of DTMF signals transmitted from the far-end subscriber's tone dialling telephone when a PTN call path is established, the tone receiver sensitivity of the CPE shall take account of the range of sending levels of DTMF signals from the far-end telephone as well as the local line loss at the distant end. It is preferred that the tone receiver sensitivity of the CPE should enable detection of DTMF signals down to -23 dBm0.

11. REFERENCE

11.1 ITU-T Recommendation G.121 - Loudness Ratings (LRs) of National Systems

11.2 ITU-T Recommendation G.122 - Influence of National Systems on Stability and Talker Echo in International Connections

11.3 ITU-T Recommendation G.703 - Physical/Electrical Characteristics of Hierarchical Digital Interfaces

11.4 ITU-T Recommendation G.704 - Synchronous Frame Structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s Hierarchical Levels

11.5 ITU-T Recommendation G.706 - Frame Alignment and Cyclic Redundancy Check (CRC) Procedures Relating to Basic Frame Structures defined in Recommendation G.704

11.6 ITU-T Recommendation G.711 - Pulse Code Modulation (PCM) of Voice Frequencies

11.7 ITU-T Recommendation G.822 - Controlled Slip Rate Objectives on an International Digital Connection

11.8 ITU-T Recommendation G.824 - The Control of Jitter and Wander within Digital Networks which are Based on the 1544 kbit/s Hierarchy

11.9 ITU-T Recommendation Q.23 - Technical Features of Push-Button Telephone Sets

11.10 HKTA 2001 - “Compliance Test Specification - Safety and Electrical Protection Requirements for Subscriber Telecommunications Equipment” issued by the Telecommunications Authority

11.11 HKTA 2201 - “General Technical Characteristics of the Fixed Telecommunication Networks in Hong Kong” issued by the Telecommunications Authority

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