

# Data Transmission Using Codan HF Radios

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**GCP/INT/651/NOR  
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Improving Pesticide Application  
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### **Introduction**

This note describes the set up and use of the Codan radio and Psion hand held computer for electronic transmission of data from the field to a base station. In addition to this note, in order to configure the system correctly access is required to the Codan operating manual and the XTM installation manual (available with the programme).

### **Hardware Requirements**

The system described in this paper consists of Codan 9360 radios, equipped for data transmission, together with Codan 9002 fax/data modems. It should be noted that the 9360 radios have to be equipped with cooling fans to dissipate the heat during data transmission – this option has to be specified at the time of purchase of the radios and cannot be retrofitted. The base station modem is connected to a PC running 9102 software. The mobile station is connected to the Psion 5MX by means of the data cable supplied with the Psion.

### **Setting up the Codan Radios**

In order to use the data transmission system, the Codan radios have to be correctly set up. Full details of the set up can be found in the appropriate manuals, but in essence the radios have to be configured for Selcall. This means that each radio has to be given a unique address (up to 6 numbers, although some radios may be limited to 4); once this is done then the channels on which the Selcall can be used are defined.

A Selcall (selective call) is analogous to a telephone call, in that the desired address to be called is entered into the transmitting station. This puts out a call on the chosen frequency, which is received by all stations listening on that frequency. If the station that is addressed receives the call, it will respond by ringing to alert the operator, and by emitting a tone at the transmitting station. Although the other stations on the same frequency are able to hear the call, they do not respond. For data transmission this response is required before the data can be sent.

A refinement on this process is to set the receiving station to scan a number of channels sequentially. By using a Selective beacon call on each of these channels in turn, the best channel can be selected before initiating the selcall. The selective beacon call is responded to by the receiving station – the strength of the connection is indicated by a series of beeps.

Because there is a need to establish the selcall before data transmission can be begin, atmospheric condition may prevent this link, although weak voice communication may be possible.

### **Software**

The Codan Modem 9002 units are supplied with proprietary software, 9102, which is a DOS programme. This can be installed on a PC and run in the background after launching from the DOS prompt.

In order to run this software on a Psion, a DOS emulator needs to be installed on the Psion. The one used to develop the data transmission system is a shareware programme, XTM, available for download from [www.nb-infor.co.uk](http://www.nb-infor.co.uk). The cost of registration is GB£25 (approximately US\$40). This file is unzipped (if necessary) and the programme XTM.SIS is run by double clicking the icon and after having connected the Psion to the computer.

In order to install XTM on the Psion, a copy of DOS needs to be available. This is most easily obtained from an old computer which is no longer used (due to licence agreements, each copy of DOS is registered to a user, and therefore cannot be copied for multiple uses). A boot disk is created from the DOS computer. Note that Windows 95/98 DOS will not work on this system. Use either a DOS computer or one running Windows 3.1 – Windows 3.1 runs on DOS as the operating system. A boot disc can be created by typing “Format a: \S” at the DOS prompt (the exact syntax will depend on the version of DOS being used). This will create a boot disc that can be used to start a computer in DOS. It loads the minimum number of programmes in order to execute DOS. In addition, specific files from the XTM software are copied to this disc – see the XTM manual for full details. This includes a config file.

One further file needs to be put onto this disc, which is an autoexec.bat file which will automatically run the data transmission programme. In Windows Notepad, the file is:

```
C:\  
CD\9102  
9102x XXXX c:\elocust.dbf
```

This file, which is executed on the start up of the XTM emulator, causes the default directory to be changed to C:\ (line 1), then to change to the 9102 directory (CD\9102) – line 2. The third line tells XTM to execute the programme 9102x. The characters following the command 9102x are related to the radio station to call and the file to send to that station.

Note that XXXX is the address of the radio base station, and will be particular for each country. This file is saved as autoexec.bat, and copied to the boot disc.

After completing these steps, the XTM programme “Makedisc” is run. This is a DOS programme which converts the boot disc into a form understandable by the Psion. This creates a programme called “Drivedsk” on the PC hard drive. This file is copied to the XTM directory (created automatically when XTM.SIS is run) on the Psion by dragging and dropping.

On the Psion, the next stage is to create a directory for the 9102 software. This is done on C: through the use of the “My Psion” programme installed automatically on the PC when the Psion manufacturers software is first installed.

The final stage is to copy the programme 9102x from the PC to the Psion under the 9102 directory. The difference between 9102 and 9102x is that 9102 is the fully functioning programme, and can be used to enter messages before sending them as text to the receiving computer, as well as other functions for managing the way data is transmitted, received and stored. 9102x on the other hand, does not have any of these functions – it simply connects to the modem and sends the data file specified (as described above).

## **Setting 9102 Options**

There are a number of options which need to be correctly set on the base 9102 software to ensure that the data is received. The Comm port must be set up correctly (8 bits, no parity, 1 stop) at 9600 baud on the correct Comm port (usually Comm 1), and handshaking set to CTS/RTS. Again under “Options”, the address of the base station needs to be entered. This can be any 4 or 6 figure number (depending on radio), but must be unique to the radio – it is this address that is called at the start of the data transmission process. Under the “Receive Files” option, the most important setting to set is the location where the transmitted files are stored. The default is C:\9102\binaries\. This can be changed to whatever directory is required by the user. On further option in this section is to select the date format for recording the date and of incoming messages. The “Journal”, “Printer” and “Preferences” options do not need to be changed. It has not been possible so far to get a direct printout of the incoming file automatically, as there appears to be some clash between the DOS print option and the Windows 98 printer driver.

## **Running the Data Transmission System**

The advantage of running 9102 on the base computer is that it can left running in the background, and will automatically answer any call to that address. Therefore no operator needs to be present for the data transmission at the base station.

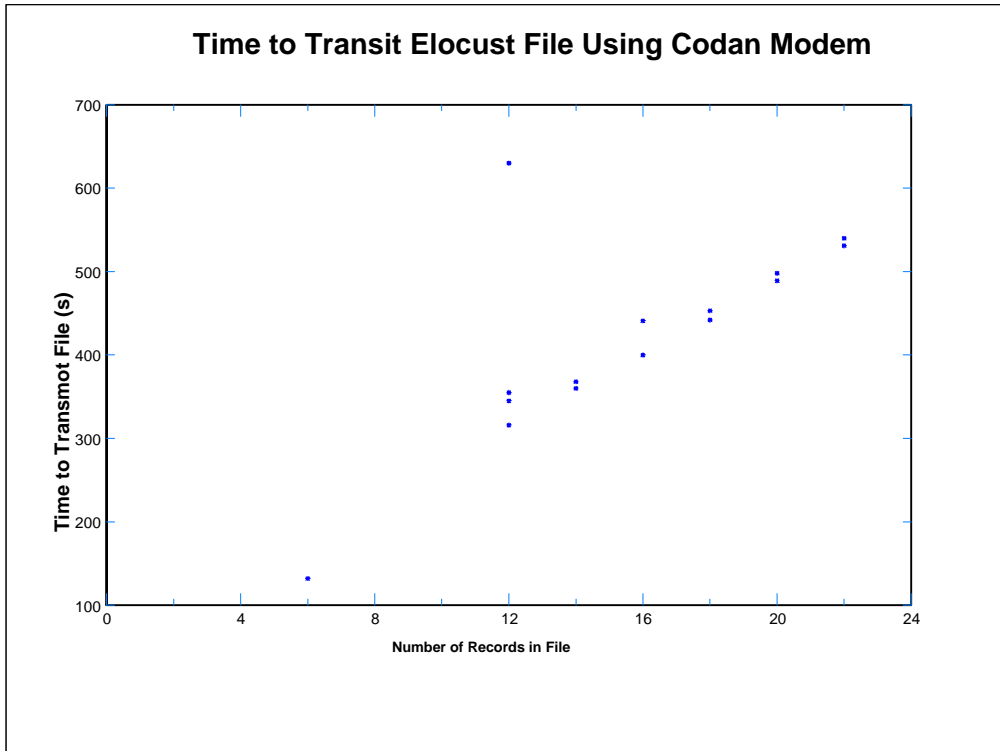
Once the system is set up as described above, the system of data transmission is straightforward. In order to confirm that the conditions are good enough for sending data, a selective beacon call is made on the chosen frequency. If this proves successful, data transmission will succeed. If no response is received to this call, then no connection will be made. If data transmission from the Psion is initiated in the absence of a positive response to the selective beacon call, the programme will report “No Answer”.

At the end of each day of data collection, from elocustM2 a standard elocust export is performed. After the export is complete, the software asks whether to connect to XTM. If answered yes, XTM is automatically launched, and following the instruction in the autoexec.bat file, 9102x is launched, connects to the address specified and transmits the file specified in the autoexec.bat file. Once the data has been successfully transmitted, the radios automatically disconnect. Pressing “Exit” on XTM takes the programme back to elocust.

## **Time for Data Transmission**

Table 1 contains information of the times to transmit a small data file from the field to the base station. Table 2 presents information on the effect of file size on time of transmission.

Figure 1 presents these data graphically.



Because it was not possible to establish a selcall link during certain periods of the day (from about 12.00 to 15.00) it was not possible to transmit data at this time. Note that in the graph above, there is one data point at file size 12 which is considerably longer than the other times. This is due to poor reception conditions (strength 2) at this time. Interestingly, normally at strength 2 the radios fail to establish selcall connection.

### Regular Use of Data Transmission

The system has been simplified to the degree that its use under operational conditions is feasible. Once the software has been installed, then field use is straightforward, and should present no difficulties to a survey officer with a minimal amount of training.

It has been found that if the radios are able to connect (which is a function of atmospheric conditions), then the data is transmitted without losing the link. When the link was artificially broken – by turning off the radio – the software will reconnect automatically.

### File Size

The time taken to transmit the data is a function of file size. A day's worth of field data is about 12 records in elocust. The file size is 21 Kb, which takes about 6 minutes to transmit. A file containing 20 records is 33 Kb. It should be noted that there appears to be no difference in file size whether the records contain any data or not. Therefore it is important not to have empty records in the file to be transmitted.

### Improvements to The System

Two improvements are already underway and will be available soon. Both are concerned with the operation of the Psion. Firstly, the remote link needs to be turned off before starting XTM – failure to do this results in an error in the XTM programme (unable to find Comm 1), which means the programme has to be exited and restarted. Secondly, the auto off function on the Psion has to be disabled, as if the time for data transmission exceeds the auto off period, the Psion will shut down and data transfer will be suspended – although on switching on the Psion it commences from where it was suspended.

A further refinement would be for XTM to exit automatically at the end of data transmission and return to Elocust.

A final matter is related to hardware. A special adapter is available which allows the Psion to be connected to a GPS and to a power source. Output of the GPS information to the Psion is via a serial cable. In order to prevent the disconnection and connection of the Psion cable to the modem, a second serial cable output from the adapter which could connect directly to the modem would be advantageous. This would need to take all of the outputs from the Psion to the modem. A third serial output – also GPS would enable the GPS to be connected to the Codan for vehicle tracking purposes.

Time for Data Transmission

Distance from Base Station (Km)	Time of Transmission <sup>1</sup>	File Size Transmitted (b)	Average Throughput (% of Maximum)	Reception Conditions <sup>2</sup>		Time to Establish Connection (s)	Time to Transmit File (s)	Frequency (Hz)
				Reference Station <sup>3</sup>	Target Station <sup>4</sup>			
129	19.30	8157	70	5 <sup>a</sup>		42	130	8030
129	21.30	8157	50	3 <sup>a</sup>		44	138	8030
129	07.10	8157	100	4 <sup>b</sup>		44	132	8030
148	09.47	8157	98	4 <sup>a</sup>	4	42	132	8030
148	09.50	8157	100	4 <sup>a</sup>	4	42	132	8250
154	10.45	8157	100	3 <sup>a</sup>		42	132	8030
N/A	12.45	8157		2 <sup>a</sup>	2	No Link		
319	19.30	8157	90	4 <sup>b</sup>		43	133	8030
319	21.55	8157	50	3 <sup>b</sup>		42	143	8030
357	19.45	8157	80	4 <sup>b</sup>		43	130	8030

Notes :

1. GMT
2. Reception conditions are indicated on a scale of 1 – 5, where 5 represents clear reception.
3. The reference station used was the BBC World Service, on either 15400 (<sup>a</sup>) or 15485 (<sup>b</sup>) HZ. This was to give an indication of reception conditions, although it should be noted that the transmitter stations change throughout the day and thus may not give a true picture of reception conditions from one location.
4. The target station was the station to which the data was sent, checked before transmission using a voice message.

Distance from Base Station (Km)	Time of Transmission <sup>1</sup>	File Size Transmitted (b)	Average Throughput (% of Maximum)	Reception Conditions <sup>2</sup>		Time to Establish Connection (s)	Time to Transmit File (s)	Frequency (Hz)
				Reference Station <sup>3</sup>	Target Station <sup>4</sup>			
129	00:05	20749	15	2 <sup>b</sup>		43	355	8030
129	00:15	20749	5	2 <sup>b</sup>		55	630	8030
139	10:17	20749	95	5 <sup>a</sup>		43	316	8030
139	18:26	23887	90	5 <sup>a</sup>		43	360	8030
139	18:39	27025	75	5 <sup>a</sup>		43	400	8030
139	18:44	30163	85	5 <sup>a</sup>		43	442	8030
139	18:54	33301	80	5 <sup>a</sup>		43	489	8030
139	19:04	36439	75	5 <sup>a</sup>		43	531	8030
139	20:30	36439	65	4 <sup>a</sup>		43	540	8030
139	20:43	33301	65	4 <sup>a</sup>		43	498	8030
139	20:55	30163	65	4 <sup>a</sup>		43	453	8030
139	21:05	27025	45	4 <sup>a</sup>		46	441	8030
139	21:15	23887	55	4 <sup>a</sup>		43	368	8030
139	21:25	20748	30	3 <sup>a</sup>		43	345	8030