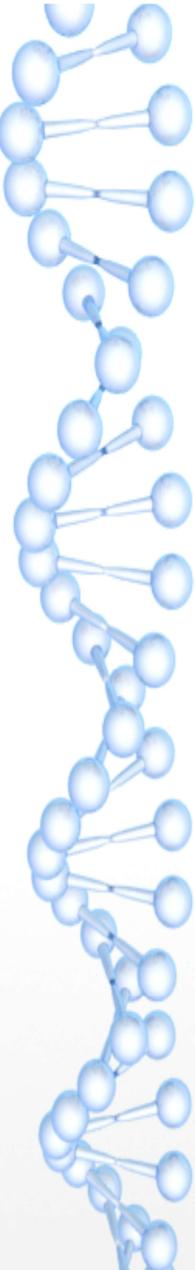


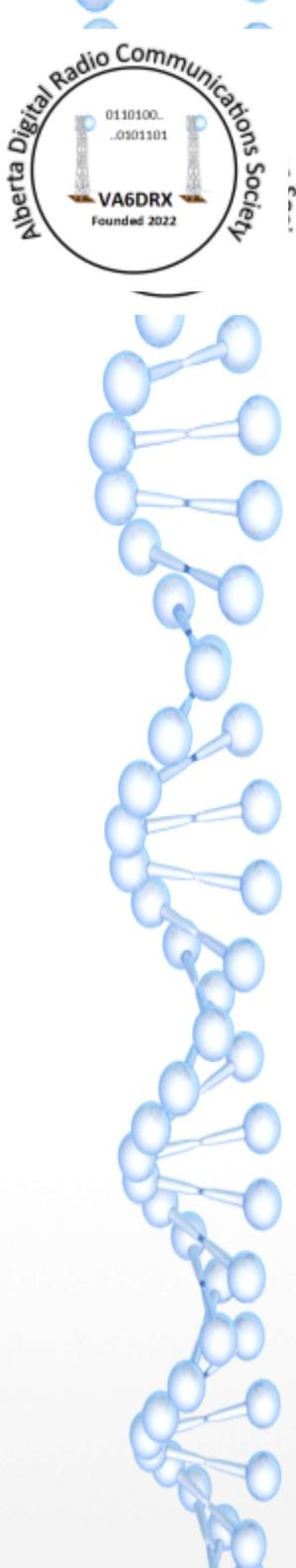


# ADRCS presents IP400



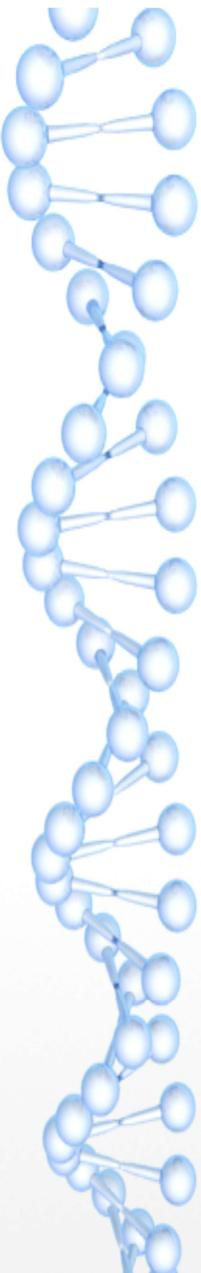
## Our Journey Today

- About the Alberta Digital Radio Communications Society
- The IP400 Project features and goals
- What IP400 is and what it isn't
- Example application
- Project Aspects
  - Transceivers
  - User Interfaces
  - Applications
- Work In progress



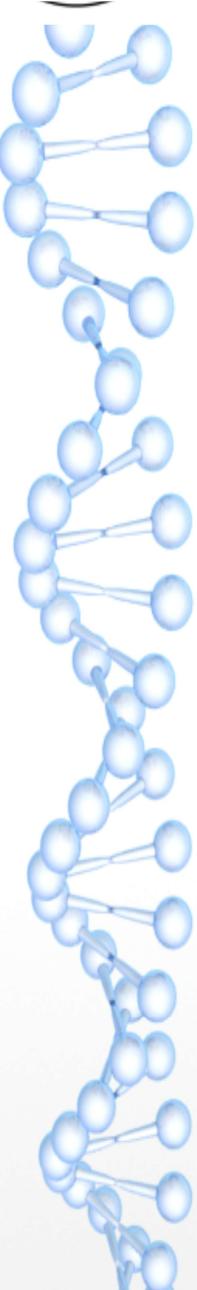
# About the Society

- The Alberta Digital Radio Communications Society was formed in 2022 to:
  - Promote the use digital communication in Amateur Radio
  - Develop and deploy digital networks
    - using both currently available technologies and those that we develop ourselves



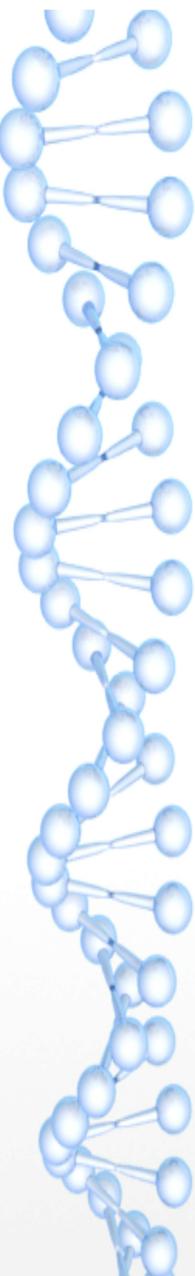
# Accomplishments so far

- Deployed the Amateur Radio Emergency Data Network (AREDN) mesh network
  - in Western Canada (BC, AB, MB), including the NW Territories and parts of Northern Montana
- Enhanced the network with:
  - Installed enterprise grade servers
  - Developed applications for digital repeater linking, gathering and disseminating weather and air quality information, repeater telemetry monitoring
  - Deployed secure e-mail
  - Portal to for Internet of Things devices and APRS
- Launched the IP400 Project



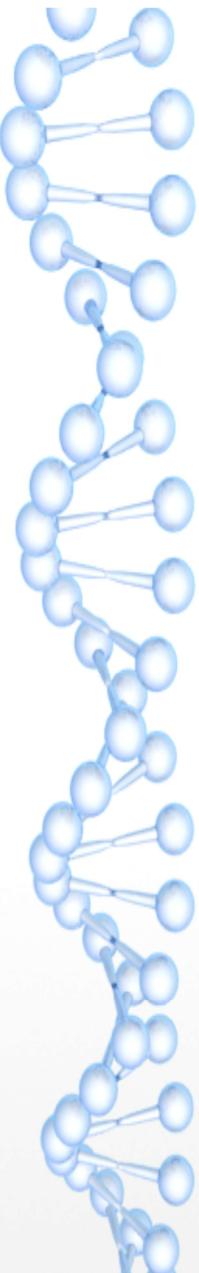
# The IP400 Project and Goals

- **IP400 arose from the confluence of several trends:**
  - A new type of Amateur Radio Operator is emerging more technical such as software developers that are more data-centric
  - Ongoing potential threats to Amateur Radio VHF / UHF spectrum (the old use it or lose it imperative)
  - An increase in use of data modes, but using simplex connections, few networks, just simple hubs, like Winlink Radio Message Servers
- **The goal of the IP400 Network Project is:**
  - To develop a next generation data communications system for Amateur Radio by Amateur Radio.
    - higher speeds (min 100 kbps),
    - robust modulation
    - forward error correction
    - the ability to transport widely varying data types



# The IP400 Features and Rollout

- **Some features of IP400:**
  - Higher data speed than most Amateur Radio data systems
  - Implement a simple mesh network
  - Ability to pass data packets using encapsulation
  - Lightweight, and extensible protocol
- **Phased rollout plan:**
  - Early phases use off the shelf and an inexpensive node
    - Proof of concept and as a development platform
    - Designed for later volume production
  - Subsequent phases will produce a high speed modem for the 400MHz and 900MHz bands using OFDM
    - Speeds goals in excess of 1Mb/s initially
    - Target speed up to 40Mb/s



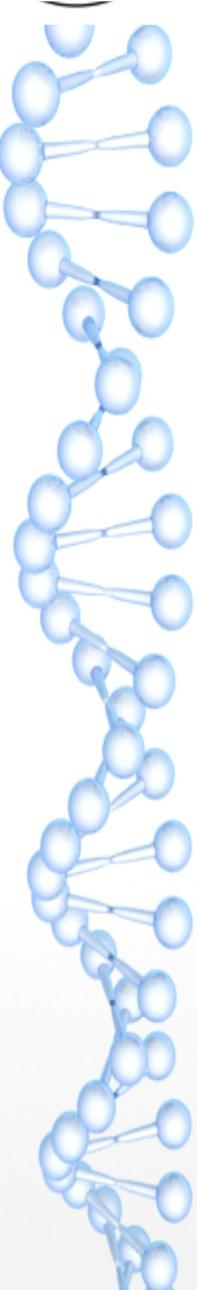
# What IP400 is

- A higher speed data mode in the 400MHz band
- Uses off the shelf components
- Digital DNA for next generation data networks
- A data transport for modern-day data streams
  - Digitized voice
  - MMDVM modes (DMR, D-Star, YSF, P25, etc)
  - Position/location data
  - Telemetry
- A local mesh network with dynamic routing information
- Fixed or mobile operation
  - location data can be static or derived from an attached GPS receiver
- An 'Intelligent Protocol', which can dynamically change formats and data rates as needed
- Able to extend an Internet Protocol LAN



# What IP400 is not

- Able to operate below 400 MHz in high speed mode:
  - Lack of required bandwidth
  - Lack of single chip to accommodate
- An SDR project
- Interoperable with the AREDN network
- Yet another implementation of an AX.25 network

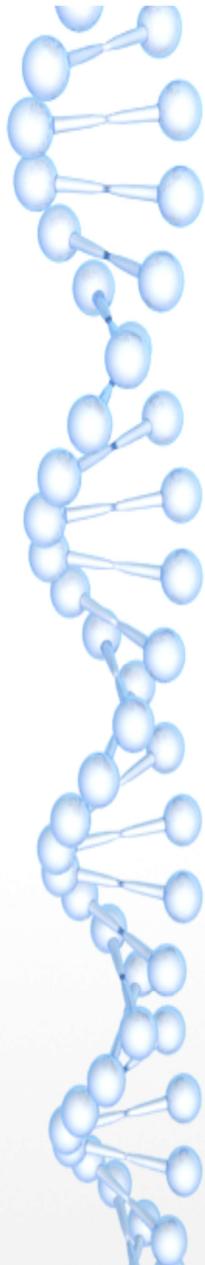


# Project Aspects

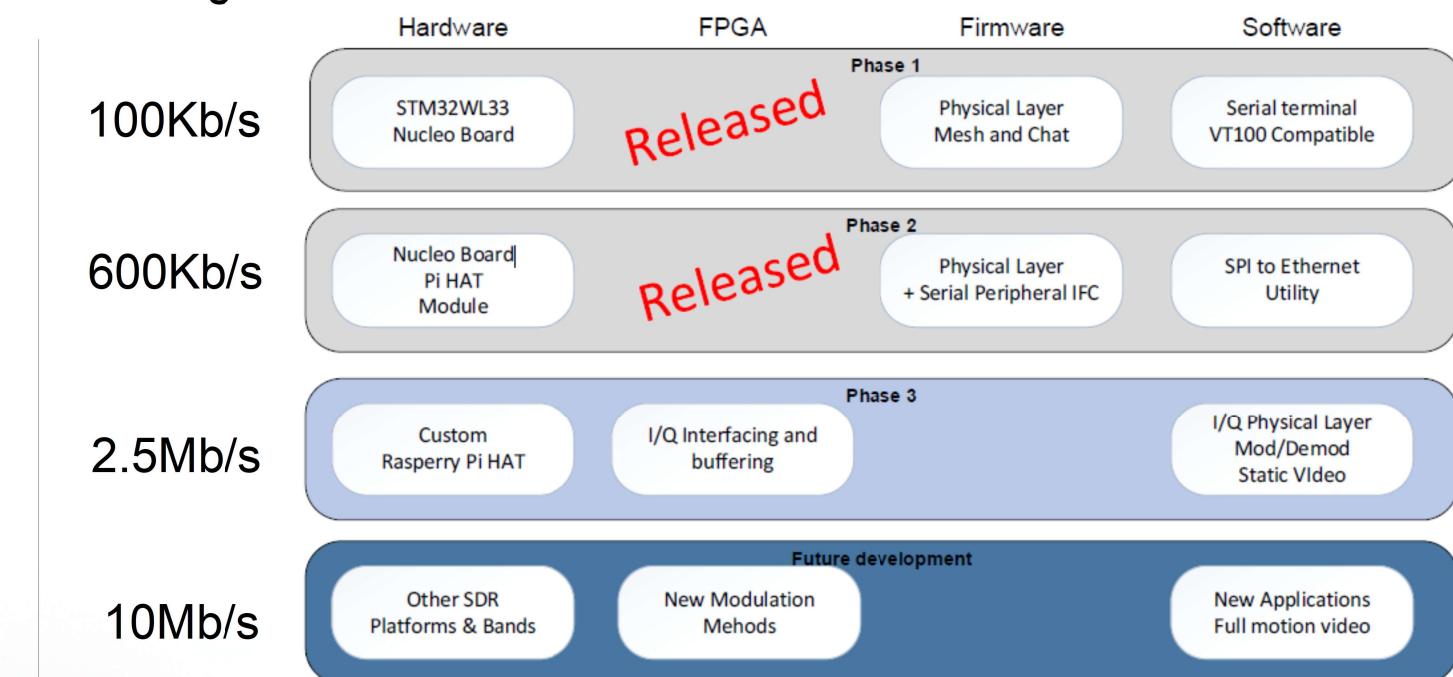
- There are three aspects to this project:
  - Transceiver development
  - User interface development
  - Application deployment

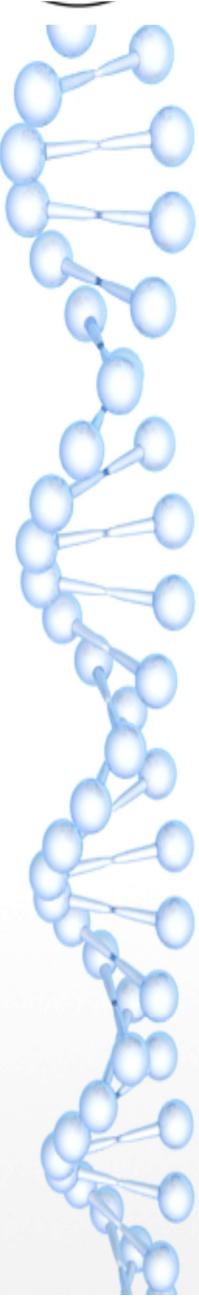


# Transceiver Development Road map



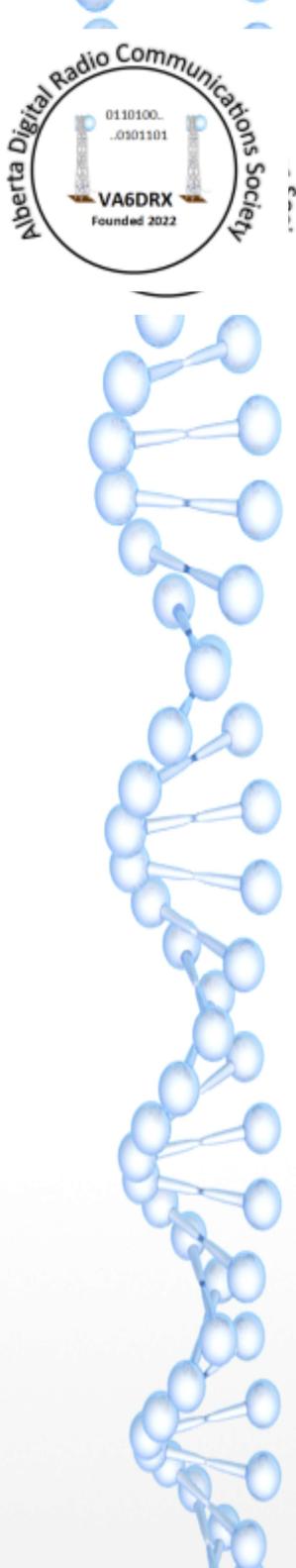
Speed  
Increasing





# Phase 1 Hardware

- Uses an off the shelf evaluation module from ST Microelectronics
- Proof of concept and software development only
- Power output limited to +16 dBm
- Unboxing:
  - Module
  - Antenna
- Basic Firmware
  - Beaconing and mesh network discovery
  - Digipeating
  - High speed data interface using SPI and attached Raspberry Pi
- User Interface
  - Menu-driven UAR/T interface is accessed from the Pi using a terminal emulator
  - Data interface using the SPI
- step-by-step instructions - available online



# Phase 2 Hardware

- Integrated Pi Zero and '**Mini node I**' HAT module
- Max power output +20dBm
- Can be operated remotely using POE kit
- Unboxing:
  - Assembled and programmed Pi HAT
  - Standoff Kit
  - Antenna
  - Pi Zero (If ordered)
- step-by-step instructions - available online
- Runs same firmware as Phase 1
  - High speed SPI data interface
  - Ethernet mode using UDP protocol
- 75 units built and shipped to date



# Next Generation Node Hardware I

- Mini Node II in a new form factor

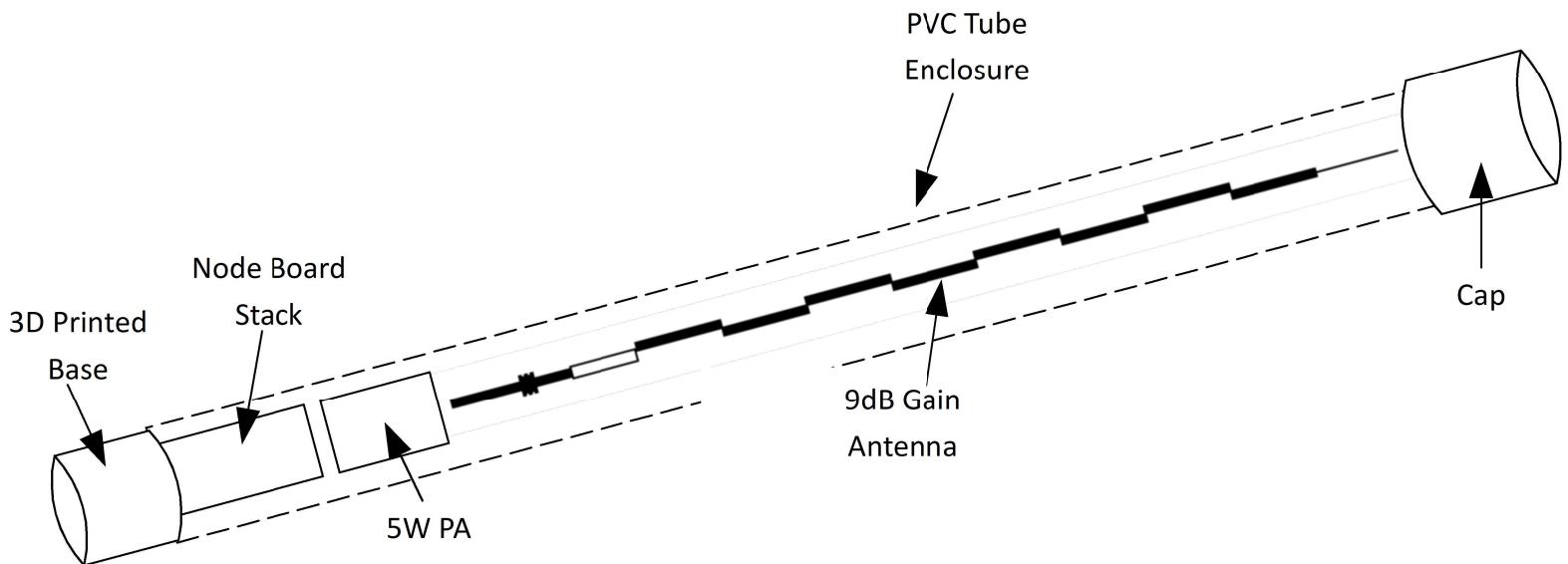


- 100% firmware compatible with mini node I
- Powered by USB only
- In Production October 2025
- Power output limited to 100mW



# Next Generation Node Hardware II

- Mini Node II with PA and integrated antenna for masthead use
- Powered by integrated POE controller
- Uses GRA5604 PA and off the shelf PVC tubing + RG58 coax

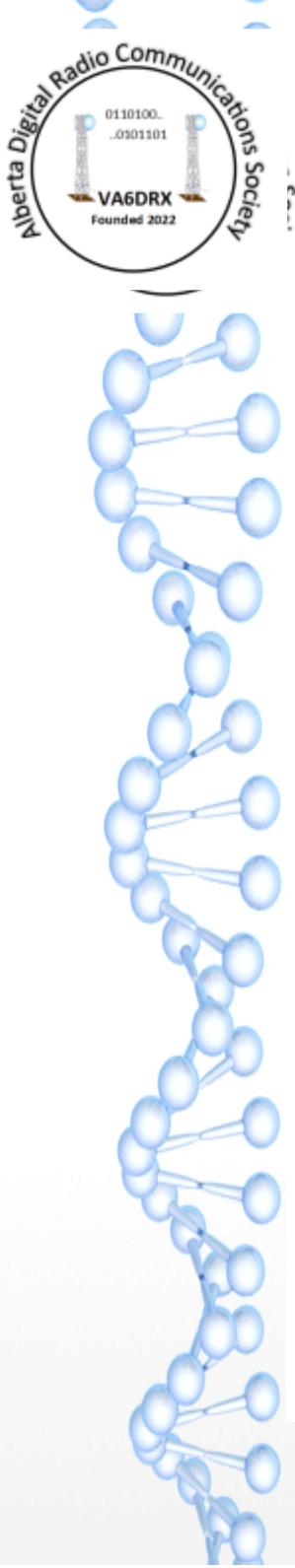


Module	Gain (dB)	Power (dBm)	Watts
Mini Node	-	+20	100mW
PA	17	+37	5 (RMS)
Antenna	9	+46	40 (EIRP)



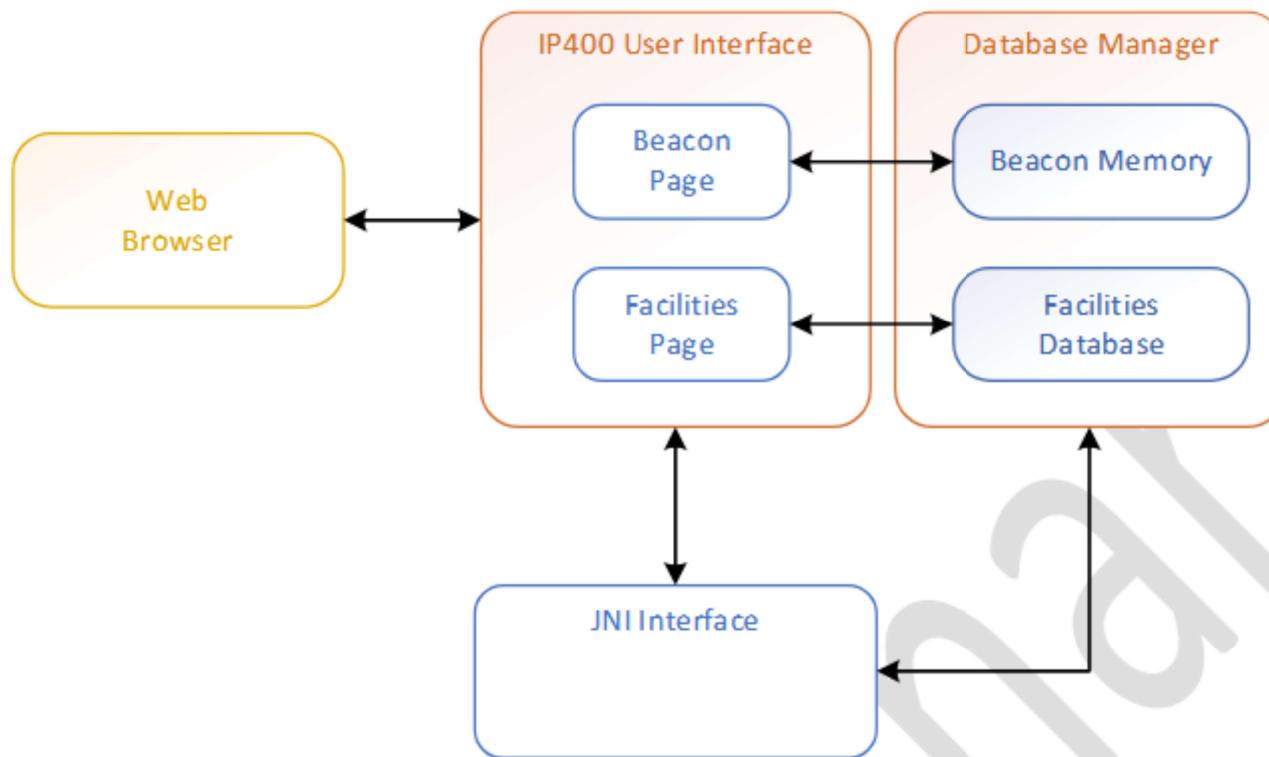
# User Interfaces

- Human Interfaces
  - Simple menu for setup and operation
    - Included in Node firmware
    - Accessed by UAR/T on Pi
  - More sophisticated UI in development
    - Java based
    - HTML access using a web browser
- Machine to Machine
  - UDP based interface for frame transmission
  - Wireshark dissector for debugging



# HTML Based User Interface

- The UI System has the following major components:
  - An HTML server which can be accessed by a web browser.
  - A Database manager to manage data collected from nodes.
  - A JNI interface which connects to local nodes and applications.



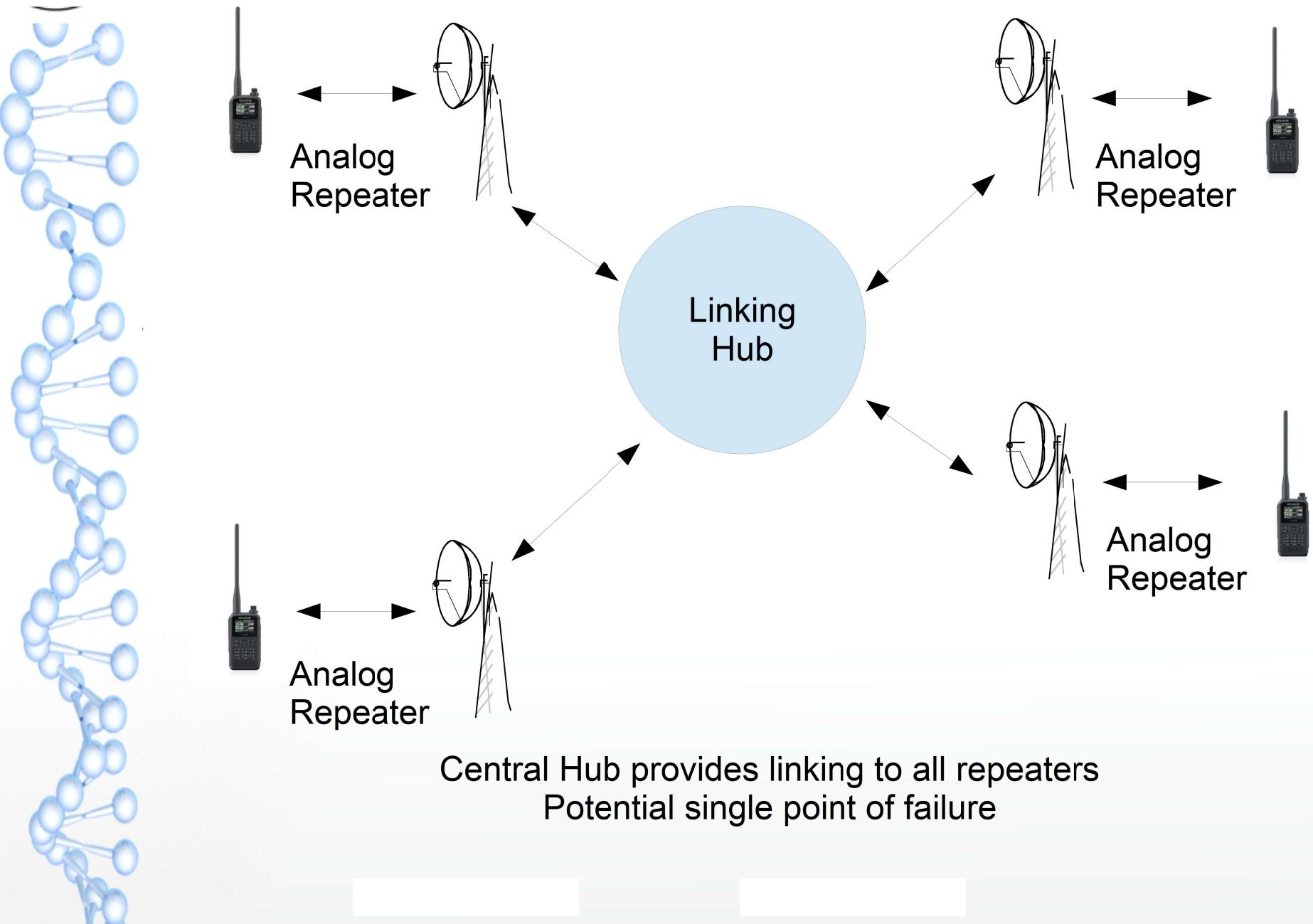


# Applications For IP400

- As a next generation packet network
  - Mini-nodes can achieve 100Kb/s, optionally to 600Kb/s
  - Interface via UDP to existing software packages
    - Winlink
- Digital repeater linking
  - Upgrade links to provide a redundant path between repeaters
  - Support analog and digital modes (DMR, D-Star, YSF, etc.)
  - Transcoding between modes

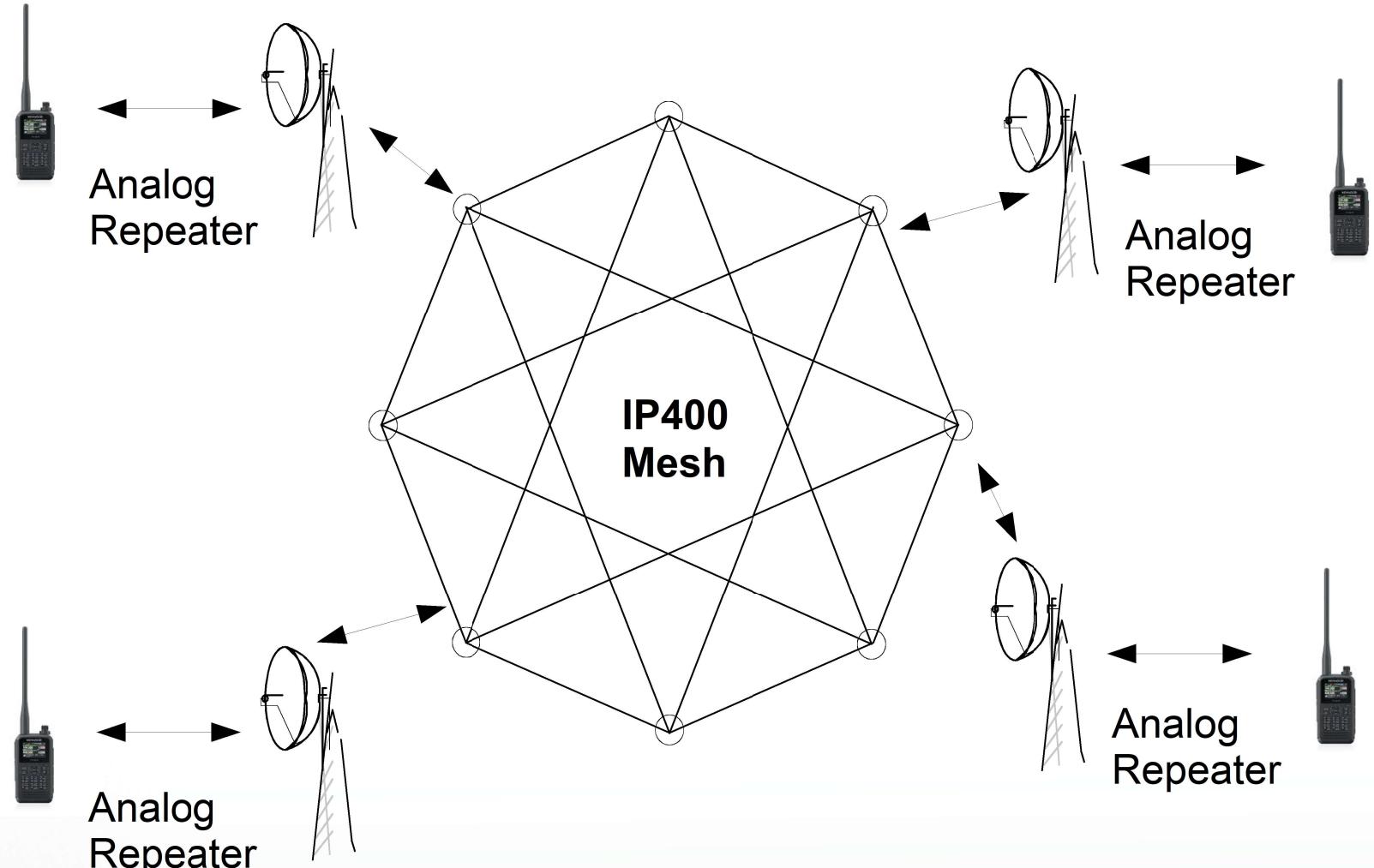


# Conventional Repeater Linking

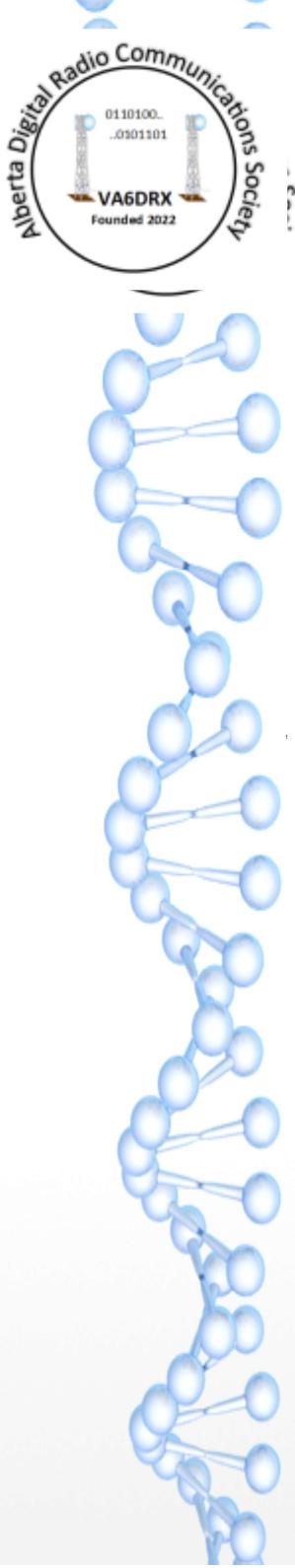




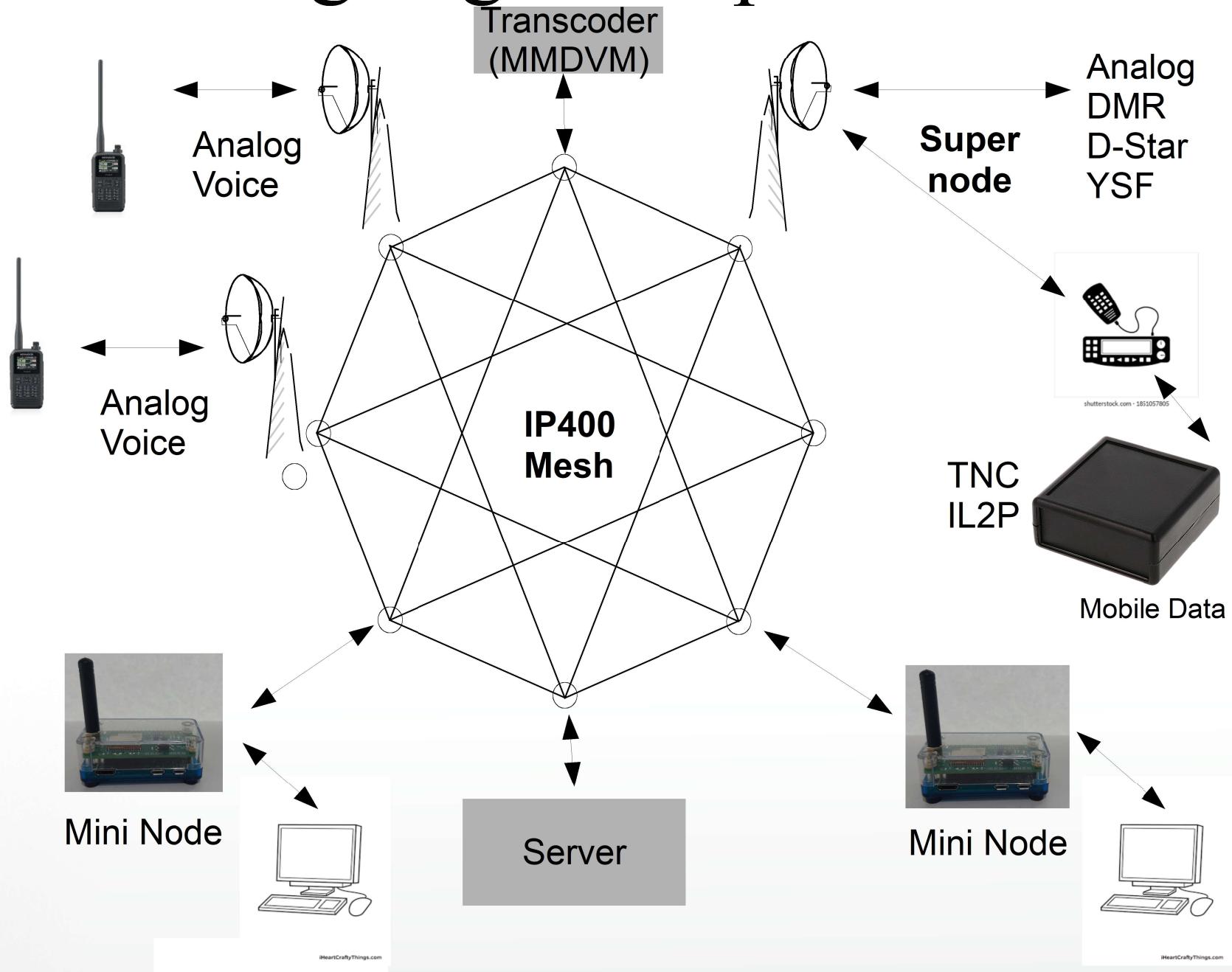
# Mesh Network Linking



Mesh network provides interconnect  
Redundant connection paths  
NO CHANGES!

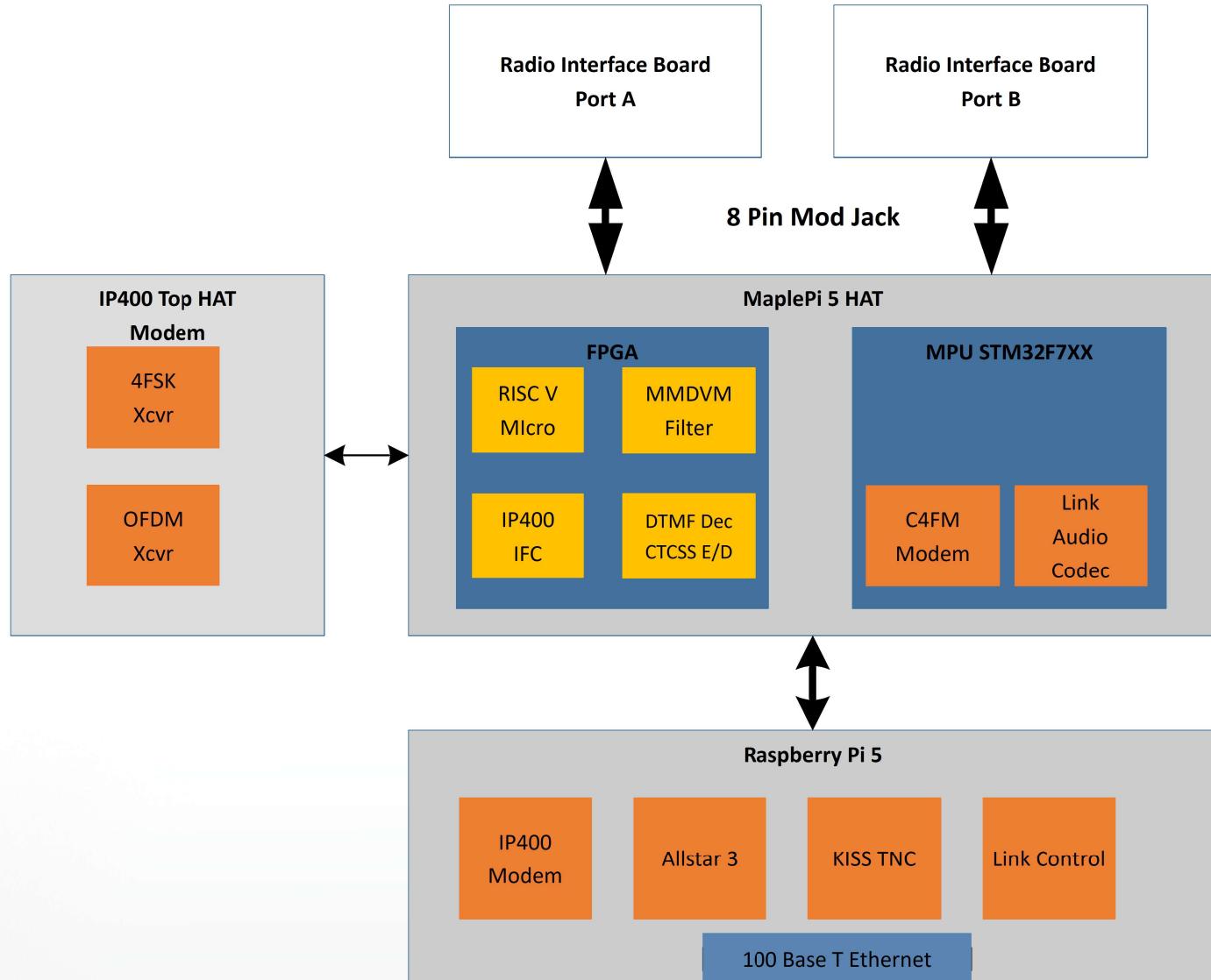


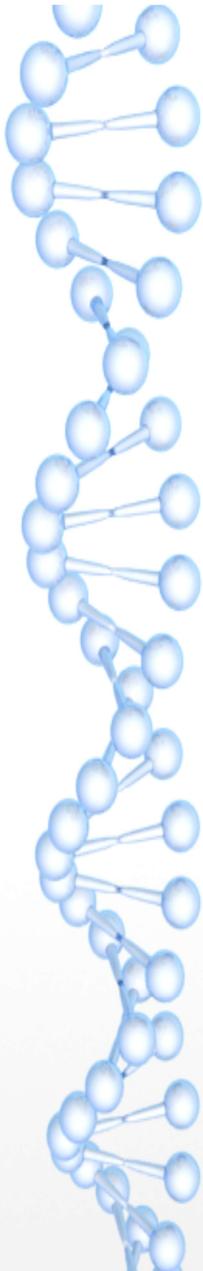
# Adding Digital Capabilities





# Phase 3 Super node

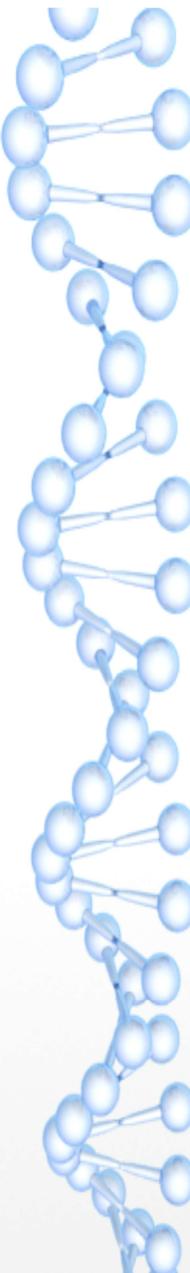




# Hardware Work in progress

- Mini Node II
  - Prototyping now, ready to ship Q4 2025
- Outdoor Node
  - PA Evaluation board available from M17 group
  - New layout required with DC regulator and Pin diode switch
- Supernode
  - Development scheduled to start Q4 2025
  - Realized on a full size Pi HAT
  - All MMDVM digital modes supported
- High Speed data modem
  - Development to follow Supernode
  - Targeting 2.5 Mb/s initially

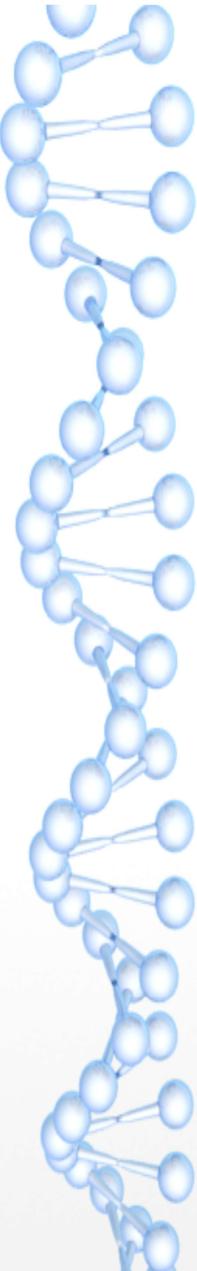
**HELP WANTED!!**



# Software Work in progress

- Mini Node II
  - Support for external PA, no new features planned
- Supernode
  - FPGA work for integrated functions
  - C Code for MMDVM modes and repeater control
- High Speed data modem physical layer
  - FFT for OFDM Modulator/Demodulator
  - Forward error correction/detection
- HTML User interface
  - Network facilities page to be developed
- Layer 3 development
  - To kiss or not to kiss
  - Session establishment protocol & network routing
  - Interfaces to popular applications

**HELP WANTED!!**



# For further information

- ADRCS Website
  - <https://adrcs.org/adrcs/>
- IP400 Project site
  - <https://ip400.adrcs.org/>
- GitHub Source code Site
  - <https://github.com/adrcs/ip400>
- Group Chat Site
  - <https://groups.io/g/ip400/messages>
- Developer Chat Site
  - <https://groups.io/g/ip400Developers>
  - For access email Martin – [ve6vh@adrcs.org](mailto:ve6vh@adrcs.org)



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**We need you!**