

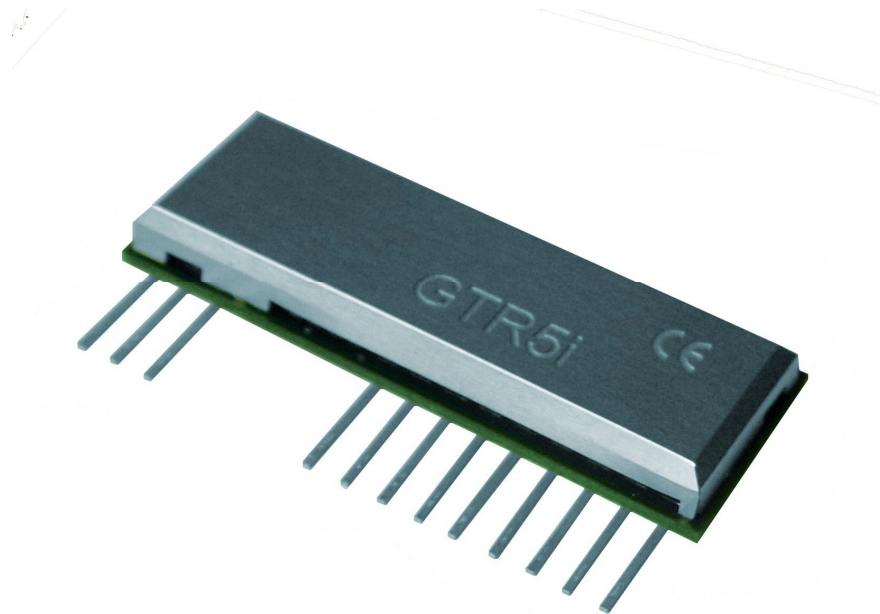
## Task Example

### Packet Radio Protocol for MK Consultants



#### Task Outline

Phasor Design were commissioned by MK Consultants to add a packet protocol layer to their existing GTR5i 169MHz, 434MHz, 868MHz and 914MHz embedded radio transceiver module. Transparent byte level half-duplex communications over up to 4km ranges was already a well-proven capability of this 25kHz channelised wireless modem. The requirement was to add packetisation including addressing, encryption and acknowledgements etc. utilising the existing 16-bit processor within the unit.



For details of the product see the following link:

<http://www.mkconsultants.eu/category/61-igenesis.aspx>

#### Background

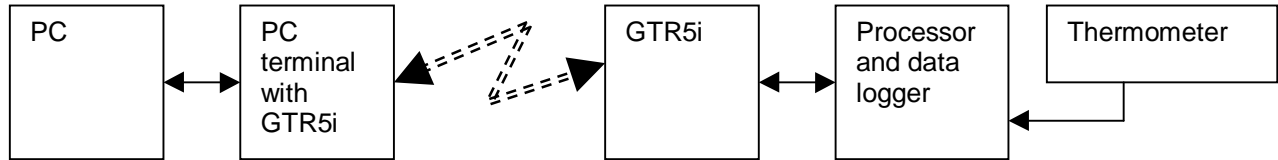
Radio telemetry systems are characterized by their huge variety. No one standard exists which can cater for all possibilities of data rate, battery life, range, cost etc. One defacto standard is the use of 25kHz channel spacing, which is a common technique in mobile radio generally. 25kHz channels support 9600 bit/s using straightforward GMSK, which leads to good sensitivity around  $-112\text{dBm}$ . This narrow band technique also makes good use of the available spectrum in contrast to some wideband techniques.

The GTR5i is a transceiver that meets the 25kHz convention and includes a data processing to provide byte level transparent communications. Note that clock recovery and frame synchronization are included in the standard product. It is widely used in scenarios where the customer embeds a GTR5i into a system with a processor that handles the application function. This processor would also have the task of forming and decoding messages as required.

The following hypothetical application example illustrates this general situation.

## Hypothetical Application Example – Remote Temperature Logging

A temperature-logging unit is placed where temperature is to be read at say 15-minute intervals over many days. This could be inside a freezer, in a farmer's barn etc. A PC is then used to remotely download the recorded temperatures for display as graph over time. The block diagram is as follows:

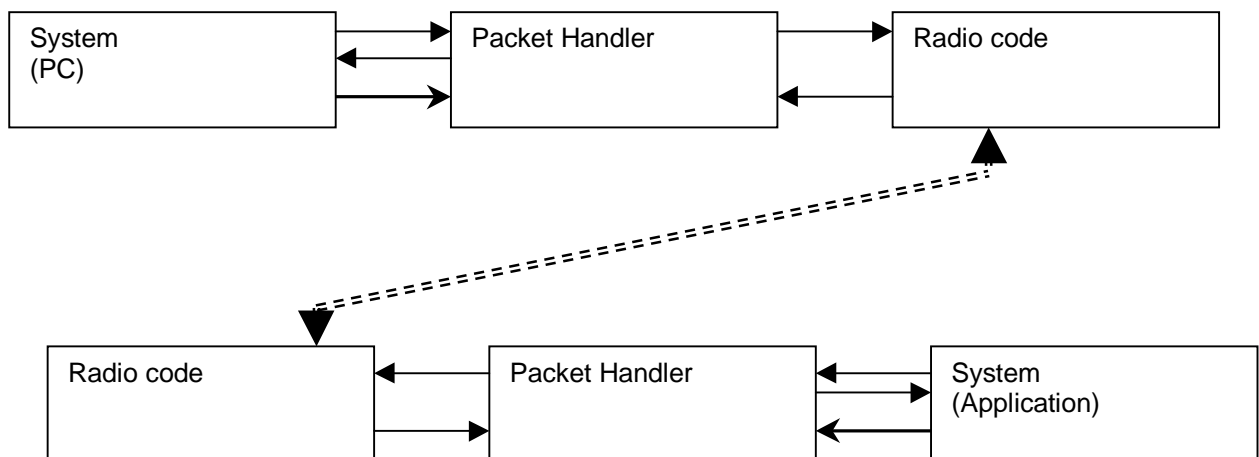


For most of the time the radio is not in use and the logger just takes temperature readings at regular intervals. To minimise logger battery consumption the GTR5i receiver would be switched on for a small percentage of time to listen for the PC. When the person operating the PC wishes to download the temperature reading set, a long transmission is made during which the logger receiver becomes active. At this point the GTR5i transceivers moves from quiescent mode to active message passing mode and a transaction begins. The transaction would consist of a number of queries consisting of a request from the PC for specific information and a reply by the logger. The nature of radio is that some queries will fail to be answered and re-tries are necessary. Eventually all the data is transferred and the system reverts to quiescent mode.

It is clear from the above example that the basic transaction consists of a message from the master (PC) to the slave (logger) and a reply bearing the information required. The message must be addressed to that specific unit and data encryption may be necessary. This essentially sums up the required capabilities of the packet radio protocol.

## The Solution

The packet protocol was prepared as C code and verified in a test harness within a PC. Interface points to the existing code where defined as follows. The code sections are shown as a block diagram with the over air link show in broken lines,



The arrows above indicate function calls between code sections. The bold arrows indicate the 8ms-packet tick.

The interface functions are:

void Packet_Tick(void)	Called by the system to indicate a 8ms tick to the Packet handler
Bool Packet_Send_Data(UINT16 Address, UINT8 *Data, UINT16 Length, bool ACK_Required)	Called by the system to tell the Packet Handler to packetise and transmit "Length" bytes of data from the radio to the specified node address (returns true if successful)
void TX(UINT8 Data)	Called by the packet handler to transmit a byte to the radio.
void Packet_Radio_RX(UINT8 Data)	Called by the radio to indicate to the packet handler that a data byte has been received from the radio.
void Data_Received(UINT16 Address, UINT8 *data, int Length)	Called by the packet handler to indicate to the system that "Length" bytes of data from the radio node at "address" has been received,
void ACK_Received(UINT16 Address, UINT8 *data, int Length)	Called by packet handler to indicate to the system that an ACK has been received from "Address". Data may be present on the ACK
void ACK_Timeout(UINT8 retries_remaining)	Called by the packet handler to indicate to the system that an ACK has timed out

The packet handler can be configured with a number of parameters as in the following list of examples.

Mode	Transparent or packet
EE_MAX_RETRIES	Number of re-tries
EE_SEND_ACK	Indicates that an ack. is expected by master.
EE_USE_ACK	Indicates that an ack. will be send by slave
EE_EMIT_ACK	Flag to say if a successful ack should be reported
EE_EMIT_NACK	Flag to say if a unsuccessful ack should be reported
EE_KEY_ON	Flag to say encryption on

Internal features of the packer handler include a sixteen-bit checksum and addressing

### Configuration Application

Phasor Design worked together with software engineers at MK Consultants who prepared the GTR5i configuration application picture below. This application allows the parameters of the radio and packet handler to be set-up and saved in a straightforward way.



## Conclusions

Phasor Design worked with the client's software engineers and external consultants in the preparation of a packet radio protocol for the GTR5i. A successful enhancement to an existing product was implemented in a cost-effective way.

## Acknowledgements

The agreement of MK Consultants (UK) Limited to publish this information is gratefully acknowledged. Contact Mr. Mohammed Chaudhary at MK Consultants for future information on the GTR5i product.

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