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In This Issue...

President's Corner

Dayton is upon us and as in years past TAPR is always in a rush to get things done or reported by convention time. No matter how early you start in the year to get ready, it always seems like there is never enough time to get things finished. This Dayton should be another fun one. The TAPR forum has a number of very good talks covering a wide range of topics. Don't forget that the forum begins on Friday morning again this year. For the dinner Friday, we have been able to get CDR Chas Richard, W4HFZ, USN who will be talking on "Amateur Radio and Submarine NR-1". The talk should be a very good one and as usual dinner should be excellent!

The date for the 2000 ARRL and TAPR Digital Communications Conference. Start planning to attend the conference to be held September 21-24, 2000 in Orlando, Florida. If you are an author, the deadline for papers will again be at the end of July.

The TAPR FHSS project with Dandin moves along. The RF board has been undergoing a circuit by circuit check by John Schorder in Dallas. When he has completed that the RF board should be ready for final layout and mfg issues can be examined. The latest version of the digital board is

Look for TAPR at these Upcoming Events

Sept 22, 2000	**Annual Board of Directors Meeting, Orlando, FL.**
Sept. 22-24, 2000	**ARRL & TAPR Digital Communication Conference Orlando, Florida**
Sept. 23, 2000	**Annual Membership Meeting; Orlando, Florida**

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out of the board house and testing has begun on it. A number of changes were made this last time based on the last version. As soon as the digital board can be debugged and the low level code updated for the new hardware configuration, we should be very close to moving to testing.

Until next quarter.
Greg Jones, WD5IVD

Elections

The last issue of the *PSR* had the election ballot for Board of Directors. First, I would like to thank all those who took the time to vote. Re-elected to the board is Greg Jones, WD5IVD, John Koster, W9DDD, and Mel Whitten, K0PFX. Thanks again to all those who made this process possible.

Greg Jones, WD5IVD
President

New CDs

TAPR is introducing a new line of CDs. No longer can we get everything on one CD, so we are breaking it up into several. CD number one will be the traditional software library. Yes, you can get all these right off the web, but the reason we still make this available is that not everyone has web access or the bandwidth for the information they require. CD number two will be the SIG archives. CD number three will be a series of CDs covering the various Digital Communication Conferences. We have PDFed the various proceedings and will be including these searchable documents along with the audio from the conference for those years we have it. These will be bundled with the actual paper copy of the proceedings while supplies last. When the supply of a proceeding has run out, then only the CD will be available. CD number four will be a series of CDs covering the PSR in pdf format. The PSR CD is still under scanning and is a little while off from being available.

ARRL/TAPR DCC 2000

The date has been set for the 2000 ARRL and TAPR Digital Communications Conference. It will be held on September 21-24, 2000 in Orlando, FL, just a few miles from the Orlando International airport. The full details on the conference will appear in the next PSR. In addition, there will be a TAPR membership meeting during the conference. Be sure to spread the work about the DCC. Check the web page for full details as we know them www.tapr.org/dcc.

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Article submission deadlines for upcoming issues:

Fall 2000	**September 15, 2000**
Winter 2000	**December 15, 2000**
Spring 2001	**March 15, 2001**
Summer 2001	**June 15, 2001**

Submission Guidelines.

TAPR is always interested in receiving information and articles for publication. If you have an idea for an article you would like to see, or you, or someone you know, is doing something that would interest digital communications, please contact the editor so that your work can be shared with the Amateur community.

The preferred format for articles is plain ASCII text; the preferred graphic formats are JPG, or PCX. However, we can accept many popular

GPS Selective Availability Turned Off Permanently

Statement By The President Regarding the United States' Decision To Stop Degrading Global Positioning System Accuracy
May 1, 2000

Today, I am pleased to announce that the United States will stop the intentional degradation of the Global Positioning System (GPS) signals available to the public beginning at midnight tonight. We call this degradation feature Selective Availability (SA). This will mean that civilian users of GPS will be able to pinpoint locations up to ten times more accurately than they do now. GPS is a dual-use, satellite-based system that provides accurate location and timing data to users worldwide. My March 1996 Presidential Decision Directive included in the goals for GPS to: "encourage acceptance and integration of GPS into peaceful civil, commercial and scientific applications worldwide; and to encourage private sector investment in and use of U.S. GPS technologies and services." To meet these goals, I committed the U.S. to discontinuing the use of SA by 2006 with an annual assessment of its continued use beginning this year.

The decision to discontinue SA is the latest measure in an on-going effort to make GPS more responsive to civil and commercial users worldwide. Last year, Vice President Gore announced our plans to modernize GPS by adding two new civilian signals to enhance the civil and commercial service. This initiative is on-track and the budget further advances modernization by incorporating some of the new features on up to 18 additional satellites that are already awaiting launch or are in production. We will continue to provide all of these capabilities to worldwide users free of charge.

My decision to discontinue SA was based upon a recommendation by the Secretary of Defense in coordination with the Departments of State, Transportation, Commerce, the Director of Central Intelligence, and other Executive Branch Departments and Agencies. They realized that worldwide transportation safety, scientific, and commercial interests could best be served by discontinuation of SA. Along with our commitment to enhance GPS for peaceful applications, my administration is committed to preserving fully the military utility of GPS. The decision to discontinue SA is coupled with our continuing efforts to upgrade the military utility of our systems that use GPS, and is supported by threat assessments which conclude that setting SA to zero at this time would have minimal impact on national security. Additionally, we have demonstrated the capability to selectively deny GPS signals on a regional basis when our national security is threatened. This regional approach to denying navigation services is consistent with the 1996 plan to discontinue the degradation of civil and commercial GPS service globally through the SA technique.

Originally developed by the Department of Defense as a military system, GPS has become a global utility. It benefits users around the world in many different applications, including air, road, marine, and rail navigation, telecommunications, emergency response, oil exploration, mining, and many more. Civilian users will realize a dramatic improvement in GPS accuracy with the discontinuation of SA. For example, emergency teams responding to a cry for help can now determine what side of the highway they must respond to, thereby saving precious minutes. This increase in accuracy will allow new GPS applications to emerge and continue to enhance the lives of people around the world.

RIGBlaster - A SoundCard to Rig Interface

Mel Whitten, K9PX
mel@ao.net

Here is a short review on the new RIGblaster that became available in April. It was "easily" ordered from West Mountain Radio's secure website (www.westmountainradio.com) and received about a week later. The following comments are only my opinions. I have no association with West Mountain Radio.

How does it look?

The unit looks as good as its picture, the cabinet is metal and all the connector "cutouts" are precise with clear silk screen nomenclature, nice form and fit. Inside is a high quality PCB assembly with soldermask and silkscreen. It is an attractive unit that will compliment the gear you have in the shack.

Is it easy to hook up?

So much for good looks, but does it work and is it easy to "hook up"? Yes to both of these. Push on a few jumpers for configuring the RIGblaster to match your radio's mic pin out and replace the case's cover. Next, connect the sound card line out to the RIGblaster for MIC audio to radio and if using PTT, connect a standard RS232 cable to your PC's com port. Finally, connect the RIGblaster cable to your radio's mic connector. DC power is provided using the supplied wall wart. A pot is accessible on the rear for adjusting the mic audio level.

Does it work?

Several sound card programs were tried and all worked without problems. Audio level was easy to adjust, IMD reports were good. A front panel switch allows R, L or Both selection for line out audio to mic in. Another switch selects either PTT or VOX operation. PTT worked

fine with the programs that required either RTS or DTR control. RIGblaster allows you to keep you radio's mic connected for normal voice.

What about sound card line-in audio?

I would like to have seen a couple jacks for passing the radio's speaker audio through a 1:1 transformer and out to the sound card's line in. Also, an adjustable amplifer stage to bring up the audio for low level receive audio typically found on the "rear" accessory connectors of most radios would have been a nice option. Perhaps, if the developer's receive feedback for these options, they could be considered in future designs. I use the rear audio in/out connector on my JRC JST-245 for a SCS PTCII, but I believe the RIGblaster could be connected here as well.

Nitpicking...

No schematic is provided in the manual but; it is available from West Mountain's web site. The manual is a little sparse but provides adequate information. A "cabling" diagram showing the connections between the radio, RIGblaster and PC would be helpful for the first time PSKers.

Good value?

Yes. At first, the price may seem a little high but it is well made, works "as advertised" and makes life so much "easier" for making sound card to radio connections. It provides some nice features that would require quite a bit of effort for most folks to duplicate. I plan to buy another one for my second sound blasted radio.

Multiport Packet Radio PC-Card

Description

This card named "EASY SCC4" has been implemented by a French amateur, F1FRV, to answer the needs of packet radio network nodes and BBS sysops. The design has addressed the difficulties of using different SCC (Synchronous Communication Controller) cards existing on the European market, and has integrated the necessary functions for an easy implementation. This card provides four serial ports to modems or TNCs. It is possible to install up to four cards on the same PC for a total of 16 ports.

Criteria of Design

Any "average Ham" can build it, if he knows how to read a layout, and how to hold a soldering iron by the right side... or having friends to help him.

The board is compatible with various protocols including: FLEXNET, NOS, THENET, ROSE, FPAC, AX25, TCP-IP, KISS, XSCC of PE1DNN, TFPCX of DG0FT, ASYSCC of IK5NAX etc.

Technical Specifications

The board is a double sided printed circuit board with metallized holes, silkscreen, and solder masks. It is an ISA 16 bit card (length 200 mm) allowing for use of IRQs 3, 4, 5, 6, 7, 9, 10, 11, 12, 14, or 15.

It includes four synchronous or asynchronous, simplex or duplex ports, with only one IRQ used by card. The speed of transmission and mode of operation of each port is configuralble separately by software.

It can be set to operate at four possible addresses selectable by jumpers (150h, 300h, 2B0h, 2C0h).

It includes protection against supply over-voltages and over-currents. The card can supply power to the modems at 12V or 5V using the serial cables. A watchdog circuit is used for automatic reset of the PC in case of software "hang".

It includes the ability to use the internal clock output of the card to synchronize external modems. The clock output is configurable to either x32 or x16 (G3RUH modems). The clock can be used for the synchronization of each port, either the clock divider of the card, or from an external modem.

Troubleshooting is aided by activity LEDs, and test points for the clocks on each port.

All signals entering and exiting the card are fully buffered. These circuits protect the card in the event of a severe accident or mistake on the external equipment.

The oscillator is designed to accept crystals of 4.9152 MHz and even multiples, and has built in dividers by 1, 2 and 4 to adapt to the different configurations and available crystals.

Availability

This Kit, including 10 MHz 85C30s, pre-wired connectors, printed circuit board, and all necessary components and accessories, is commercialized by the French company AEI. The price list is on the web site of the company AEI (www.aeitech.com). [About $150 U.S. dollars plus shipping.]

Schematics, layouts, technical documentation on the 85x30s, and a lot of other ham related files and links, are on the web site of the radio club F6KBF (www.multimania.com/f6kbf)

Future Developments

A GMSK modem compatible G3RUH, K9NG, DF9IC etc. for transmission speeds of 4800 to 200 kbps is in preparation. The design is finished, and the realization of prototypes will be made during March 2000.

Announcing "APRSdec" The Full APRS Decoder Program

Ian Wade, G3NRW
Technical Editor, APRS Protocol Specification

While working on the APRS Protocol Specification, I found it useful to write an APRS Decoder Program (APRSdec) to verify the details of the protocol.

APRSdec parses APRS packets in TNC/IGate output format or UI-View log format, producing a full decode of every data element in each packet.

APRSdec is a particularly useful tool for:
- APRS software development and testing.
- PIC development and testing.
- Network fault-finding and diagnostics.
- Learning about the APRS protocol.
- Checking packet formats.

Among the more obscure formats, APRSdec fully understands Mic-E, compressed positions and area objects (circles, triangles etc).

The following pages show examples of APRSdec output.

With a few unimportant exceptions, APRSDEC understands all of the APRS features included in the Protocol Specification.

APRSDEC even recognizes Kenwood TM-D700 radios, and corrects the posit to be a "current" posit rather than an "old" posit. Position ambiguity (Mic-E and uncompressed lat/long) is also handled correctly.

APRSDEC includes extensive error reporting, showing, for example, when a parameter is out of range, or is in the wrong format, or (in the case of NMEA sentences) where there is a bad checksum.

Features

- Runs under native DOS, Win 95/98 and Linux/Unix. (It will almost certainly run under Windows NT and Windows 2000 as well, but this has not been tested).
- Accepts raw input in TNC/IGate output format (TNC_header:data).
- Accepts raw input in UI-View 2-line log format; it is no longer necessary to edit log files before using APRSdec. In addition, as well as decoding APRS packets, APRSdec also decodes the 15-digit UI-View timestamp.
- Performs rigorous format checking, with detailed error reporting.
- Understands position ambiguity, reporting the bounding box in which the station is located.
- Compares lat/long position against a prefix/country database – if the station's position appears to be outside the country, APRSdec reports a possible anomaly.
- Reports data values in imperial, nautical and metric units.
- Fully decodes Mic-E and compressed position formats.
- Recognizes data from Kenwood TH-D7 and DM-700 radios, and changes the incorrect DM-700 APRS Data Type Identifier to "Current Mic-E Data".
- Provides detailed weather station reports, including the calculation of windchill and dew point.
- Decodes storm data.
- Decodes bearing and range data.
- Decodes DX Cluster reports, showing the data as it will appear on TH-D7 and DM-700 screens.

APRSdec is provided in Perl 4 source, allowing it to run on most platforms including DOS, Windows and Linux/ Unix. It may be downloaded from www.nettn.co.uk/aprs.htm. There are two distribution files: "aprsdecd.zip" for DOS/Windows and "aprsdecu.tar" for Unix/Linux. The DOS/Windows distribution includes a suitable Perl compiler.

APRSdec is made available under GNU General Public License. APRSdec is a trademark owned by Ian Wade, G3NRW.

APRS Working Group: Protocol Reference Third Public Draft

The APRS Working Group has now published the third (and hopefully final) public draft of the APRS Protocol Reference. It is available on the TAPR website, at www.tapr.org/tapr/html/Faprswg.html.

This latest draft incorporates "hundreds" of items of feedback received since the previous draft published last December, and has now grown to 115 pages.

Several sections have been considerably expanded and clarified. In particular, the chapters on Mic-E, Weather Reports and APRS Symbols have been substantially rewritten.

The Working Group invites feedback on the specification, although due to the extensive public comments that we have already received on prior drafts, we will not have a formal comment period as defined in the WG charter; what we ask for now are additional eyes to ensure that we haven't inadvertently introduced new errors to this draft. Comments should be addressed to the TAPR "aprsspec" mailing list. Details of how to join the list are given on page 2 of the document.

John Ackermann, N8UR
Administrative Chair, APRS Working Group

Example output from the APRSdec program.

A simple lat/long report:

```
Record #170
KB4SSTAPRS,W4HHV-5,WIDE*,WIDE/I:@02707002340N.74W/07934;60W- John in Marion, SC-731-
 APRS Data Type= Posit w/ time. With APRS
 Day= 27  Time= 07 hours 00 mins UTC
 Lat= 34 deg 08.76 min N  Long= 79 deg 24.60 min W
 Icon= House QTH VHF   Overlay= (none)
-------------------------------------------------------------
```

A raw Mic-E report. APRSdec recognizes this comes from a Kenwood TM-D700 radio and automatically changes the APRS Data Type to "Current Mic-E data":

```
Record #6251
KC7SQLVE7VAN-1*WIDE3-1T8SPWPW:'3T1lZe-/]"5})Mark at home awaits sunset
 APRS Data Type= Current Mic-E data
 Radio= Kenwood TM-D700
 Message Type= /M2/In Service
 Lat= 48 deg 07.27 min N  Long= 123 deg 27.45 min W
 Icon= House QTH VHF   Overlay= (none)
 Course= 173 deg   Speed= 4 knots (4.6 mph  7.4 kph  2.1 m/s)
 Altitude= 397 feet (121 meters)
-------------------------------------------------------------
```

A compressed lat/long position, within an Object report:

```
Record #1763
W9ZCWAPRS11,AXPA 10*,WIDE) 2:;ARLE_111826z\5E+;DvAI5k(}R-05260/437.051/13Km:/APRS
 APRS Data Type= Object
 Object Name= 'ARLE     '  Object Status= Killed
 Day= 11  Time= 18 hours 26 mins UTC
 Lat= 51 deg 14.20 min N  Long= 34 deg 54.30 min W
 GPS Fix= Old (last)   NMEA Source= Other   Compression Origin= Compressed
 Course= 296 deg  Speed= 1019 knots (1172.5 mph  1885.3
 kph  523.7 m/s) Icon= Satellite/PAC   Overlay= (none)
-------------------------------------------------------------
```

A lat/long report with position ambiguity. The station may be located anywhere inside the bounding box:

```
Record #121
W9ZOGAPRS46,WA4WRD-3*,WIDE/r:=2559.  N/08010.  W $PHG5360/Carl's Beetle!
 APRS Data Type= Posit w/o time. With APRS
 Ambiguous position. Opposite corners of bounding box:
  NW Corner: Lat=25 deg 59.99 min N  Long= 80 deg 10.99 min W
  SE Corner: Lat=25 deg 59.00 min N  Long= 80 deg 10.00 min W
 Icon= House QTH VHF   Overlay= (none)
 Power= 36 watts   Height above average terrain= 320 feet (97.5 meters)
  Gain= 6 dB   Range Circle= 41.4 miles (66.6 km)
 Directivity= Omni-directional
-------------------------------------------------------------
```

A UI-View report, including the decoded UI-View timestamp. (This report shows APRS Working Group Chairman John Ackermann, N8UR, jogging towards G3NRW's QTH at over 72mph -- he was on a train at the time! APRSdec also recognizes that John is outside the contiguous 48 states, so it questions the reported location):

```
Record #632
N8UR-7*RELAYWIDEWIDEWIDE3-2U10VXX (UI):'v3f"(/"58}
 UI-View Timestamp= 27 May 2000   11 hrs 56 mins 32 secs (PC clocktime)
  APRS Data Type=Current Mic-E data Radio=Kenwood TH-D7
 Message Type= /M2/In Service
 Lat= 51 deg 56.88 min N  Long= 0 deg 35.74 min W
**QUESTION: Is this lat/long position reasonable?
           It seems a long way from home for this callsign.
 Icon= Jogger   Overlay= (none)
 Course= 1 deg   Speed= 63 knots (72.5 mph  116.7 kph  32.4 m/s)
 Altitude= 407 feet (124 meters)
-------------------------------------------------------------
```

A full WX station report, with computed windchill and dewpoint:

```
Record #5034
EF52M*APRS19,GATE,WIDE2-2:@0111955z4447.24N/09329.48W_125/008g009t079r000p003....h41b10190auzk
 APRS Data Type= Posit w/ time. With APRS
 Day= 11  Time= 19 hours 55 mins UTC
 Lat= 44 deg 47.24 min N  Long= 93 deg 29.48 min W
 Icon= WX station   Overlay= (none)
 Wind Direction= 125 deg   Speed= 008 knots (9.2 mph  14.8 kph  4.1 m/s)
  Gust Speed= 9 mph (14.5 kph  4.0 m/s  7.8 knots) Temp= 79 degF
 (26.1 degC)   Windchill= 76.5 degF (24.7 degC) Rain: Last hour= 0 in
  (0.0 mm)   Last 24 hrs= 0.03 in (0.8 mm)
       Since midnight= (indeterminate)
 Humidity= 41 percent   Dew Point= 53.2 degF (11.8 degC)
 Barometric Pressure= 1019 mbar/hP
```

THE STRUCTURE OF THIS SPECIFICATION

This specification describes the overall requirements for developing software that complies with APRS Protocol Version 1.0. The information flow starts with the standard AX.25 UI-frame, and progresses downwards into more and more detail as the use of each field in the frame is explored.

A key feature of the specification is the inclusion of dozens of detailed examples of typical APRS packets and related math computations.

Here is an outline of the chapters:

Introduction to APRS — A brief background to APRS and a summary of its main features.

The APRS Design Philosophy — The fundamentals of APRS, highlighting its use as a real-time tactical communications tool, the timing of APRS transmissions and the use of generic digipeating.

APRS and AX.25 — A brief refresher on the structure of the AX.25 UI-frame, with particular reference to the special ways in which APRS uses the Destination and Source Address fields and the Information field.

APRS Data in the AX.25 Destination and Source Address Fields — Details of generic APRS callsigns and callsigns that specify display symbols and APRS software version numbers. Also a summary of how Mic-E encoded data is stored in the Destination Address field, and how the Source Address SSID can specify a display icon.

APRS Data in the AX.25 Information Field — Details of the principal constituents of APRS data that are stored in the Information field. Contains the APRS Data Type Identifiers table, and a summary of all the different types of data that the Information field can hold.

Time and Position Formats — Information on formats for timestamps, latitude, longitude, position ambiguity, Maidenhead locators, NMEA data and altitude.

APRS Data Extensions — Details of optional data extensions for station course/speed, wind speed/direction, power/height/gain, pre-calculated radio range, DF signal strength and Area Object descriptor.

Position and DF Report Data Formats — Full details of these report formats.

Compressed Position Report Data Formats — Full details of how station position and APRS data extensions are compressed into very short packets.

Mic-E Data Format —Mic-E encoding of station lat/long position, altitude, course, speed, Mic-E message code, telemetry data and APRS digipeater path into the AX.25 Destination Address and Information fields.

Object and Item Reports — Full information on how to set up APRS Objects and Items, and details of the encoding of Area Objects (circles, lines, ellipses etc).

Weather Reports — Full format details for weather reports from stand-alone (positionless) weather stations and for reports containing position information. Also details of storm data format.

Telemetry Data — A description of the MIM/KPC-3+ telemetry data format, with supporting information on how to tailor the interpretation of the raw data to individual circumstances.

Messages, Bulletins and Announcements — Full format information.

Station Capabilities, Queries and Responses — Details of the ten different types of query and expected responses.

Status Reports — The format of general status messages, plus the special cases of using a status report to contain meteor scatter beam heading/power and Maidenhead locator.

Network Tunneling — The use of the Source Path Header to allow tunneling of APRS packets through third-party networks that do not understand AX.25 addresses, and the use of the third-party Data Type Identifier.

User-Defined Data Format — APRS allows users to define their own data formats for special purposes. This chapter describes how to do this.

Other Packets — A general statement on how APRS is to handle any other packet types that are not covered by this specification.

APRS Symbols – How to specify APRS symbols and symbol overlays, in position reports and in generic GPS destination callsigns.

APRS Data Formats – – An appendix containing all the APRS data formats collected together for easy reference.

The APRS Symbol Tables —A complete listing of all the symbols in the Primary and Alternate Symbol Tables.

ASCII Code Table — The full ASCII code, including decimal and hex codes for each character (the decimal code is needed for compressed lat/long and altitude computations), together with the hex codes for bit-shifted ASCII characters in AX.25 addresses (useful for Mic-E decoding and general on-air packet monitoring).

Glossary — A handy one-stop reference for the many APRS-specific terms used in this specification.

References — Pointers to other documents that are relevant to this specification.

3 APRS AND AX.25

Protocols

At the link level, APRS uses the AX.25 protocol, as defined in *Amateur Packet-Radio Link-Layer Protocol* (see Appendix 6 for details), utilizing Unnumbered Information (UI) frames exclusively. This means that APRS runs in *connectionless* mode, whereby AX.25 frames are transmitted without expecting any response, and reception at the other end is not guaranteed.

At a higher level, APRS supports a messaging protocol that allows users to send short messages (one line of text) to nominated stations, and expects to receive acknowledgements from those stations.

The AX.25 Frame

All APRS transmissions use AX.25 UI-frames, with 9 fields of data:

AX.25 UI-FRAME FORMAT

	Flag	*Destination Address*	*Source Address*	*Digipeater Addresses (0-8)*	*Control Field (UI)*	*Protocol ID*	*INFORMATION FIELD*	*FCS*	*Flag*
Bytes:	1	7	7	0-56	1	1	1-256	2	1

Flag — The flag field at each end of the frame is the bit sequence 0x7e that separates each frame.

Destination Address — This field can contain an APRS destination callsign or APRS data. APRS data is encoded to ensure that the field conforms to the standard AX.25 callsign format (i.e. 6 alphanumeric characters plus SSID). If the SSID is non-zero, it specifies a generic APRS digipeater path.

Source Address — This field contains the callsign and SSID of the transmitting station. In some cases, if the SSID is non-zero, the SSID may specify an APRS display Symbol Code.

Digipeater Addresses — From zero to 8 digipeater callsigns may be included in this field. **Note**: These digipeater addresses may be overridden by a generic APRS digipeater path (specified in the Destination Address SSID).

Control Field — This field is set to 0x03 (UI-frame).

Protocol ID — This field is set to 0xf0 (no layer 3 protocol).

Information Field — This field contains more APRS data. The first character of this field is the APRS Data Type Identifier that specifies the nature of the data that follows.

Frame Check Sequence — The FCS is a sequence of 16 bits used for checking the integrity of a received frame.

4 APRS DATA IN THE AX.25 DESTINATION AND SOURCE ADDRESS FIELDS

The AX.25 Destination Address Field

The AX.25 Destination Address field can contain 6 different types of APRS information:

A generic APRS address.

A generic APRS address with a symbol.

An APRS software version number.

Mic-E encoded data.

A Maidenhead Grid Locator (obsolete).

An Alternate Net (ALTNET) address.

In all of these cases, the Destination Address SSID may specify a generic APRS digipeater path.

Generic APRS Destination Addresses

APRS uses the following generic beacon-style destination addresses:

AIR* †	ALL*	AP*	BEACON	CQ*	GPS*	DF*
DGPS*	DRILL*	DX*	ID*	JAVA*	MAIL*	MICE*
QST*	QTH*	RTCM*	SKY*	SPACE*	SPC*	SYM*
TEL*	TEST*	TLM*	WX*	ZIP* †		

The asterisk is a wildcard, allowing the address to be extended (up to a total of 6 alphanumeric characters). Thus, for example, WX1, WX12 and WX12CD are all valid APRS destination addresses.

† The AIR* and ZIP* addresses are being phased out, but are needed at present for backward compatibility.

All of these addresses have an SSID of –0. Non-zero SSIDs are reserved for generic APRS digipeating.

These addresses are copied by everyone. All APRS software must accept packets with these destination addresses.

The address GPS (i.e. the 3-letter address GPS, not GPS*) is specifically intended for use by trackers sending lat/long positions via digipeaters which have the capability of converting positions to compressed data format.

The addresses DGPS and RTCM are used by differential GPS correction stations. Most software will not make use of packets using this address, other than to pass them on to an attached GPS unit.

The address SKY is used for Skywarn stations.

Packets addressed to SPCL are intended for special events. APRS software can display such packets to the exclusion of all others, to minimize clutter on

the screen from other stations not involved in the special event.

The addresses TEL and TLM is used for telemetry stations.

Generic APRS Address with Symbol

APRS uses several of the above-listed generic addresses in a special way, to specify not only an address but also a display symbol. These special addresses are GPSxyz, GPSCnn, GPSEnn, SPCxyz and SYMxyz, and are intended for use where it is not possible to include the symbol in the AX.25 Information field.

The GPS addresses above are for general use.

The SPC addresses are intended for special events.

The SYM addresses are reserved for future use.

The characters xy and nn refer to entries in the APRS Symbol Tables. The character z specifies a symbol overlay. See Chapter 20: APRS Symbols and Appendix 2 for more information.

APRS Software Version Number

The AX.25 Destination Address field can contain the version number of the APRS software that is running at the station. Knowledge of the version number can be useful when debugging.

The following software version types are reserved (xx and xxx indicate a version number):

APCxxx	APRS/CE, Windows CE
APExxx	PIC-Encoder
APIxxx	Icom radios (future)
APICxx	ICQ messaging
APKxxx	Kenwood radios
APMxxx	MacAPRS
APPxxx	pocketAPRS
APRxxx	APRSdos
APRS	older versions of APRSdos
APRSM	older versions of MacAPRS
APRSW	older versions of WinAPRS
APSxxx	APRS-SA
APWxxx	WinAPRS
APXxxx	X-APRS
APYxxx	Yaesu radios (future)
APZxxx	Experimental

This table will be added to by the APRS Working Group.

For example, a station using version 3.2.6 of MacAPRS could use the destination callsign APM326.

The Experimental destination is designated for *temporary* use only while a product is being developed, before a special APRS Software Version address is assigned to it.

Mic-E Encoded Data

Another alternative use of the AX.25 Destination Address field is to contain Mic-E encoded data. This data includes:

- The latitude of the station.
- A West/East Indicator and a Longitude Offset Indicator (used in longitude computations).
- A Message Code.
- The APRS digipeater path.

This data is used with associated data in the AX.25 Information field to provide a complete Position Report and other information about the station (see Chapter 10: Mic-E Data Format).

Maidenhead Grid Locator in Destination Address

The AX.25 Destination Address field may contain a 6-character Maidenhead Grid Locator. For example: 1091SX. This format is typically used by meteor scatter and satellite operators who need to keep packets as short as possible.

This format is now obsolete.

Alternate Nets

Any other destination address not included in the specific generic list or the other categories mentioned above may be used in Alternate Nets (ALTNETs) by groups of individuals for special purposes. Thus they can use the APRS infrastructure for a variety of experiments without cluttering up the maps and lists of other APRS stations. Only stations using the same ALTNET address should see their data.

Generic APRS Digipeater Path

The SSID in the Destination Address field of all packets is coded to specify the APRS digipeater path.

If the Destination Address SSID is -0, the packet follows the standard AX.25 digipeater ("VIA") path contained in the Digipeater Addresses field of the AX.25 frame.

If the Destination Address SSID is non-zero, the packet follows one of 15 generic APRS digipeater paths.

The SSID field in the Destination Address (i.e. in the 7th address byte) is encoded as follows:

APRS Digipeater Paths in Destination Address SSID

SSID	Path
-0	Use VIA path
-1	WIDE1-1
-2	WIDE2-2
-3	WIDE3-3
-4	WIDE4-4
-5	WIDE5-5
-6	WIDE6-6
-7	WIDE7-7

SSID	Path
-8	North path
-9	South path
-10	East path
-11	West path
-12	North path + WIDE
-13	South path + WIDE
-14	East path + WIDE
-15	West path + WIDE

The AX.25 Source Address SSID to specify Symbols

The AX.25 Source Address field contains the callsign and SSID of the originating station. If the SSID is -0, APRS does not treat it in any special way.

If, however, the Source Address SSID is non-zero, APRS interprets it as a display icon. This is intended for use only with stand-alone trackers where there is no other method of specifying a display symbol or a destination address (e.g. MIM trackers or NMEA trackers).

For more information, see Chapter 20: APRS Symbols.

5 APRS DATA IN THE AX.25 INFORMATION FIELD

Generic Data Format

In general, the AX.25 Information field can contain some or all of the following information:

APRS Data Type Identifier
APRS Data
APRS Data Extension
Comment

	Generic APRS Information Field			
	Data Type ID	*APRS Data*	*APRS Data Extension*	*Comment*
Bytes:	1	n	7	n

APRS Data Type Identifier

Every APRS packet contains an APRS Data Type Identifier (DTI). This determines the format of the remainder of the data in the Information field, as follows:

APRS Data Type Identifiers

Ident	*Data Type*
0x1c	Current Mic-E Data (Rev 0 beta)
0x1d	Old Mic-E Data (Rev 0 beta)
!	Position without timestamp (no APRS messaging), or Ultimeter 2000 WX Station
"	*[Unused]*
#	Peet Bros U-II Weather Station
$	Raw GPS data or Ultimeter 2000
%	Agrelo DFJr / MicroFinder
&	*[Reserved — Map Feature]*
'	Old Mic-E Data (but *Current* data for TM-D700)
(	*[Unused]*
)	Item
*	Peet Bros U-II Weather Station
+	*[Reserved — Shelter data with time]*
,	Invalid data or test data
-	*[Unused]*
.	*[Reserved — Space weather]*
/	Position with timestamp (no APRS messaging)
0–9	*[Do not use]*
:	Message
;	Object

Ident	*Data Type*
<	Station Capabilities
=	Position without timestamp (with APRS messaging)
>	Status
?	Query
@	Position with timestamp (with APRS messaging)
A–S	*[Do not use]*
T	Telemetry data
U–Z	*[Do not use]*
[	*[Unused]*
\	*[Unused]*
]	*[Unused]*
^	*[Unused]*
_	Weather Report (without position)
`	Current Mic-E Data (*not* used in TM-D700)
a–z	*[Do not use]*
{	User-Defined APRS packet format
|	*[Do not use — TNC stream switch character]*
}	Third-party traffic
~	*[Do not use — TNC stream switch character]*

Note: There is one exception to the requirement for the Data Type Identifier to be the *first* character in the Information field — this is the *Position without Timestamp* (indicated by the ! DTI). The ! character may occur *anywhere up to and including the 40th character position* in the Information field. This variability is required to support X1J TNC digipeaters which have a string of unmodifiable text at the beginning of the field.

Note: The Kenwood TM-D700 radio uses the ' DTI for *current* Mic-E data. The radio does not use the ' DTI.

APRS Data and Data Extension

There are 10 main types of APRS Data:

- Position
- Direction Finding
- Objects and Items
- Weather
- Telemetry
- Messages, Bulletins and Announcements
- Queries
- Responses
- Status
- Other

Some of this data may also have an APRS Data Extension that provides additional information.

The APRS Data and optional Data Extension follow the Data Type Identifier.

The table on the next page shows a complete list of all the different possible types of APRS Data and APRS Data Extension.

	Possible APRS Data	*Possible APRS Data Extension*
Position	Time (DHM or HMS) Lat/long coordinates Compressed lat/long/course/speed/radio range/altitude Symbol Table ID and Symbol Code Mic-E longitude, speed and course, telemetry or status Raw GPS NMEA sentence Raw weather station data	Course and Speed Power, Effective Antenna Height/Gain/Directivity Pre-Calculated Radio Range Omni DF Signal Strength Storm Data (in Comment field)
Direction Finding	Time (DHM or HMS) Lat/long coordinates Compressed lat/long/course/speed/radio range/altitude Symbol Table ID and Symbol Code	Course and Speed Power, Effective Antenna Height/Gain/Directivity Pre-Calculated Radio Range Omni DF Signal Strength Bearing and Number/Range/Quality (in Comment field)
Objects and Items	Object name Item name Time (DHM or HMS) Lat/long coordinates Compressed lat/long/course/speed/radio range/altitude Symbol Table ID and Symbol Code Raw weather station data	Course and Speed Power, Effective Antenna Height/Gain/Directivity Pre-Calculated Radio Range Omni DF Signal Strength Area Object Storm Data (in Comment field)
Weather	Time (MDHM) Lat/long coordinates Compressed lat/long/course/speed/radio range/altitude Symbol Table ID and Symbol Code Raw weather station data	Wind Direction and Speed Storm Data (in Comment field)
Telemetry	Telemetry (non Mic-E)	
Messages, Bulletins and Announcements	Addressee Message Text Message Identifier Message Acknowledgement Bulletin ID, Announcement ID Group Bulletin ID	
Queries	Query Type Query Target Footprint Addressee (Directed Query)	
Responses	Position Object/Item Weather Status Message Digipeater Trace Stations Heard Heard Statistics Station Capabilities	Course and Speed Power, Effective Antenna Height/Gain/Directivity Pre-Calculated Radio Range Omni DF Signal Strength Area Object Wind Direction and Speed
Status	Time (DHM zulu) Status text Meteor Scatter Beam Heading/Power Maidenhead Locator (Grid Square) Altitude (Mic-E) E-mail message	
Other	Third-Party forwarding Invalid Data/Test Data	

Comment Field

In general, any APRS packet can contain a plain text comment (such as a beacon message) in the Information field, immediately following the APRS Data or APRS Data Extension.

There is no separator between the APRS data and the comment unless otherwise stated.

The comment may contain any printable ASCII characters (except | and ~, which are reserved for TNC channel switching).

The maximum length of the comment field depends on the report — details are included in the description of each report.

In special cases, the Comment field can also contain further APRS data:

- **Altitude** in comment text (see Chapter 6: Time and Position Formats), or in Mic-E status text (see Chapter 10: Mic-E Data Format).

  Maidenhead Locator (grid square), in a Mic-E status text field (see Chapter 10: Mic-E Data Format) or in a Status Report (see Chapter 16: Status Reports).

  Bearing and Number/Range/Quality parameters (/BRG/NRQ), in DF reports (see Chapter 7: APRS Data Extensions).

  Area Object Line Widths (see Chapter 11: Object and Item Reports).

  Signpost Objects (see Chapter 11: Object and Item Reports).

  Weather and Storm Data (see Chapter 12: Weather Reports).

  Beam Heading and Power, in Status Reports (see Chapter 16: Status Reports).

Base-91 Notation

Two APRS data formats use base-91 notation: lat/long coordinates in compressed format (see Chapter 9) and the altitude in Mic-E format (see Chapter 10).

Base-91 data is compressed into a short string of characters. All the characters are printable ASCII, with character codes in the range 33–124 decimal (i.e. ! through |).

To compute the base-91 ASCII character string for a given data value, the value is divided by progressively reducing powers of 91 until the remainder is less than 91. At each step, 33 is added to the modulus of the division process to obtain the corresponding ASCII character code.

For example, for a data value of 12345678:

$12345678 / 91^3$ = modulus **16**, remainder 288542
$288542 / 91^2$ = modulus **34**, remainder 6988
$6988 / 91^1$ = modulus **76**, remainder **72**

The four ASCII character codes are thus 49 (i.e. 16+33), 67 (i.e. 34+33), 109 (i.e. 76+33) and 105 (i.e. 72+33), corresponding to the ASCII string **1Cmi**.

APRS Data Units

For historical reasons there is some lack of consistency between units of data in APRS packets — some speeds are in knots, others in miles per hour; some altitudes are in feet, others in meters, and so on. It is emphasized that this specification describes the units of data as they are transmitted on-air. It is the responsibility of APRS applications to convert the on-air units to more suitable units if required.

The default GPS earth datum is World Geodetic System (WGS) 1984.