DISCRIMINATING SELECTOR REPEATER

INTRODUCTION

Before delving into the description there a couple of things that need clarifying

Junctions & Trunks

Outside the USA, the term “Junction” is common. In the USA, Junction is not used to refer to inter-office lines, in this case the term “Trunk” is used.

While this may be confusing, in this description I have kept to the terminology used in New Zealand. “Switches” are “Exchanges”.

Junctions are links between local exchanges and between local and national exchanges. Trunks, on the other hand, are the links between national exchanges, between national and international exchanges, and between international exchanges, i.e., the long-distance network. Trunks are also links between PABXs (Private Automatic Brach Exchanges), between PABXs and local exchanges and between PABXs and national exchanges.

Discriminating Selector Repeater

If the proportion of local calls was comparatively high, or if the distance between Central and Satellite exchanges was considerable, it was generally economical to provide special arrangements which keep the junction requirements down to the lowest possible figure. A two-motion selector, known as a Discriminating Selector Repeater (D.S.R.) was developed to meet this requirement. This switch combines the functions of both a selector and a repeater. It serves as a repeater on outgoing calls and a selector on local calls.

The D.S.R. features include; junction hunters for outgoing calls to the central exchange, digit repeater on outgoing calls, digit absorption eliminating need for local 2nd group selectors, and a transmission bridge to maintain required standard of transmission performance.

Junction Guarding of ‘P’ Wire

A Junction Hunter junction consisted of two wires, with 'A' and 'B' legs. In addition to the ‘A’ and ‘B’ wires but not included in the Junction cable, was a Private or 'P' wire dedicated to each junction. When a junction was busy, a positive potential (Earth) was present on the 'P' wire. As a result, when another Junction Hunter uniselector was hunting for a free junction, the presence of Earth on the 'P' wire would cause the Junction Hunter to step over that junction outlet.

Junction Guard Relays were installed in the Satellite Exchanges to perform this task. During the release of a junction call, the Junction Guard Relays guarded the ‘P’ wire until the selectors in the Central Exchange had fully released. If this junction guarding facility did not exist, it could have been possible for a new call to seize the junction and because the selectors in Central had not fully released, the call would fail.

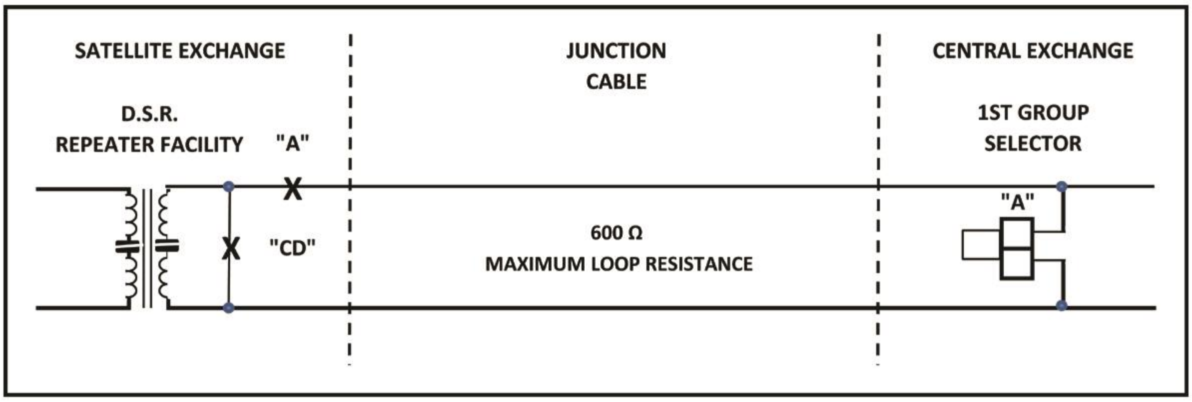
The Junction’s ‘P’ wire, on a D.S.R. Level Call, was guarded by a positive potential (Earth) applied by the D.S.R. through its ‘P’ wiper.

LOOP RESISTANCE

Loop Resistance pertains to the loop resistance of Junction Cable pair, or a Subscriber Cable pair and doesn’t include the resistance of the attached equipment at either end.

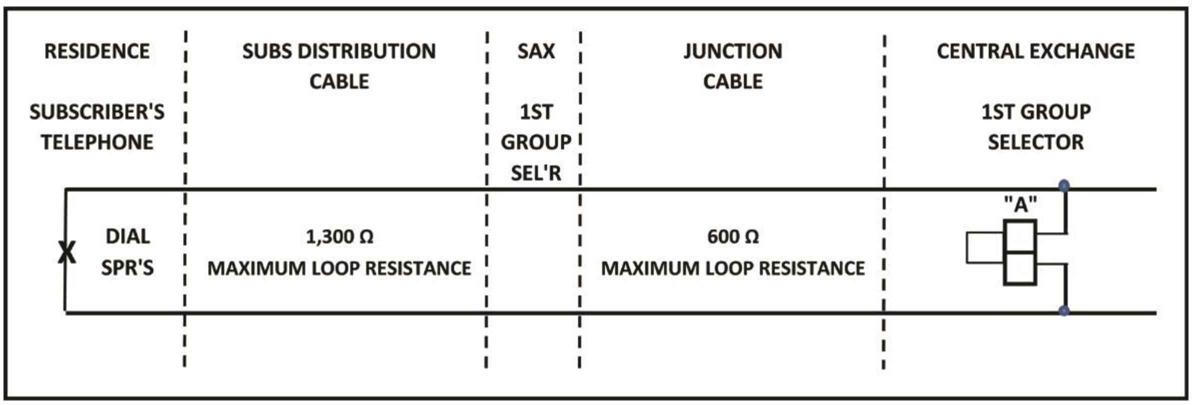
Maximum Loop resistance for a Junction Hunter Junction:
Because the D.S.R. serves as a repeater on outgoing calls, only the cable pair from the Satellite to the Central Exchange is in the equation.

The cable pair from the Satellite to Central, 600 ohms was the maximum loop resistance.



Maximum Loop Resistance of a Subscribers Line
The DC resistance in the subscriber's loop causes signals to weaken as they travel a greater distance. The maximum allowable DC loop resistance is 1300 ohms, occurring at a distance of 18,000 feet (5 km / 3 miles) when using a standard 26 Standard Wire Gauge (SWG) copper cable pair. However, this distance could be extended up to 22 km (14 miles) when using a thicker 19 SWG copper cable pair.

Maximum Loop resistance for a 1st Group Selector outgoing junction:
Because the 1st Group Selector had no repeater facility, the Satellite to the Central Exchange loop was extended to include the calling subscriber’s loop. The cable pair from the Satellite to Central, 600 ohms was the maximum loop resistance. The subscriber’s line was 1300 ohms maximum line loop resistance.



Results:
The maximum permissible Loop Resistance was 600 ohms for the D.S.R. and 1,900 ohms for the Satellite outgoing Group Selector.

The D.S.R. won the day because its loop resistance was lower than that of the Group Selector option. This was because the Group Selector not having a repeater the loop was extended to include the loop resistance of the subscriber’s line.

The D.S.R. loop ended at the D.S.R. repeater, which excluded the subscriber’s loop.

Auto-to-Auto Relay-Set
Had Auto-to-Auto relay-sets been installed as additional equipment, between the Group Selector and the Junction, the maximum Loop Resistance would have been the same as that of the D.S.R.. However, Auto-to-Auto relay-sets would have been no match for D.S.R., because Auto-to-Auto relay-sets only repeat dialled digits once they had been selected by a Satellite 1st Group Selector.

DISCRIMINATING SELECTOR REPEATER - (D.S.R.)

The Discriminating Selector Repeater (D.S.R.) referred to in this description was one of the largest, 2000 type two motion selectors used in step-by-step Satellite Exchanges. The one shown in the photo (Refer to Fig. 1) was one of many manufactured by various companies (ATE, ETL, GEC and STC) in the UK, to GBW 20184 specifications. Its mechanism, with the exception of NP spring sets and Vertical Marking Bank Wipers, was essentially identical to a Group Selector mechanism.

For the Discriminating Selector Repeater or D.S.R. to function as intended, a Vertical Marking Bank, a Junction Hunter uniselector and two Discriminating Relays were required.

VERTICAL MARKING BANK

The Vertical Marking Bank (VMB), as shown in Fig. 2, consisted of two sets of 11 terminals. These included the home position and 10 others, with one for each level of the selector bank. The terminals were arranged vertically on each side of molded insulation. The VMB terminals were connected to U/Point Jacks, which were mounted on the top and back of the D.S.R.s Cradle. The VMB pivoting shaft was connected to an extension of a metal plate clamped between the base of the D.S.R. Cradle and the top of the D.S.R. Bank assembly.

The Vertical Marking Bank (VMB) Wipers were bridging wipers designed to complete an electrical circuit between a contact on one side of the VMB and a contact on the other side. The VMB was pivotable, allowing the VMB Wipers to be disengaged and the VMB to be swung out of the way before the D.S.R. was removed from its cradle.

As the VMB Wipers were free to rotate on the D.S.R. selector shaft, care had to be taken to ensure that the VMB Wipers were held clear of the selector bank when the D.S.R. was being returned to its Cradle.

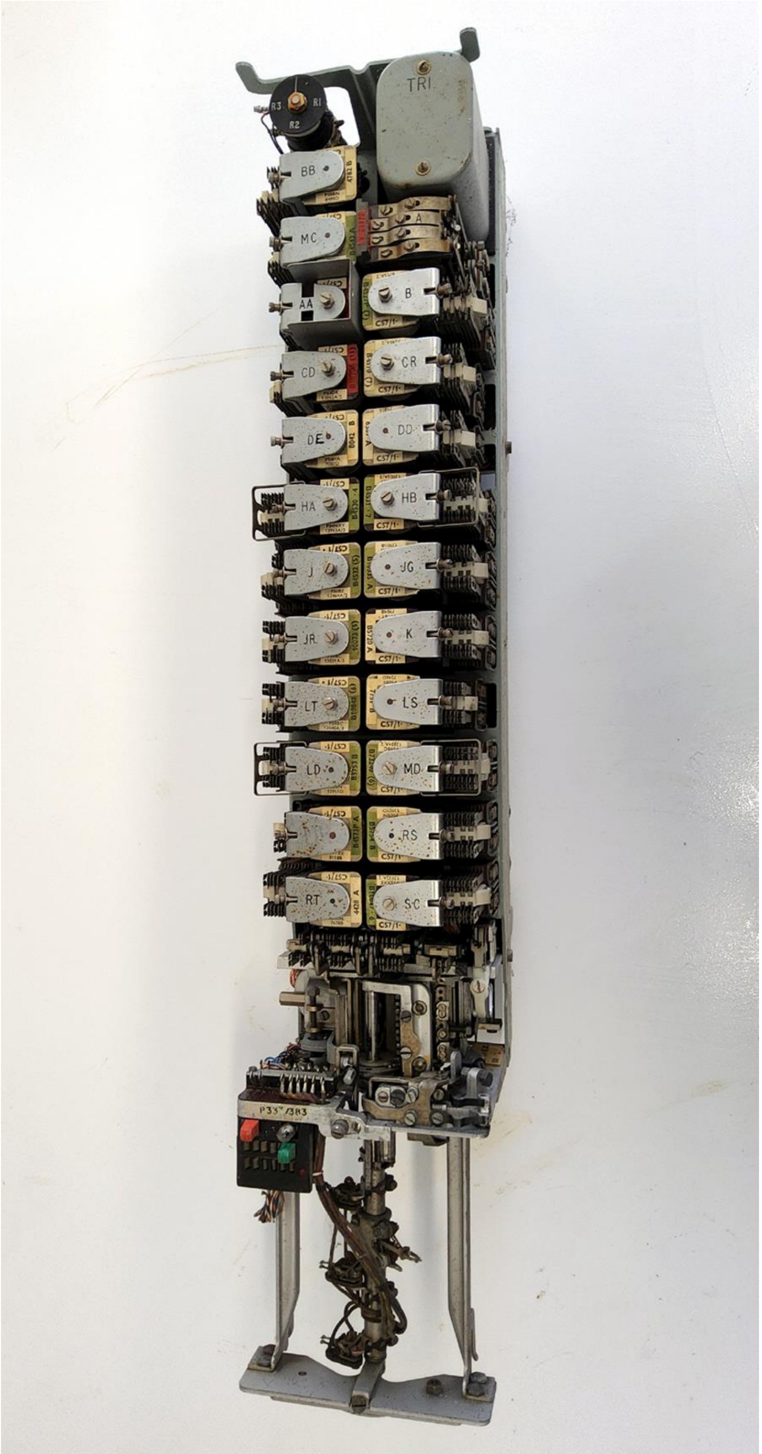


Fig. 1 – Discriminator Selector Repeater

JUNCTION HUNTER UNISELECTOR

The Junction Hunter uniselector had 10 banks with 25 outlets each. However, the uniselector wiper assembly was composed of 10 offset wipers (5 + 5), so only 5 wipers made contact with the outlets at a time. As a result, the uniselector had 50 outlets when the wiper assembly made one complete rotation (360 degrees).

For clarity, half the wipers were odd numbered, while the other half even numbered. Each of the uniselector’s 50 outlets was connected to an outgoing Junction to the Central Exchange.

DISCRIMINATING RELAYS

The contacts of 2 discriminating relays were wired to the corresponding D.S.R. Rack U/Points. The discriminating relays, located in a relay set on the bottom shelf of the D.S.R. Rack (refer to Fig. 3), were directly involved in the D.S.R.'s digit discrimination process. Each relay set contained the discriminating relays for 3 D.S.R.s.

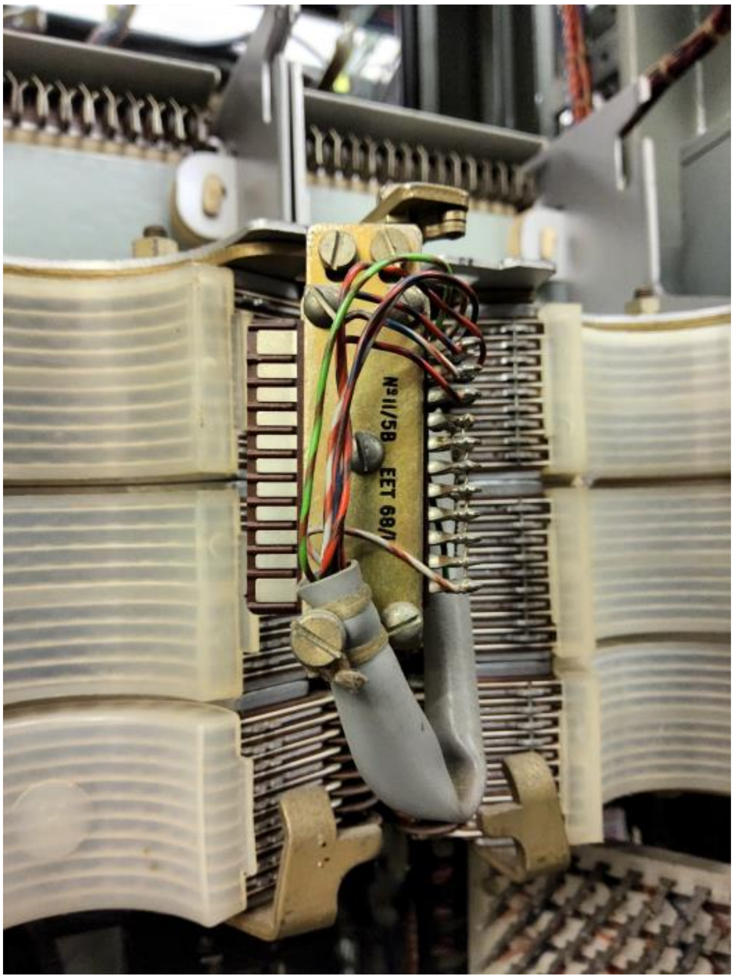


Fig. 2 – Vertical Marking Bank

SELECTOR 200 OUTLET BANKS

The Christchurch Satellite Exchanges were all equipped with 200 outlet Selectors, D.S.R.s, 3rd Group Sel's, 4th Group Sel's and Final Selectors.

In Fig 2, the vacant selector banks have plastic protective dust covers fitted, even so, three tiers are clearly visable. The top tier referred to as the HA + and - bank, the middle the HB +' and –' bank and the bottom the Private or P and P' bank for the HA and HB banks.

The lower U/Point Jacks are also clearly visable. The D.S.R. has two of these, the lower set and an upper set to accommadate all the circuit wiring connections.

ACRONYMS

Cent	Central Exchange
D.S.R.	Discriminating Selector Repeater
SAX	Satellite Automatic Exchange
Sel	Selector
SxS	Step by Step
VMB	Vertical Marking Bank

REVERSE DIAL

In 1913, New Zealand chose W.E. Rotary for their main switching system, however when the telephones arrived they were equipped with W.E. 7001 reverse dials, numbering 0, 1, 2, 3, 4, , , , , 9. For example, when 6 was dialled on a reverse dial, 4 impulses were generated, the complement of 10.

During the 1950s, about the time the W.E. Rotary began being replaced with 2000 type SxS switching equipment, a decision was made to retain the reverse dial. This decision resulted in reverse selector Level numbering on the SxS equipment. Dial 111 for Police, Fire or Ambulance.

D.S.R. RACK

The capacity of a D.S.R. rack, (Refer Fig. 3), was 30 D.S.R.s, 30 Junction Hunters and 30 pairs of Discriminating Relays in 10 relay sets on the bottom shelf.

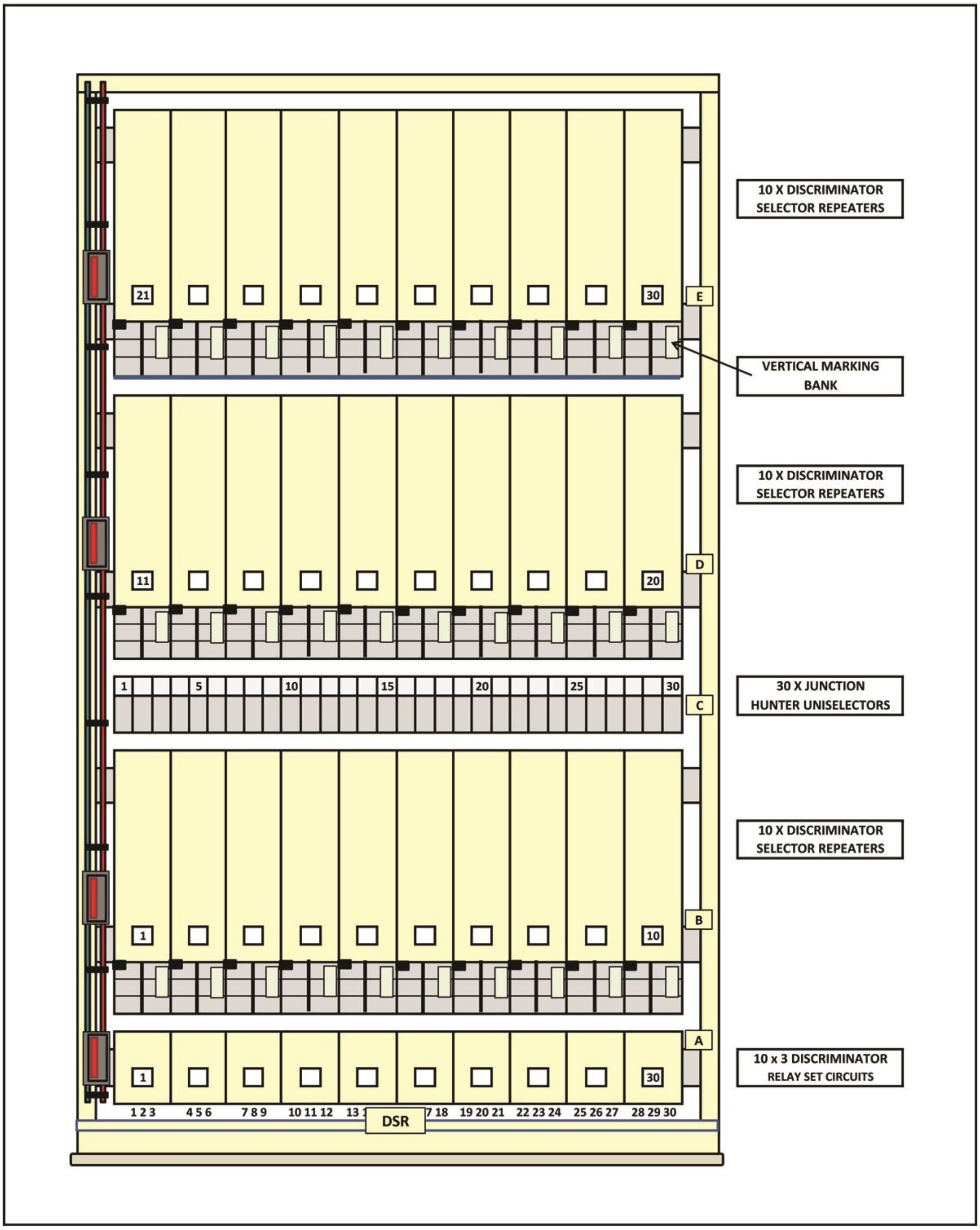


Fig. 3 – D.S.R. Rack

CHRISTCHURCH SAX NETWORK

To better explain the Christchurch Satellite Exchange Network, I have created four Sub-Networks, based upon the first digit of their telephone numbers and because there were several SAXs in each Sub Group I have provided their first two digits in parentheses.

(32 & 37) BKM - Beckenham and (38) HTN - Hilmorton;

(45 & 48) RIC - Riccarton, (49) ISL - Islington and (42) AVO - Avonhead;

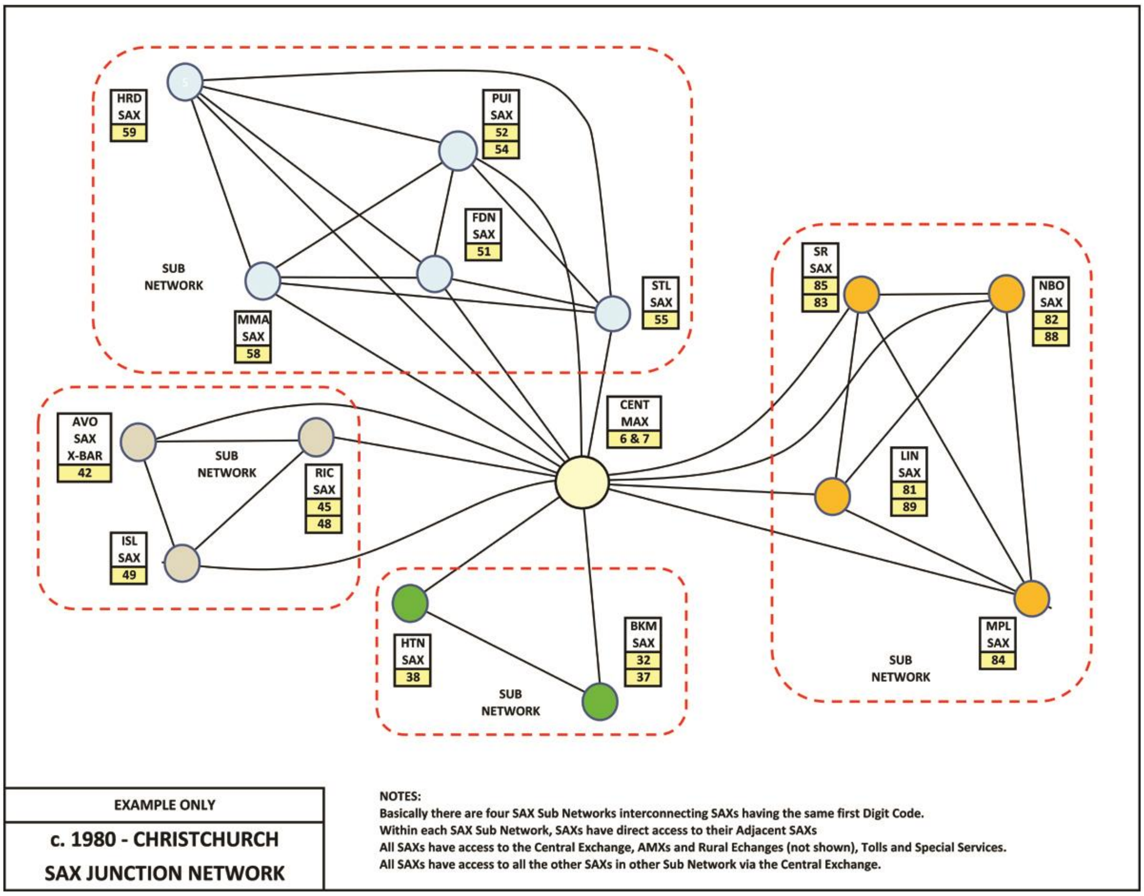
(51) FDN - Fendalton, (52 & 54) PUI - Papanui, (55) STL - St Albans, (68) MMA - Memorial Avenue and (59) HRD - Harewood;

(81 & 89) LIN - Linwood, (82 & 88) NBO - New Brighton, (84) MPL - Mount Pleasant and (83 & 85) SR - Shirley.

The acronyms preceding the name of the SAX are discrete within New Zealand.

The network map while not to scale, indicates the Satellite Exchanges approximate location when using the Central Exchange as a reference point.

Each SAX had junctions to all adjacent SAX and junctions to the Central Exchange. However they did not have junctions to DAXs in another Sub Network, access was via the Central Exchange.



CHRISTCHURCH FREE CALLING AREA

No.	Code	Exchange	Route	Comments
0		Tolls	Junction Hunter Call	
1		Special Services	Junction Hunter Call	
23xxxx	BEL	Belfast	Junction Hunter Call	
28xxxx	LYT	Lyttelton	Junction Hunter Call	
26xxxx	SUM	Sumner	Junction Hunter Call	
32xxxx	BKM	Beckenham	Junction Hunter Call	
37xxxx	BKM	Beckenham	Junction Hunter Call	
38xxxx	HTN	Hillmorton	Junction Hunter Call	
42xxxx	AVO	Avonhead	Adjacent Exchange Call	1st Digit Discrimination
45xxxx	RIC	Riccarton	Local Call	1st Digit Discrimination
48xxxx	RIC	Riccarton	Local Call	1st Digit Discrimination
49xxxx	ISL	Islington	Adjacent Exchange Call	1st Digit Discrimination
51xxxx	FDN	Fendalton	Junction Hunter Call	
52xxxx	PUI	Papanui	Junction Hunter Call	
54xxxx	PUI	Papanui	Junction Hunter Call	
55xxxx	STL	St Albans	Junction Hunter Call	
58xxxx	MMA	Memorial Avenue	Junction Hunter Call	
59xxxx	HRD	Harewood	Junction Hunter Call	
6xxxxx	CH3	Christchurch Central	First Digit Level Call	
7xxxxx	CH4	Christchurch Central	First Digit Level Call	
81xxxx	LIN	Linwood	Junction Hunter Call	
82xxxx	NBO	New Brighton	Junction Hunter Call	
83xxxx	BUR	Burwood	Junction Hunter Call	
84xxxx	MPL	Mount Pleasant	Junction Hunter Call	
85xxxx	SR	Shirley	Junction Hunter Call	
88xxxx	NBO	New Brighton	Junction Hunter Call	
89xxxx	LIN	Linwood	Junction Hunter Call	

COMMON ACTION WITH EVERY CALL

When a Satellite Exchange subscriber lifts the receiver to originate a call, a D.S.R. is seized and the associated Junction Hunter selects a Junction to the Central Exchange, where a 1st Group Selector is also seized.

Regardless of the first digit dialled the corresponding train of dial pulses step both the D.S.R. and 1st Group Selector in unison. The 1st Group Selector hunts for a free 2nd Group Selector.

LOCAL CALL – Levels 45 and 48 – (RIC) Riccarton SAX

As previously stated, when a Satellite Exchange subscriber lifts the receiver to originate a call, a D.S.R. and a 1st Group Selector in the Central Exchange are seized.

When '4' is dialled as the first digit the corresponding train of dial pulses cause both the D.S.R. and 1st Group Selector to step to Level 4. The 1st Group Selector hunts for a free 2nd Group Selector and the D.S.R. discriminates, its wipers in one continuous movement, cut-in on Level 4, step over all outlets, exit the bank, and return to normal. The D.S.R. is said to have "absorbed" this digit.

When either ‘5’ or ’8’ is dialled, the second train of dial pulses step the D.S.R., and at the Central Exchange the 2nd Group Selector in unison. At the SAX the D.S.R. cuts into the dialled Lev and seizes a free local 3rd Group Selector. (Refer Fig. 4)

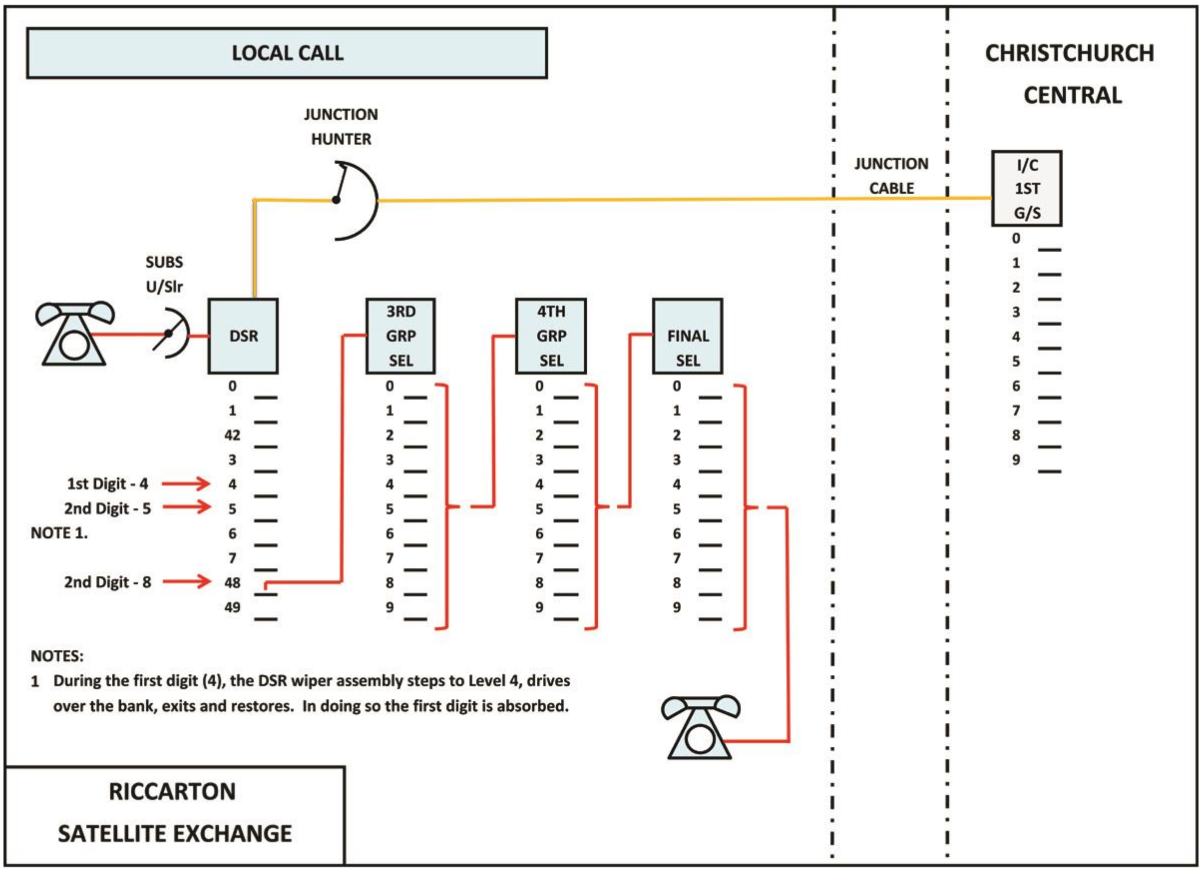


Fig. 4 – Local Call

Meanwhile the Junction Hunter, the Junction to the Central Exchange and the 1st and 2nd Group Selectors there, released and became available for other calls. Junction Guard Relays at the Satellite Exchange temporarily guard the Junction's 'P' wire, with a Positive (Earth) potential, to prevent another call from picking the Junction before the 1st and 2nd Group Selectors at the Central Exchange had fully released.

Two relays in the Discriminating Relay Set, strapping of D.S.R. U/Points (Jacks) and VMB, determined how the D.S.R. would respond to the 1st digit dialled. For example, when the digit '4' was dialled, a predetermined circuit was completed for D.S.R. 1st Digit Discrimination (1st Digit absorption).

D.S.R. 1st Digit Discrimination (1st Digit Absorption) meant that instead of there being the normal 5 selection stages, there was now only 4, (D.S.R., 3rd Group, 4th Group and Final Selector), the 2nd Group selection stage having been completely eliminated.

ADJACENT EXCHANGE CALL

Lev 42 – Avonhead SAX
Lev 49 – Islington SAX

As previously stated, when a Satellite Exchange subscriber lifts the receiver to originate a call, a D.S.R. and a 1st Group Selector at the Central Exchange are seized.

When '4' is dialled as the first digit the corresponding train of dial pulses cause both the D.S.R. in the SAX and 1st Group Selector in the Central Exchange to step in unison. The 1st Group Selector hunts for a free 2nd Group Selector. The D.S.R. discriminates, its wipers one continuous movement, cut-in

on the dialled Lev, step over all outlets, exit the bank, and return to normal. The D.S.R. is said to have "absorbed" the digit.
The second train of dial pulses step the D.S.R. and 2nd Group Selector at the Central Exchange, in unison. The D.S.R. wipers cut into the dialled Level, 2 for AVO or 9 for ISL and seizes a free 3rd Group Selector at the associated adjacent Satellite Exchange. (Refer Fig. 5)

The Junction Hunter, Junction and at the Central Exchange, the 1st and 2nd Group Selectors release and become available for other calls. Junction Guard relays at the Satellite Exchange, temporarily guard (with an Earth) the Junction's 'P' wire to prevent another call from picking the Junction before the 1st and 2nd Group Selectors at the Central Exchange have fully released.

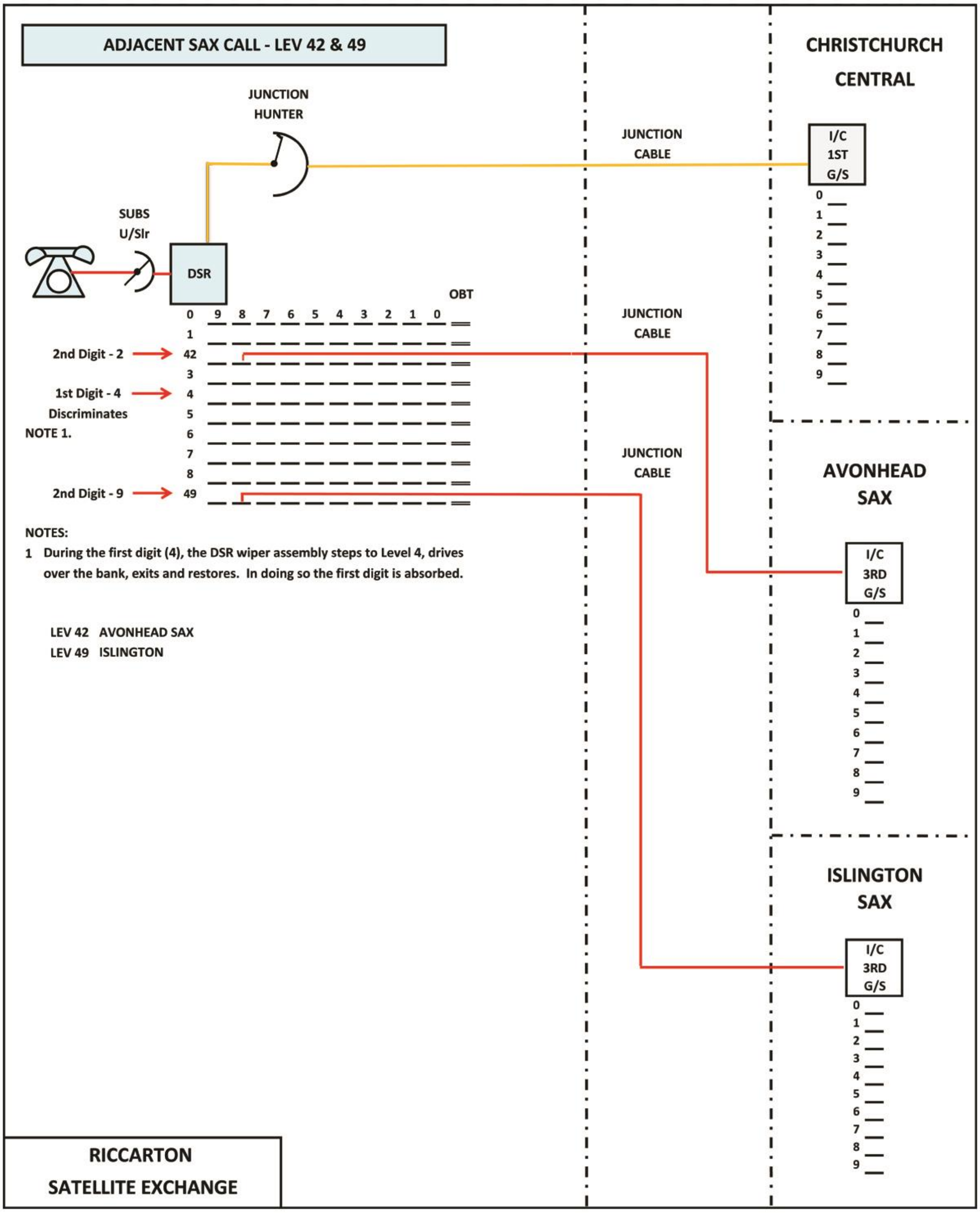


Fig. 5 – Adjacent Satellite (SAX) Call

1ST DIGIT LEVEL CALL

Lev 6 and 7 – Christchurch Central

As previously stated, when a Satellite Exchange subscriber lifts the receiver to originate a call, a D.S.R. in the SAX and an incoming 1st Group Selector in the Central Exchange are seized.

When an '6' or '7' is dialled as the first digit the corresponding train of dial pulses cause both the D.S.R. and the incoming 1st Group Selector to step vertically in unison. The D.S.R. wipers cut into the bank and hunt for a free outlet to a 2nd Group Selector at the Central Exchange. (Refer Fig. 6)

When a free outlet is found the Junction Hunter, junction and its associated incoming 1st and 2nd Group Selectors release and become available for other calls.

In the event that all the associated D.S.R. Level outlets are busy, Overflow Busy Tone is returned to the caller and an associated Lev Overflow meter registration is made.

When the Satellite Exchange's D.S.R. Level Overflow meters show excessive overflow registrations, a single cam can be installed on each D.S.R. NP Lever on the relevant Lev. Then, when a D.S.R. reaches the 11th step of the associated Lev, the cam operates the NP1 spring contacts. This prevents the Overflow Busy Tone from being returned to the caller and, through 'Overflow Routing', allows the call to proceed via the Junction Hunter and its 1st and 2nd Group Selectors in the Central Exchange.

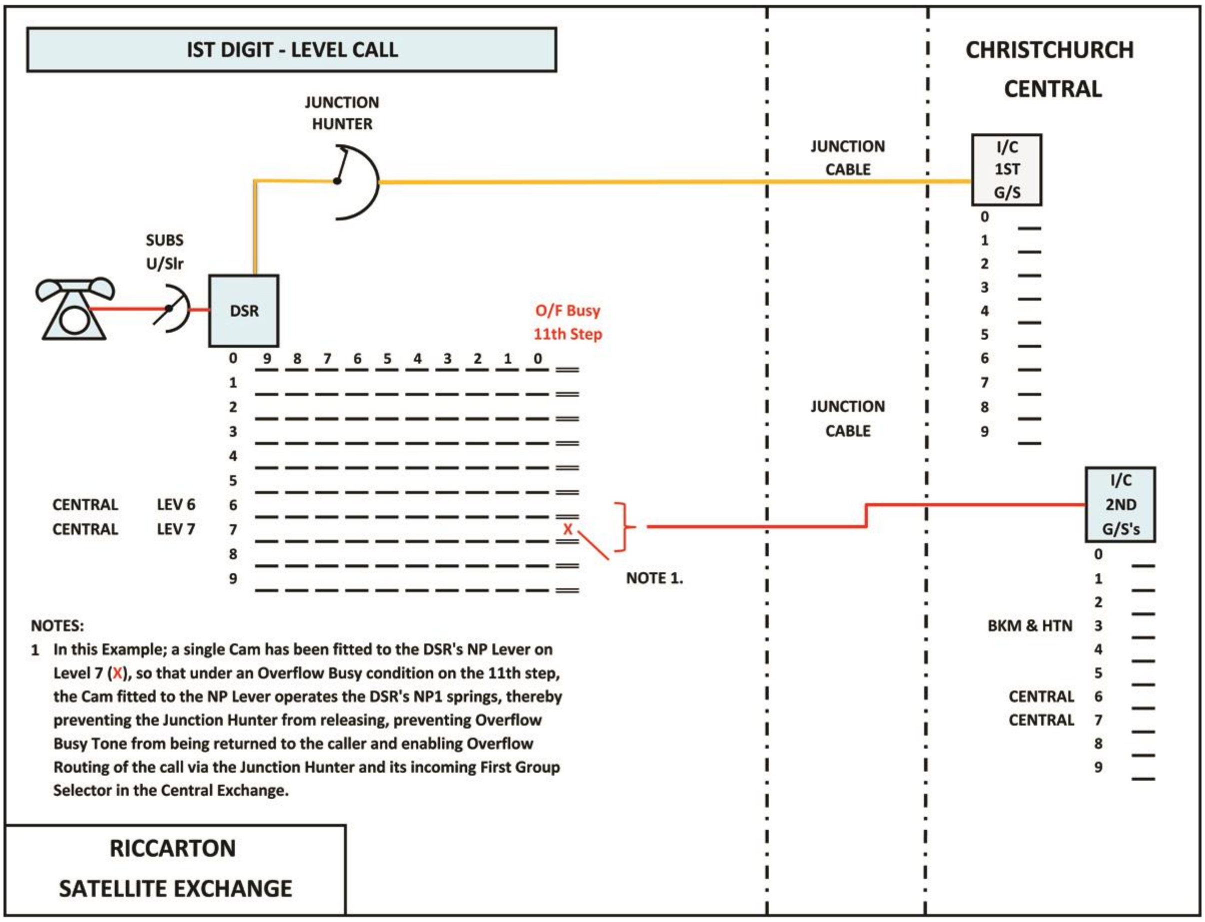


Fig. 6 – 1st Digit Level Call

JUNCTION HUNTER CALL

Lev 0 – Tolls
Lev 1 – Special Services
Lev 2 – Minor Exchanges,
Lev 3 – BKM Beckenham and HTN Hillmorton SAXs
Lev 5 – FDN Fendalton, PUI Papanui, STL St Albans, MMA Memorial Ave and HRD Harewood SAXs
Lev 8 – LIN Linwood, NBO New Brighton, BUR Burwood, MPL Mount Pleasant, SR Shirley SAXs

As previously stated, when a Satellite Exchange subscriber lifts the receiver to originate a call, a D.S.R. in the SAX and an incoming 1st Group Selector in the Central Exchange are seized.

When '2' or '3' is dialled as the first digit the corresponding train of dial pulses cause both the D.S.R. and the incoming 1st Group Selector to step vertically in unison. The 1st Group Selector hunts for a free 2nd Group Selector. The D.S.R. wipers however remain outside the bank** (the wipers do not enter the bank) allowing the call to proceed via the Junction Hunter. (Refer Fig. 7)

** Through a combination of predetermined D.S.R. 'U' Point and VMB strapping and the addition of two relays in the Discriminating Relay Set, and the Rotary stepping circuit was broken.

Because the 'U' Points and VMB were external to the D.S.R., it meant D.S.R.'s could be interchanged between SAXs and that they would function as normal, without strapping changes.

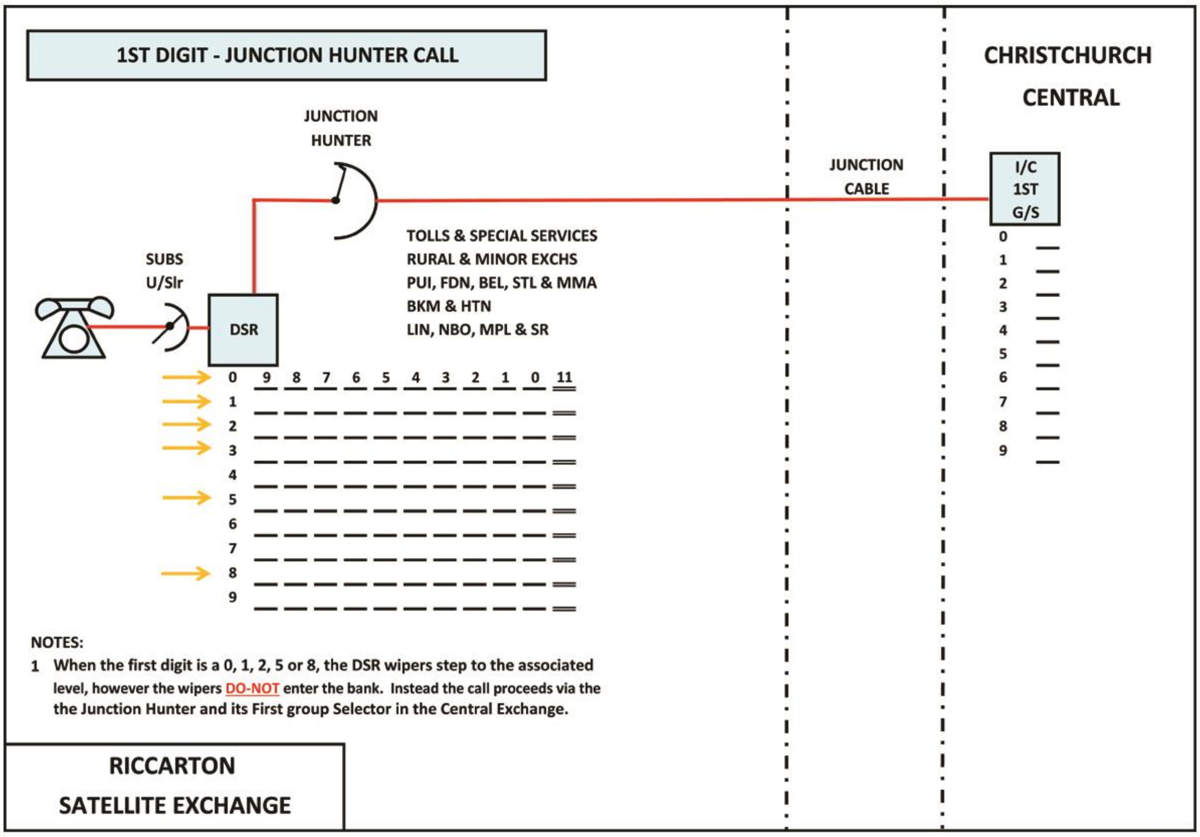


Fig. 7 – Junction Hunter Call

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