The IP400 Networking Project

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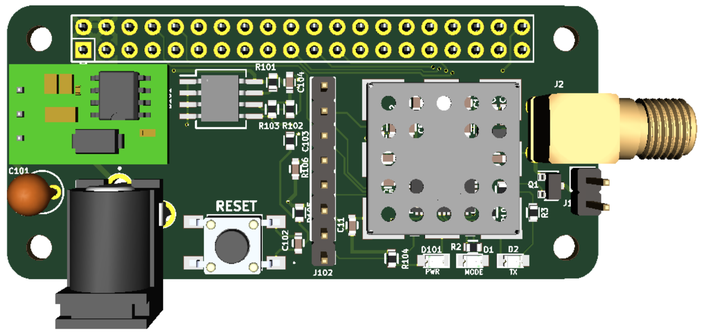
Abstract

The goal of the IP400 Network Project is to develop a next generation data communications system by Amateur Radio for Amateur Radio. Features include higher speeds (minimum 100 kbps), robust modulation (eventually OFDM) and forward error correction, automatic discovery and routing to form peer to peer mesh networks (interoperable with AREDN), and ability to transport widely varying data types, from short text messages, through digital voice and video, including AX.25 and TCP/IP. IP400 will offer an adapter (Supernode) for repeaters to allow them to interoperate with IP400 user nodes. An initial IP400 radio is expected to be available in mid 2025. IP400 is in very active development and is sponsored by the Alberta Digital Radio Communications Society.



Current IP400 Meshnode Radio HAT for Raspberry Pi

Overall Goals of the IP400 Network Project

- Automatic mesh networking / discovery with mesh (node advertising) compatibility with AREDN.
- Open source provided wherever possible.
- Meshnode Raspberry Pi HAT units to be available assembled projected for mid-2025.
- Meshnodes will transmit at 100 mW power, but can be easily interfaced to external power amplifiers.
- Supernode for adapting FM voice repeaters to be compatible with IP400 (retains ability to use FM voice) is in development, along with other IP400 modules.
- **SAFAUSR (Silly Accommodation for Arcane US Regulations)** mode. Currently US Amateur Radio regulations for data communications on the 420-450 MHz band limit the maximum bandwidth to 100 kHz and 56,000 symbols per second. (Other countries, and especially Canada, have no such limitations.) As a potential alternative to SAFAUSR in the US 420-450 MHz band, the radio chipsets in use for IP400 nodes can also be used in the 902-928 MHz band, where SAFAUSR isn't needed.

Inspirations for the IP400 Network Project

There are four primary inspirations for the scope of the IP400 Network Project - AREDN, Amateur Radio VHF / UHF repeaters, new technologies, and the opportunity to attract new Amateur Radio Operators that prefer data modes.

Amateur Radio Emergency Digital Network (AREDN) Project
In many ways, AREDN is the ideal Amateur Radio network system as it incorporates automatic mesh network (discovery and routing) techniques, high speeds (10 Mbps and faster), and native support for TCP/IP. But AREDN only operates on microwave frequencies (2.x GHz and 5.x GHz) which is not amenable to deployment in many terrains without affordable, accessible high locations for hub nodes.

Amateur Radio VHF / UHF Repeaters
Since the 1950s, VHF / UHF repeaters have been used in Amateur Radio to allow reliable operation on VHF / UHF by base stations, mobile stations, and portable radios. But with only a few exceptions, VHF / UHF repeaters have not been used for data communications, only voice (including digital voice). In the 2020s, repeaters are increasingly falling "quiet" from lack of use, creating an opportunity to adapt repeaters to support wide-area data communications networks for Amateur Radio.

New Technologies
In the 2020s, vastly improved radio, computer, and software technologies have become available that make it feasible to create a new data communications system such as IP400 by Amateur Radio for Amateur Radio. Such technologies include highly integrated radio modules, powerful, inexpensive embedded computers, and increasing sophistication of software defined radio technology… emphasis on software, including vast libraries of open source code for Amateur Radio, and software defined radio frameworks such as GNU Radio.

New Generations of Amateur Radio Operators
Any communications system is "just another technology" without a user base to use a new communications system. It's my… and others… perspective that there is a new generation of (current, and potential) Amateur Radio Operators that would actively embrace and use data communications in Amateur Radio if there were a system that was easier to use than current data communications systems available in Amateur Radio, that works reliably, embraces current network technologies, and is designed to support modest stations.

Key Differences of IP400 Network System Versus Previous Data Communications Systems

- Use of Amateur Radio 420-450 MHz band for better range (compared to microwave, including ability to use higher power transmitters).
- Higher speeds than previously achieved with Amateur Radio VHF / UHF data communications systems - minimum 100 kbps, but scalable to higher speeds.available.
- Automatic routing via IP400 enabled repeaters (SuperNodes) when available.
- Improved reliability by use of a robust modulation system that will include Forward Error Correction and eventually Orthogonal Frequency Division Multiplexing (OFDM) in the radio domain, not the audio domain.
- "Transparent" protocol that will encapsulate other systems / technologies for transport through an IP400 network. Examples include:
  - TCP/IP
  - AX.25
  - Amateur Radio voice systems (likely incorporating Multi Mode Digital Voice Modem - MMDVM)
  - Amateur Radio data systems such as telemetry, APRS, short messages, bulletins, file transfers, email
  - Video
- Designed for use on small, inexpensive, embedded computers (such as Raspberry Pi) that can be dedicated to IP400 operation.

Development Help Needed

- Background in C, writing code for a Raspberry Pi and / or ST microcontrollers.
- FPGA design in Verilog would really be helpful for development of the Supernode (repeater controller).
- Please contact Martin Adcock VE6VH ve6vh@adrcs.org.

Zero Retries Newsletter

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