Converting a Working ARF 102 Exchange to ARE-11

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The first public working 10,000 line ARF 102 exchange converted to ARE 11 control in Australia was cut-over in June 1977. This paper describes data preparation and the date changes necessary at each level of control to convert Salisbury, near Adelaide, South Australia, to direct control of all switching stages. Readers are directed to previous articles by W. Close, vol 27/1 and C. Dougall, vol 27/2 for a system appreciation.

INTRODUCTION

The Salisbury Telephone Exchange was selected as a national field trial to evaluate the installation techniques associated with converting a working ARF 102 crossbar local exchange to ARE 11.

Salisbury exchange is located approximately 20 km north of Adelaide in the Outer Metropolitan area of the Adelaide Telephone District. It serves a mainly residential population and has an average growth rate of approximately 1000 lines per year.

The crossbar equipment was installed from 1965 onwards, and at the time of conversion, had 10,000 lines of ARF 102, m=6A, subscribers' equipment installed. All incoming junctions employed MFC signalling and, consequently, the conversion of incoming decadic junctions was not included in the trial. An in-dialling PABX of 8,000 lines, which provides service for the Department of Defence, Weapons Research Establishment, is trunked from the GIV stage and uses a separate 10,000 line code having a mixture of six and seven digit numbering.

Installation work on the ARE 11 equipment was carried out solely by Telecom Australia staff. This included rack erection, cabling, modifications to the existing ARF racks to permit operation in both the ARF 102 and ARE 11 modes, data preparation, testing and cutovers. The testing of the individual processors, devices and finally the overall system, required approximately six months to prove the procedures and documentation but this time should be reduced considerably in future installations using pre-tested equipment. Staff employed consisted of a Technical Officer in Charge (TOIC), Telecom Technical Officer Grade 1 and two Technicians. Only the TOIC had any ARE 11 background, having previously been involved with the installation of the Telecom Model ARE 11 Exchange in Melbourne.

Cutover commenced with the initial phase on the 27th of February 1977, with the final phase being completed on 3rd June 1977. All conversions took place in periods of light traffic, either on Sunday mornings or between 5 a.m. and 8 a.m. on a week day. A detailed account of the cutover phases is given in **Appendix 1.**

ARF EQUIPMENT MODIFICATIONS

Some items of ARF 102 equipment require modification to work in the ARE 11 mode. These modifications are designed such that the equipment will still work in the ARF 102 mode thus permitting them to be modified and tested in advance of cutover.

The equipment requiring modification is:

• SR	required	for	level	1	control
• SLM/S	"	"	"	1	"
• GVM	"	"	"	3	"
• GIVM	"	"	"	4	"
• SLC/D	"	"	"	4	"
• PBX 'C' Wires	"	"	"	4	"

The SLM modification was carried out on working equipment and was assisted by previously ensuring that the adjacent rack was spare or could have the relay sets removed without affecting service. Each SLM modification was tested, in the direct control mode, in a light traffic period using the MTE (Marker Test Equipment).

Each GVM was also removed from service in turn, in a light traffic period, modified and tested for direct control operation with the MTE. Normal ARF test instructions were used to ensure that the ARF functions were satisfied for both SLM/S and GVM.

All the 'C' wires, from the SLA/B racks, had to be wired out to a new PBX, 'C' wire, IDF and a single wire jumper used to connect the required 'C' wire to the cabling of the PBXC equipment. Apart from wire testing, no functional testing of the PBX 'C' wires could be performed until the SLA/B's were converted to direct control.

DATA PREPARATION — CENTRAL STORE

Data for the Central Stores, that is the Translation Store (TRS) and the Subscribers' Category store (SCS), was prepared by office based staff. This work requires a sound network knowledge and a reasonable understanding of the ARE 11 system.

A series of proformae was developed by Telephone Switching Construction Branch HQ, to assist with the gathering and formatting of data for the TRS and a further set for SCS data collection. These proformae were found to be very useful during the installation to give the installers an appreciation of the meaning of particular data words and the analysis required. During the cutover phases, when editing of the data was necessary, they were indispensable.

From the data compiled on the proformae, a TRS loading tape for Salisbury was produced by the National Support Centre staff using an assembler programme on an IBM 370 computer. The TRS tape was required early in the testing phase to test the addressing functions of the store and, as its production took several months, a modified version of the Telecom ARE 11 model exchange tape was used in lieu for the initial testing. Approximately 3-4 months were required to establish all the 'B' number analysis data, but this time would be reduced for subsequent exchanges in the same local network as the codes used would be common to all exchanges.

The data for the SCS is subject to daily change due to the variations of subscribers' requirements, and should not be prepared until the latter stages of testing. At Salisbury, a modified version of the Model Exchange tape was also used for SCS store address testing.

TRANSLATION STORE (TRS)

This store is made up of 4K, 9-bit ferrite core modules, as required, up to a maximum size of 16K. The store is duplicated, for security reasons, with one store being 'executive' and the other on 'standby' to take over in case of executive store failure.

The TRS is divided up into 64 'Base Areas' which contain data tables used in the setting up of a call (TRAFFIC DATA) or for defining the configuration of the ARE 11 equipment (REFRESH DATA). Data defining the location of each Base Area, in TRS, is contained in the first area called the BASE ADDRESS AREA. To obtain the actual start word address of a Base Area, the data word in the BASE ADDRESS AREA is modified with the appropriate store size multiplication factor. The multiplication factor for a TRS store size of 4K, 8K and 16K is X16, X32 and X64 respectively.

Traffic Data

Data tables such as BNRAN ('B' NumbeR ANalysis), DESTDATA (DESTination DATA), ESDATA (End of Selection DATA) and ROUTECODE (route data), are used in the analysis of dialled digits to determine TOTE (Type Of Terminating Equipment) and routing information. All the network codes, including barred and unallotted codes, must be specified to obtain analysis tables for all possible codes.

Digit and routing analysis can be performed in two distinct areas; BNRAN 1, DESTDATA 1, or BNRAN 2, DESTDATA 2. At Salisbury, the required codes were split into two groups so that approximately one half were contained in each of the separate areas. If analysis starts in the first area, it is possible to point out (that is; provide the address of the next data table to be used) a DESTDATA table, CALLTYPE 3, which allows for further analysis, and the second area can be specified for this analysis. Local calls must use the DESTDATA 1 area because of the continued digit analysis required to define the thousand group route, a feature which permits PBX numbers to be allocated throughout the 10,000 line group.

Once the codes for each area have been decided, the DESTDATA tables can be specified against a particular code and the pertinent barring categories (AO value). The DESTDATA tables are numbered in sequence, TDA001 being the first DESTDATA table in the first area and TDB001 the first DESTDATA table in the second area. The first DESTDATA table, in each area, is used to point out the local NUT route.

the DESTDATA table, the following is specified:

- Call type.
- Requirement for further analysis for local codes.
- Further analysis to define the 'B' number length for mixed length codes.
- Type of call — DESTDATA (DESTination DATA).
- GV call point — STARTLOC (START LOCation).
- 'B' NumbeR Length — BNRL.
- Send method, MFC, decadic or both at different stages.
- Address of tables for further 'B' number length or GV analysis.
- Table address of the route of the GUV (STARTROUTE).
- Table address of the route of the GIV (SECROUTE).

The STARTROUTE and SECROUTE words are defined in the DESTDATA table but are not used, for determining routing, until the corresponding GV stage is converted to direct control (at levels 3 and 4), when the routing analysis function is removed from the GV markers.

The DESTDATA information is read by the TRAFFIC CONTROL PROCESSOR (TCP) and an image of the data is stored in its REA (REgister Area) page of the DAS (DAta Store). It is then available readily for the TCP, without further bus connection, to process the set up of the call.

At Salisbury, it was found necessary to specify a SEANADR table (SEnd ANalysis ADdRess) rather than a SENDDATAADR table (SEND DATA ADdRess) as a number of MFC destinations had decadic in-dialling PABX's connected, and these are not catered for if a SENDDATAADR MFC table is used.

For a normal call, digit and routing analysis proceeds from the AO (barring category) value of the subscriber to analysis of the dialled digits in BNRAN to DESTDATA. From DESTDATA, the start route word points out a ROUTEADR (ROUTE ADdRess) table. Specified in this table are, all the available routes for the dialled code, the address of the ROUTECODE table, further alternatives (if available) and the first digit of the 'B' subscriber's number to be sent to line in each case. The ROUTECODE tables pointed out contain data specifying the send method required on the route (either MFC or direct control), and the W, R and CR relays required to switch to the selected route.

Interpretation of TRS Printout

Two outputs are available from the application of the Assembler Programme to the TRS data; the TRS loading tape as described earlier and a TRS printout which describes the data loaded into TRS in a legible form. An explanation of a TRS printout containing the TRS word addresses, Base Areas and data information is shown in **Appendix 2.**

Refresh Data

This data defines the configuration of the ARE 11 equipment and is used as permanent data to refresh the TCP and OMP data stores (DAS). 'Refreshing' is executed, by programme RTS, at regular intervals and after any processor disturbance, to ensure the data stores contain correct information. During installation, a fuse alarm can be used to trigger a 'Refresh'. The Random Access Memories (RAM) in the processor data stores are then reloaded with the permanent data stored in TRS.

The Refresh Data contains information concerning all the racks that are in use and how many devices of each type are installed on the racks. This involves data detailing the rack address, called Device Group Address (DGA), and DEvice Address (DEA) so that the processors can access the devices via the MUltipleXors (MUX). Time supervision, disturbance counter values and alarm conditions for the devices are also specified in this area.

When allocating STU's for TCP O, their position in the rack must be considered. The STU's need to be in a continuous group and situated either at the start of a rack or in the end positions. The range of addresses for the STU's controlled is defined by the minimum and maximum DEA values, together with the row inhibit data (ROWINH). A split range is not acceptable as the processors can only define a start and stop address. This must be considered when setting the ROWINH bits to define which groups of five STU's are controlled by TCP O and any other TCP which has access to the same STU rack.

At Salisbury, the DGA for the first STU rack was set to 02 instead of 00. If the first available DGA, for STU's, 00, is used it can cause confusion as all spare data words are written as 00. Hence specifying 02, DGA, makes it unique and limits mistakes when reading data printouts.

The refresh data prepared for Salisbury initially specified additional equipment required for a later extension and this caused a problem. These words had to be written out of TRS as they caused BCU (Bus Control Unit) alarms when the MUX routine tests were performed by the processors.

SUBSCRIBERS' CATEGORY STORE (SCS)

This store also consists of 4K, 9-bit ferrite modules and a discrete SCS is required for each 10,000 line group.

The store is divided into three parts. In part one a hexadecimal character (O-F) is entered for each installed line in the 10,000 group. This hexadecimal character, (the CO value), is used to address the Translation Table (second part of the store) to read out the subscribers' category parameters, B1, BO, A3, A2, A1 and AO. The most common subscribers' categories are obtained in this manner and constitute approximately 90% of subscribers. Other unusual categories require a list search, in the third part of the store to obtain the required category.

An initial list of all the subscribers connected, with their corresponding categories, was obtained from Customer Services Department and used for comparison with the exchange records. All variations were examined and when the list had been updated, with the current information, it was used to prepare the SCS proformae. The exchange service staff maintained a record of all subsequent subscriber variations from that date and, after the SCS input paper tape had been prepared and loaded, all the changes recorded by the service staff were loaded manually via a teleprinter.

It was found that two 4K modules of ferrite store in both SCS A and SCS B provided sufficient capacity to cater for 10,000 subscribers in this exchange. Because of the large number of applications for International Subscriber Dialling (ISD), it was necessary to make this category one of the more common and to change it from a list search. (A list search was wasteful in terms of store usage and required a longer time to obtain a result).

CONCLUSIONS

A national field trial to evaluate the feasibility of converting a working 10,000 line, ARF 102 Crossbar, local exchange to ARE 11 was successfully completed at Salisbury, South Australia.

The trial provided experience on the proposed installation techniques, testing procedures, modifications to working ARF 102 equipment and the network implications of the various levels of control. The discrepancies found in the documentation during installation were fully investigated and procedures revised which will benefit future installations.

A sound knowledge of the network is necessary to prepare the data for the Central Stores, and this work should be commenced early in the installation period. Network changes due to other exchange variations necessitate a continual review of the prepared data which must be edited as the changes occur.

Conversions of the various switching stages are easily controlled by converting each unit of a particular switching stage separately. Converting in this manner restricts faults to with a definable area and minimizes subscriber disturbances.

FURTHER READING.

1. CLOSE, W.; "ARE 11 System Appreciation," Telecommunication Journal of Australia, Vol. 27, No. 1, 1977.
2. DOUGALL, C. J.; "Elsternwick ARE 11 Exchange," Telecommunication Journal of Australia, Vol. 27, No. 2, 1977.

APPENDIX I — DETAILS OF CUTOVER STAGES

Cutovers were arranged to occur in six distinct phases.

- Phase 1 — conversion of outgoing register functions.
- Phase 2 — direct control of GUV stage.
- Phase 3 — conversion of incoming junctions.
- Phase 4 — direct control of GIV stage.
- Phase 5 — direct control of SL stage.
- Phase 6 — conversion of local FIR-P and FDC access relay sets.

This arrangement allowed the conversion of discrete switching functions to be carried out, fully tested and the effect on the overall system carefully evaluated before proceeding to the next phase. It was thus possible to revert to the preceding phase if any particular stage of conversion presented extreme problems. This condition did not eventuate and the complete conversion progressed from one phase to the next as planned. However, the ability to revert to a preceding phase was checked in each phase to confirm the validity of the concept.

Pre cutover

After the ARE 11 racks and devices had been functionally tested and the TCP 'group tests' performed, the direct control functions of each switching stage were tested to prove procedures and traffic handling data. This was achieved by converting, in sequence, one GUVM, one GIVM and a 1000 line group, not carrying traffic, to direct control in periods of light traffic. The tests allowed all the new type marker relay sets to be functionally tested in their appropriate rack positions, and the software network analysis function to be tested into the actual network using the ARE 11 Automatic Exchange Tester.

During functional testing the RSL's were double jumpered, on the IDF, to both the REG-LM's and STU-L's. The STU-L's were left unplugged at the jackfield until the REG-LM, part 2, relay sets were unjacked at Phase 1 of cutover. This was necessary to prevent voltages from the REG-LM's damaging printed circuit board components in the STU-L's.

As the TRS data had been prepared on the basis of the final condition of full direct control of all switching stages, this data required 'editing' for each cutover phase. The technique adopted here was to edit data in the 'stand-by' store and changing it to 'executive' for the cutover. Subject to satisfactory operation, the other store was then edited and returned to the 'executive' state. Prior to Phase 1, it was possible to edit both stores, TRS A and TRS B, as they had no effect on switching at that stage. Temporary analysis tables for Phase 5 cutover were also established, in the TRS, so that each 1000 line group could be converted to direct control one at a time. This restricted the planned outages to a single 1000 line group and limited fault conditions to that group.

At this stage the CD-KME's and GV-KME's were not used and were left unplugged at the jackfield. As these KME's had been specified in data as being available, numerous alarms occurred and it was necessary to 'write-out' the KME's, in the OMPDATA area of TRS, to clear the alarms. Subsequently, as each switching stage was converted the appropriate KME's were 'written-back' into the store and the cables plugged into the jackfield.

Phase 1 — Outgoing Register Functions

At the end of this phase the TCP's processed the outgoing traffic and obtained the 'A' subscribers number, via IDS (Identifier Data Sequencer) and the subscriber's category from SCS. Incoming calls to the SLC/D were handled in MFC signalling and the 'B' subscriber's category obtained from the ARF KAN. A 4 a.m. start on a Sunday was selected as the most suitable time for Phase 1 conversion because of traffic considerations.

Data Changes. As previously mentioned, the TRS data was prepared on the basis of full direct control and in this Phase normal signalling between switching stages was required and the following data changes were necessary:

- DESTDATA — CONKS (CONnect KS), in each DESTDATA table, word 01 half character '1' (HI) was changed to a value of 2 to connect an MFC type KS.
- OMDATA — SRSENDMETHOD, refresh data, word 36 character 'O' (CO) was changed to a value of 2 to indicate MFC control of the GUV.

Cutover Procedure. One half of the SR's in each 1000 group were busied and the associated RSM-L's were modified with the required strapping changes. Then one half of the GUVM's were blocked and the KMR strapping blocks replaced to introduce '3A' series signalling. The REG-LM's, part 2, were unjacked and the STU-L cables plugged in at the jackfield. The busied SR's and GUVM's were unblocked and the other half blocked in readiness for conversion. At this stage, traffic was using the STUL's and TCP's to control setting up of calls, and after satisfactory testing, the remaining racks were converted. Comprehensive testing of the outgoing traffic functions proceeded in accordance with the cutover document.

Faults

- IDS failure to identify calls due to:
  — faulty 'g & f' wires (call and acknowledge) in most 1000 groups. It is essential to thoroughly pretest all the 'g and f' wire paths to ensure continuity and to detect transpositions before cutovers commence.
  — incorrect strapping of RSM-L's in the 1000 line groups with two SLM's.
  — earth from KAN being applied to several DCI hundreds leads for subscribers with the same service classification and tens and units digit. Blocking diodes were inserted in all hundreds leads in the KAN.
  — errors in existing grading affecting 'g and f' wires. Because of these fault conditions, subscriber identification could not be completed and the call progressed as category unknown and, as the dial type was unknown, KMK 'dial' tone was sent to the subscriber. To minimize disturbance to the subscriber, resulting from this strange tone, the time supervision, of the KMK 'dial' tone, was reduced (by software changes in TRS) to one second while the faults existed.
- Subscribers' dialling habits — time supervision, before the first dialled digit and between digits, reduced to 10 seconds in ARE 11. Subscribers previously were allowed 45 seconds and their slow dialling habits caused the DPR (Dial Pulse Reception) programme to time out.
- Unallotted network codes were to have been directed to a NUT route off the GIV stage. This function was inoperative until all the GV stages were converted to direct control and to overcome the problem the first DESTDATA table was changed to a Call type 2 (reroute) and these codes were re-routed to a local PBX number connected to NUT.
- Indialling, step-by-step, PABXs in the network caused a problem as the SEND-DATA for many codes specified MFC only. This was overcome by specifying SEANADR (send analysis address) table for all codes thus allowing MFC and decadic signalling to be used as required.
- Some network codes had changed from step-by-step to crossbar after data compilation in the office, and stores had not been updated.
- Outgoing relay sets at the Weapons Research Establishment PABX could not accept a fleeting test reversal. The SCS data for these incoming lines was changed to inhibit the fleeting test reversal.

Phase 2 — Direct Control of GUV

In this phase, the GUV was converted to direct control. At Salisbury, the five GUV marker groups were converted one at a time in a light traffic period. One GUVM was blocked, the ARF relay sets removed, and the strapping blocks in jack positions 66 and 65 inserted to complete wiring for the new KMR relay set which was inserted. This marker was then unblocked and all others blocked so that the entire traffic was being carried by the one converted marker. After satisfactory testing of all the routes, by dialling codes which used all the ROUTECODE tables, the other markers were converted and tested in a similar manner.

Data Changes

- DESTDATA — CONKS, as the GUV is direct controlled no MFC KS is required. Change all DESTDATA tables, word 01/H1 value, to '1' meaning no KS is to be connected before the GV marker is called.
- OMDATA — SRSENDMETHOD, refresh data word

36/CO changed to '4' to indicate direct control of GUV.

- ROUTECODE DATA — SENDMETHOD, for every GUV to SLD route and the GUV to GIV route, change word 00/CO in their ROUTECODE tables to '2' to indicate MFC signalling on these routes.
- OMPDATA — The required GUV KME's were 'written back' into this area of TRS.

After the data changes were made and the 'stand-by' TRS made 'executive', a 'refresh' of the TCP's was necessary. This ensured that the data changes were loaded into the TCP data stores.

Converting one GUV marker group at a time proved to be a most satisfactory and easily controlled method. The only problem that existed in this phase was again concerned with the unallocated codes.

The RRDATA (Re-Route DATA) table established to process the unallotted codes in Phase 1 pointed out the local DESTDATA table which requires further digit analysis in GVAN (GV ANalysis) table to determine the route to the appropriate 1000 line group SLD. With a re-route condition, no further digits are available for analysis, hence the STARTROUTE word for the route could not be determined. A new DESTDATA table, pointed out from RRDATA, was established in which the GUV-GIV route was specified directly as the START-ROUTE word. The RRNR (Re-Route NumbeR), previously specified, was changed to a code that caused the GIV to switch to the NUT route.

Phase 3 — Introduction of RAR's

In this phase of cutover the RAR's (Register Access Relay set) and the STU-I's (Signal Translation Unit — Incoming) were introduced one at a time. The RAR's were connected between the incoming MFC junction FIR's and the GIV inlet to provide access, through an RSI introduced for ARE 11 working, to the STU-I.

The first digit was received by the STU-I and analysed in the RECAN (RECeption ANalysis) table to point out a 'transit call' RECDATA (RECeption DATA) table and a 'rejection' DESTDATA (call type 1) table. The DEST-DATA table contains the data word SROCASE (SR Operate CASE) and ORDATA yields ORCLASS (ORigin CLASSification); these two words determine the end of selection analysis tables. The ESDATA (End of Selection DATA) table, pointed out from the above analysis, ensures that the RAR will be through connected, without a MFC 'B' signal sent to line. This ensures that the first digit is received by the MFC controlled GIV-KMR.

Previous to this phase of cutover all the RAR marking leads were strapped to provide MOOFIR (MOde of Operation FIR), which addresses a word in the ORAN (ANalysis of ORigin marks) table to define the type of incoming junction. This preparatory work was carried out during Phase 1 acceptance testing and arranged as a separate project to strap all RAR's instead of individual changes as each junction was connected.

The incoming junctions of each junction group were converted one at a time and tested, using an ARF AET connected to the FIR, calling all local codes. When the junctions of one group were completed, TRT runs were carried out from remote locations. Work on this conversion commenced at 6 a.m. each day so that more than one junction could be taken out of service and converted during light traffic periods. This increased the number of junctions converted each day with approximately 13 days being required to convert 300

Data Changes

- RECAN — incoming digit analysis was changed to point out new incoming 'transit call' RECDATA and DESTDATA tables, so that rejection occurs after analysis of one digit, causing the RAR to through switch to the GIV inlet.
- Establish the new incoming RECDATA table with the following data words.

  BANW: = Result address to the new incoming DEST-DATA table.

  ANLOC: = O, indicates, in zero numbering the next digit to be analysed (in this case the first digit).

  RECASE: = 4, to indicate a transit call and hence reception analysis completed.
- Establish the new incoming DESTDATA table with the following data words.

  CALLTYPE: = 1 (rejection case)

  SROCASE: = 6 (idle charging) used to address ESANO table, together with ORCLASS value of 2, to obtain address of ESDATA table required for end of selection information.

  BNRL: = O, one digit before rejection.
- ORAN — change ORDATAADR word for the FIR-P, to point to the MFC ORDATA table, because REG-IP connected and signals in MFC to the STU-I.
- ORDATA — SENDMETHOD-I, change to 2 as the converted FIR's are connected to a MFC controlled GIV.
- ESANO — for ORCLASS: = 2 and SROCASE: = 6 set data to point out ESDATA table number 28; RAR(MFC) to local (MFC).

The data changes were made in both TRS's prior to the commencement of this conversion as the data is not used until junctions are converted.

Phase 4 — Direct Control of GIV

Following conversion of the incoming junctions to access the STU-I's, it was possible to change the GIV stage to direct control. As in Phase 2, each GIV marker group was converted, one at a time, by blocking out one GIVM, replacing the KMR relay set, plugging in the cables to the associated KME's and indicating their availability in OMPDATA area of TRS. Once the required data changes, listed below, were made in TRS, and the TCP data stores 'refreshed', the converted marker group was unblocked and all the other marker groups blocked so that only one marker group carried the traffic. The functions of the converted marker group were then tested by making test calls from an FIR to each 1000 line group code, and by making local calls with the direct GUV-SLD routes blocked to prove the direct controlled GUV-GIV overflow route.

After satisfactory testing, the other marker groups were converted in turn with only one marker group in traffic at any one time until all marker groups were completed. With direct control of the GIV, the first two digits are received by the STU-I and analysed in RECAN. From the resultant DESTDATA table, addressed by RECAN analysis, the SECROUTE word is used to determine the route relays required by the GIV-KMR for switching. As the SL stage is still MFC controlled, a revertive is required after the first two digits so that the last three digits are received by the CD-KMR in MFC. The required revertive must be specified in ROUTECODE data for each

No faults were found in the equipment or data during this conversion. However, some exchanges in the network were sending the 'C' digit on the direct routes and as RECAN tables were designed to analyse only the 'D' and subsequent digits these calls failed. This resulted from the retention of dual code strapping, in terminal exchanges, introduced to facilitate the conversion of the Adelaide network to 7 digit working in 1973. Highlighted is the need to ensure that such redundancy is removed at the earliest possible time to avoid later problems when other seemingly unrelated changes to the network are being made.

Data Changes

- RECAN — changed to **two** digit analysis to point out the new incoming 'transit call' RECDATA table.
- In 'transit call' RECDATA table established in Phase 3 change data words.

  ANLOC: = 1, with zero numbering means that 2 digits are to be analysed.

  STARTLOC I: = 8 (STARTLOC value in DESTDATA table to be reduced by 3).
- Change new incoming DESTDATA table to

  CALLTYPE: = 0, meaning normal call and contains routing information for incoming calls.

  CATAN: = O, meaning no 'B' category available from the SCS in this phase.

  All other data words to be the same as the normal incoming local DESTDATA table.
- ORDATA — SENDMETHOD-I, set to 5 as the FIR's are now connected to a direct controlled GIV.
- ROUTECODE — GUV-GIV route, SENDMETHOD: = 5 for direct control of GIV.

  — GIV-SLD routes, SENDMETHOD: = 2 for MFC control, and ROUTETYPE: = A to send an AI revertive.
- ESANO — restore, for ORCLASS: = 2 and SROCASE: = 6, comparison, resultant to normal data value.

Phase 5 — Direct Control of SL

This Phase was carried out on one 1000 line group at a time and the associated GUV and GIV routes to the SLD were changed, in TRS, from MFC to direct control as the 1000 line group was converted. To facilitate this approach the temporary analysis tables, as shown in **Fig. 1,** were established prior to Phase 1. This arrangement made the conversions easier to control, by restricting faults to within the 1000 line group and associated devices, and reduced the disturbance of service to a minimum.

One SLC/D rack was busied, and straps changed, the SM, KMR, KMT relay sets removed and the new ARE 11 KMR installed. The CD-KME plugs were inserted into the jackfield and the KME data 'written-in' the OMPDATA area of TRS. The SLC/D changes were carried out, before the SLM changes, so that the 1000 line group remained operative with traffic being handled by the remaining SLC/D rack(s). Preparing one SLC/D rack first allowed the 1000 line group to be converted to direct control immediately after the SLM rack(s) were converted.

The SLM was busied, straps changed, a new SLMS-K relay set installed, the existing 'C' wire cables from the SLA/B's removed and cables to the PBX 'C' wire IDF inserted in the same plug positions. During this time, outgoing calls could still be made, with reduced facilities, but incoming calls were not possible. Urgent incoming calls were diverted to an interception route, established off the GIV, by changing the SECROUTE word to address this temporary route. It was thus possible for the exchange staff to be informed of any urgent call so that the subscriber could be contacted if necessary.

The second SLC/D was then changed and the overall functions tested. Also at this time the PBX subscribers were tested by calls to each PBX directory number, within the 1000 group, to prove that each auxiliary line was seized, in the correct sequence, by blocking out each line in turn after seizure. This aspect of the cutover was very time consuming particularly in 1000 line groups with a high concentration of PBX numbers.

Data Changes — Refer to Fig. 1

- RECAN — change result of 'E' digit analysis, for particular 1000 line group being converted, to address normal RECDATA table.
- ROUTECODE — SENDMETHOD, was changed to 'C' for each, GUV-SL and GIV-SL, route associated with the 1000 line group being converted to direct control.
- BNRAN 1 — change result of 'E' digit analysis to address 'Continue Analysis' DESTDATA table.

Before all the 1000 line groups are converted the 'E' digit is used to determine the address of the 'continued analysis' DESTDATA table and is also required for analysis in GVAN table, for route selection, and the 'continued analysis' DESTDATA table is used to indicate that analysis is to re-commence at the 'D' digit (i.e. ANLOC = 2). This digit is analysed in BNRAN 1 to address the normal local DESTDATA table which contains the address to GVAN and indicates that B category information is now obtained from the SCS (i.e. CATAN = 1). All other, non converted, 1000 line groups have 'B' category determined in the KAN relay set.

- ROUTE LIST — SECROUTE word of 1000 line group being converted changed to point out Interception route temporarily.

Faults. The major number of the faults, found in this phase of cutover, were associated with the PBX equipment as this was the first opportunity to test this facility. Faulty printed circuit cards were found in the PBXE shelves and incorrect springset adjustments in the PBXC shelves. A software programme fault caused the PBX line test words to be set, blocking out the auxiliary lines, and has since been rectified.

A number of DIC printed circuit cards were found to be faulty, after each 1000 line group conversion, with a burnt out diode setting the tens digit word in the REA page to 'F'. The possible cause was commoning of tags, during soldering, when the SLM/S straps were being changed as insulating the adjacent tags during the latter 1000 line group conversions eliminated the problem.

Phase 6 — FIR-P Access

Until this Phase, the FIR-P circuits were connected to a REG-IP and so appeared as MFC junctions to the processor system. They accessed STU-I's via RAR relay sets strapped to address the same ORDATA information as all other MFC junctions.

In this Phase, after all the 1000 line groups were converted, the data in the ORAN table was changed to address the FIR-P, ORDATA table. The straps in the FIR-P were changed to suit the ARE 11 mode and the FIR-P connected to an RSI inlet to permit access to STU-I's. The RAR and REG-IP relay sets were then

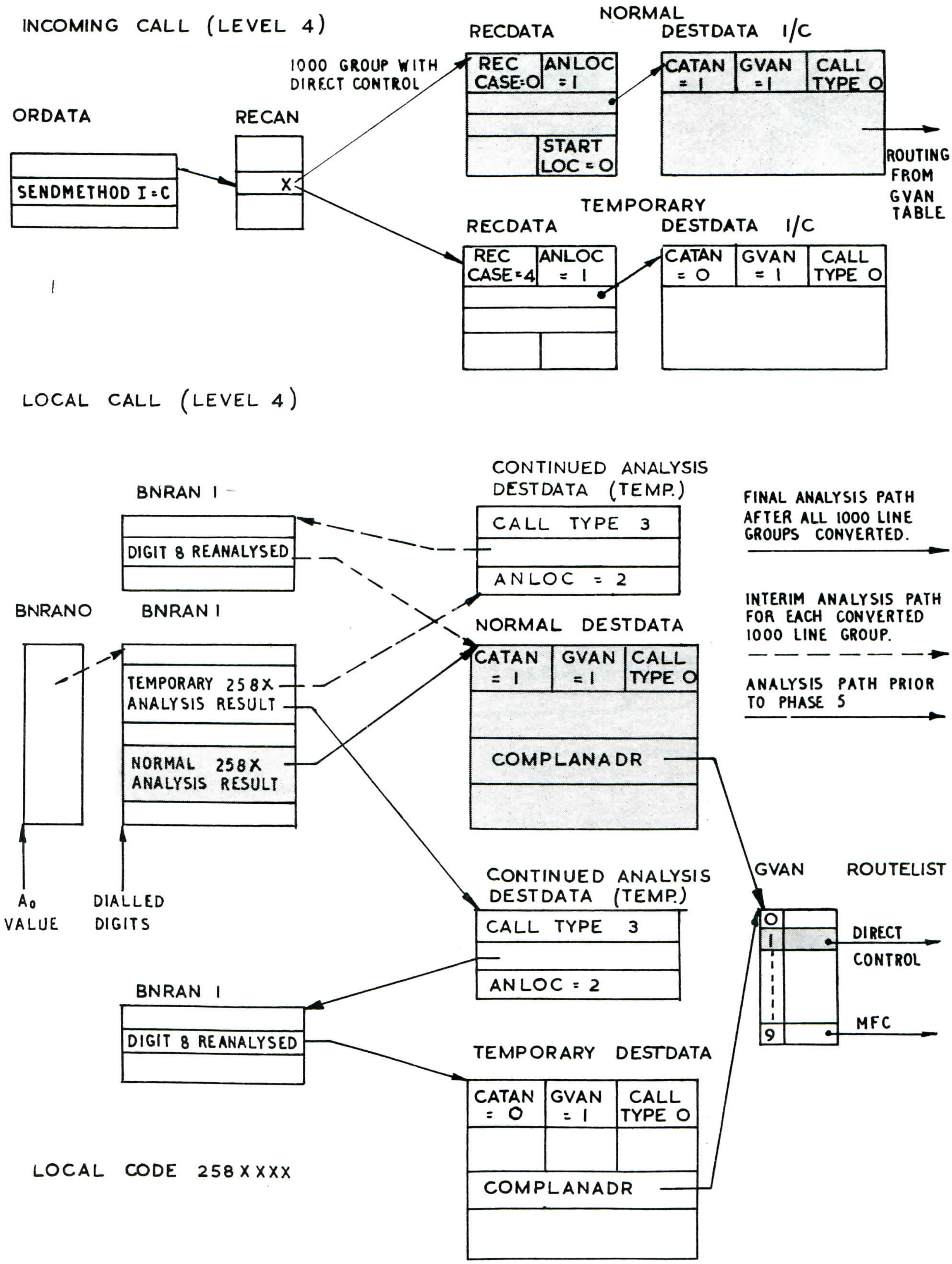

Fig. 1 — Digit and Route Analysis

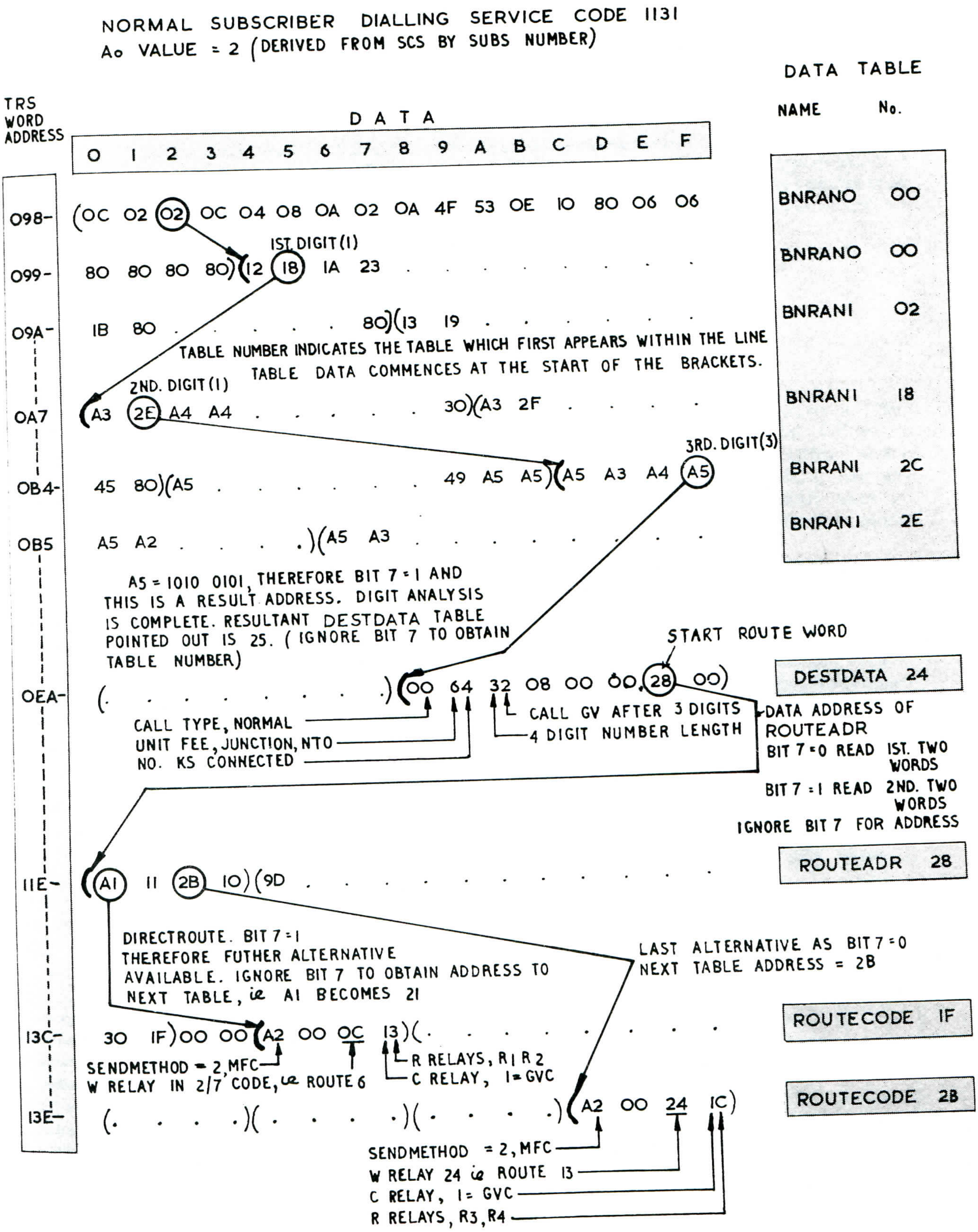

Fig. 2 — Phase 5 Analysis Changes