D-Star Low Speed Data Port

Digital Smart Technologies for Amateur Radio
D-Star

Gene Swiech
WB9COY

Overview

- Found on current ICOM D-Star Radios

- RS-232 9600 Baud two wire implementation

- Contains GPS data stream

- Always present in the D-Star transmissions

Terminology

- Digital Voice (DV)
    - 4800 bps data stream real time encoded with
        - 2400 bps voice (AMBE encoded)
        - 1200 bps Forward Error Correction (FEC) for voice
        - 1200 bps data (text messages, GPS, telemetry, etc.)
    - 6.25 kHz. Bandwidth using GMSK
- Digital Data (DD)
    - 128 kbps data stream
    - 150 kHz. Bandwidth
    - Possible extensions to other rates and bandwidths
        - E.g. 4800 bps in 6.25 kHz. (not current standard) on repeaters

Terminology

- AMBE
  - **Advanced Multi-Band Excitation** (**AMBE**) is a very powerful proprietary speech coding standard developed by Digital Voice Systems, Inc.
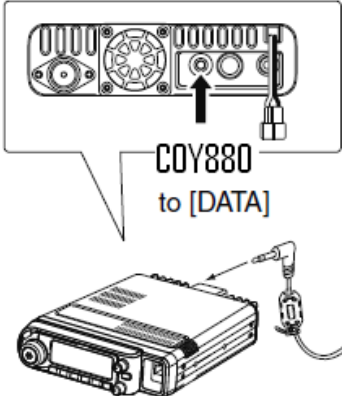   (From: http://en.wikipedia.org/wiki/Advanced_Multi-Band_Excitation)
  - Converts audio to and from the digital format used in D-Star Digital Voice at 2400 bps with 1200 bps of FEC.

- FEC
  - Forward Error Correction

Basic Hardware

COY880
to [DATA]

◇ **Low-speed data communication application setting**
- Baud rate : 9600
- Data : 8 bit
- Parity : None
- Stop : 1 bit
- Flow control : Xon/Xoff

- Radio connection
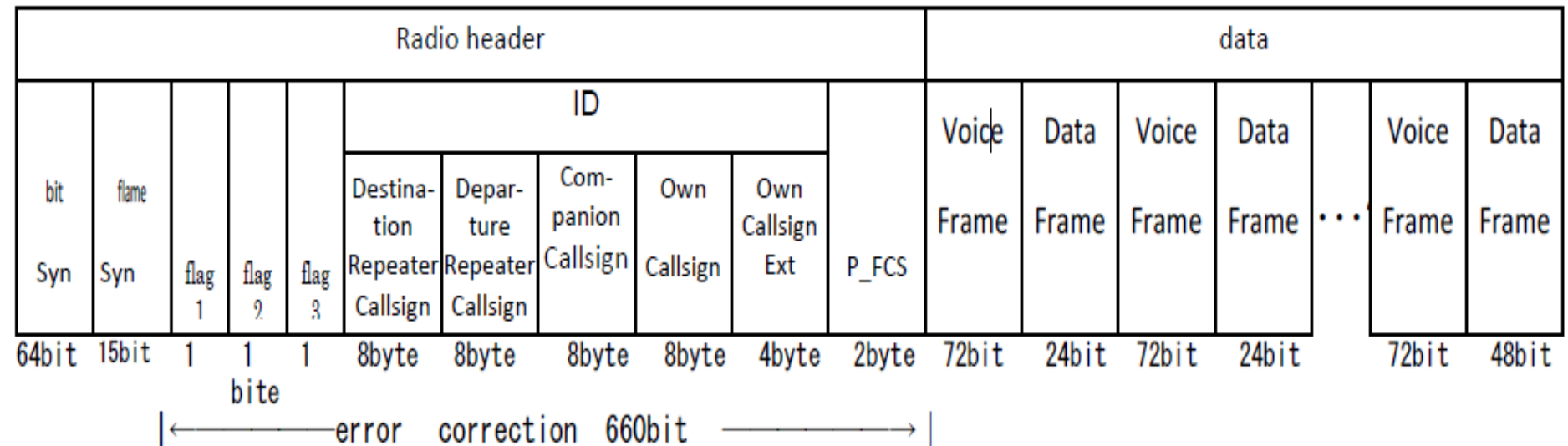
- RS-232 to USB serial converter

- Flow control characters can not be in data stream

Software

- Generic keyboard to keyboard (Hyper Terminal)

- D* Chat Brain Roode NJ6N

- DStarChatUSB Gene Swiech WB9COY

- D-RATS Dan Smith KK7DS

Under The Hood

Digital Voice Components

Radio header											data						
					ID												
bit	flame				Destina-tion Repeater Callsign	Depar-ture Repeater Callsign	Com-panion Callsign	Own Callsign	Own Callsign Ext		Voice	Data	Voice	Data		Voice	Data
Syn	Syn	flag 1	flag 2	flag 3						P_FCS	Frame	Frame	Frame	Frame	・・・	Frame	Frame
64bit	15bit	1	1	1	8byte	8byte	8byte	8byte	4byte	2byte	72bit	24bit	72bit	24bit		72bit	48bit

bite

|←——————error correction 660bit —————→|

Under The Hood

- Digital Voice (DV) uses 3600 bps for voice (2400 AMBE encoding, 1200 bps FEC) and 1200 bps for synchronization and multiuse (approximately 900 bps is available for general use).

- The content bit stream is defined as 72 bits of voice information followed by 24 bits of loosely defined "data". This pattern of 96 bits is repeated for the entirety of the transmission.

Under The Hood

- The first frame and every 21st frame thereafter is reserved for synchronization.

- There is no error detection or correction

- These bits make up 1/4th of the total 4800 bps data stream which gives a maximum transport rate of 1142 bps (1200 * 20/21).

- ICOM has made use of these data frames to repeat the RF header, repeatedly send a radio-to-radio 20 character message, and for carrying rudimentary data supplied by the user.

Under The Hood

- It is also important to note that the serial port on the ICOM radios does not give full access to the bits in the data frame. This last point brings the maximum transport rate of serial data presented to the serial port of an ICOM radio down to about 761 bps (1142 * 2/3). If the radios have a "message" programmed in, this number is even lower.

System Design Considerations

- Pros:
    - Good for sending small low priority messages
    - Provides a nice keyboard to keyboard pipe

- Cons:
    - NO FEC
    - Message content not guaranteed
   - Not a good choice for critical high priority traffic

System Design Considerations

- Pros:
  - Good for sending small low priority messages
  - Provides a nice keyboard to keyboard pipe

- Cons:
  - NO FEC
  - Message content not guaranteed
  - Not a good choice for critical high priority traffic

Baker To Vegas Kids Race

D-Star Usage Proposal

Overall System Concept

- Use voice and data to communicate race status
- Provide basic team tracking using RFID tags
- Use D-Star data capabilities to provide real time race status
- First phase will use D-Star low speed data
- Collect race status in a relational database
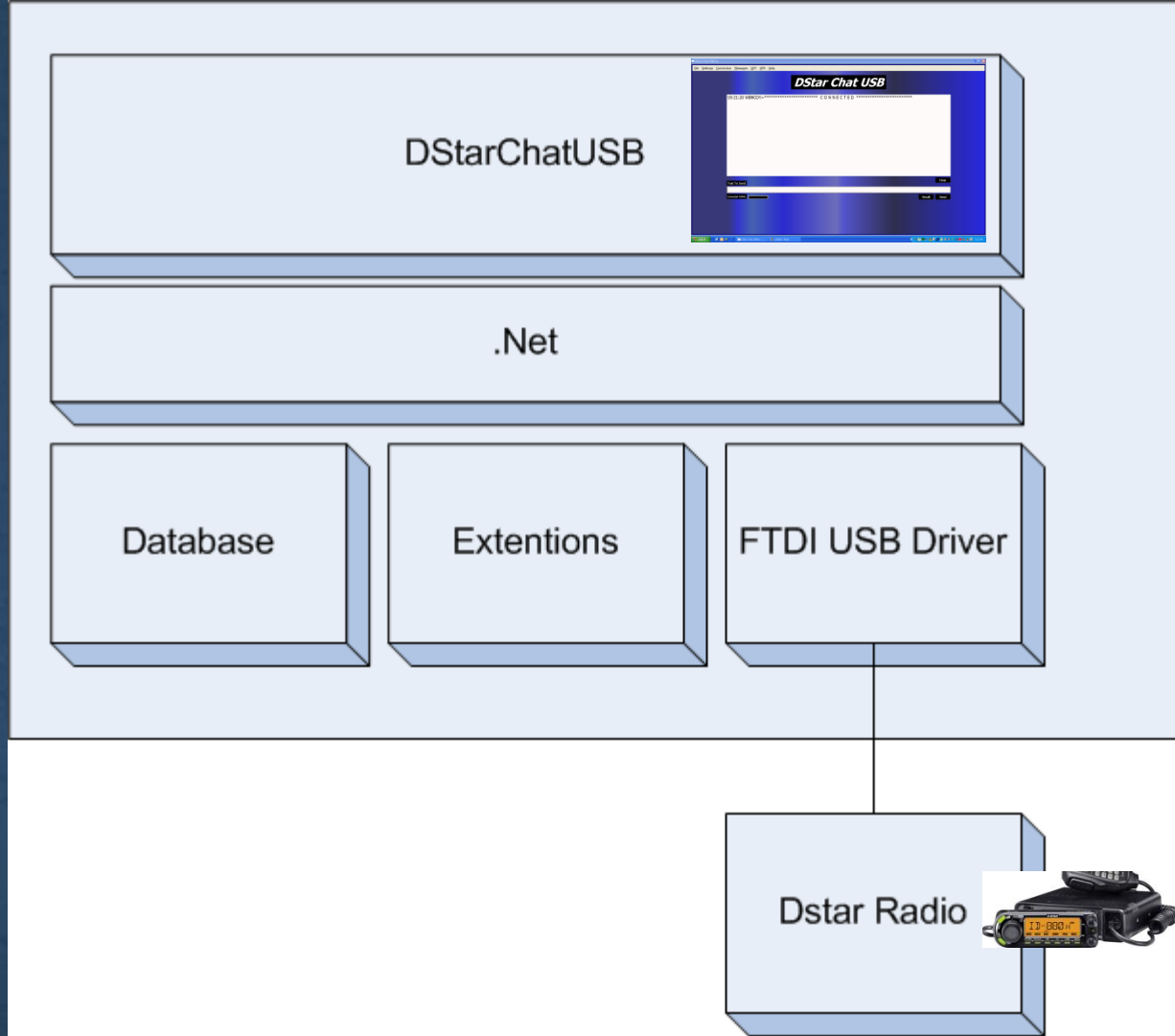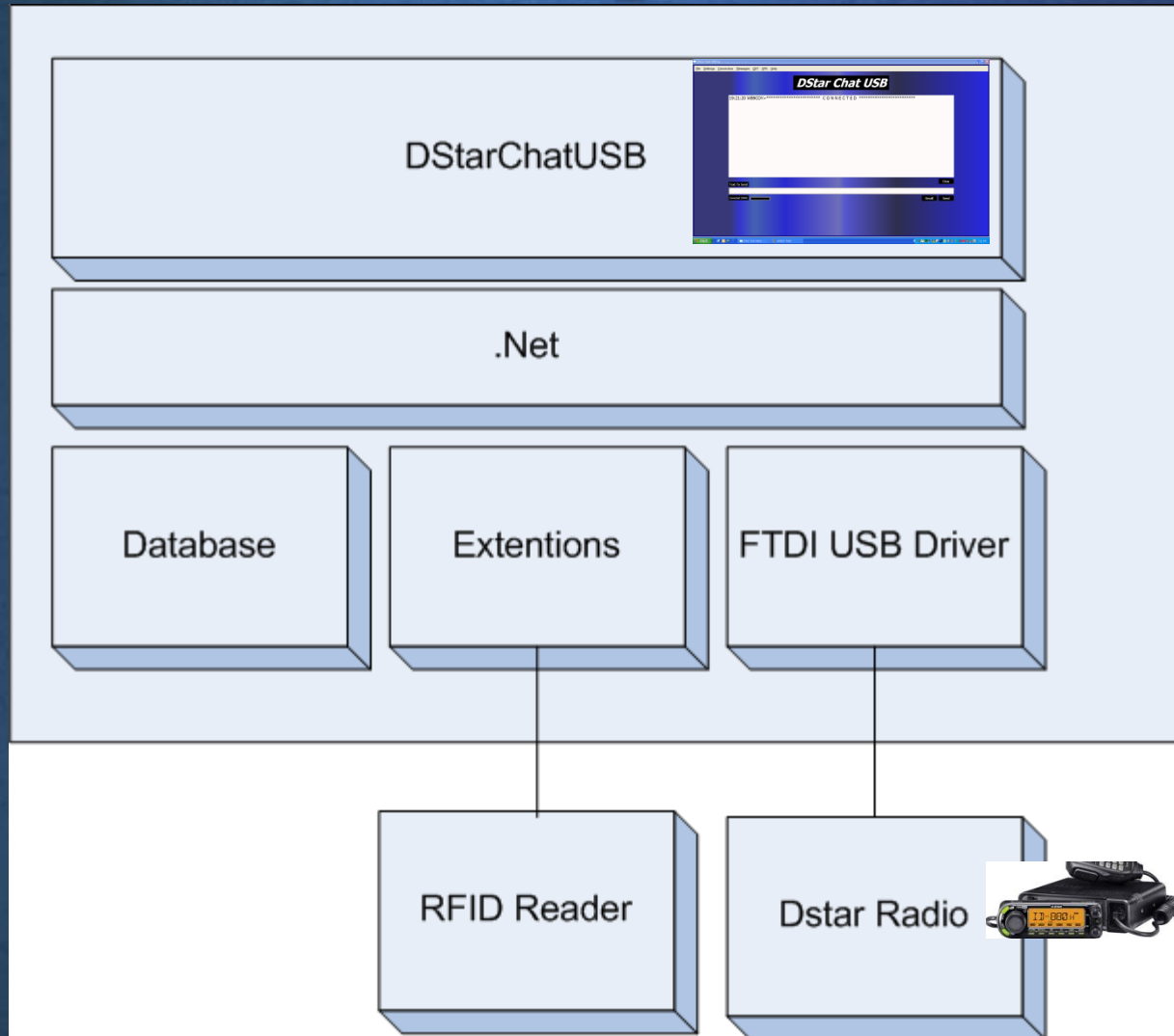- Optionally provide access to database using ID-1

Radio System
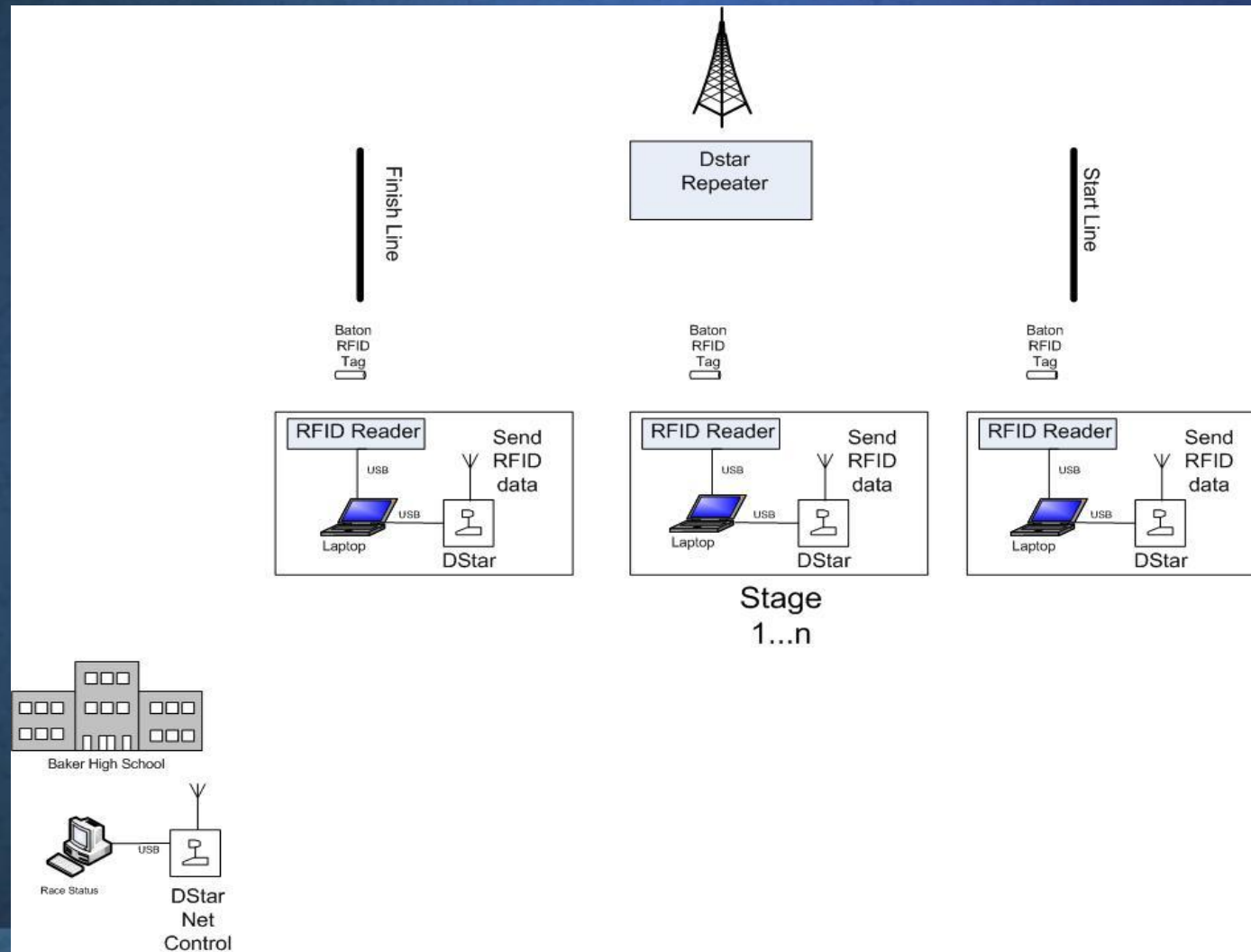
Software

- Generic building block design
- Center piece module provides basic radio connectivity
- Extensions are added to center piece to implement race administration functionality or stage operations
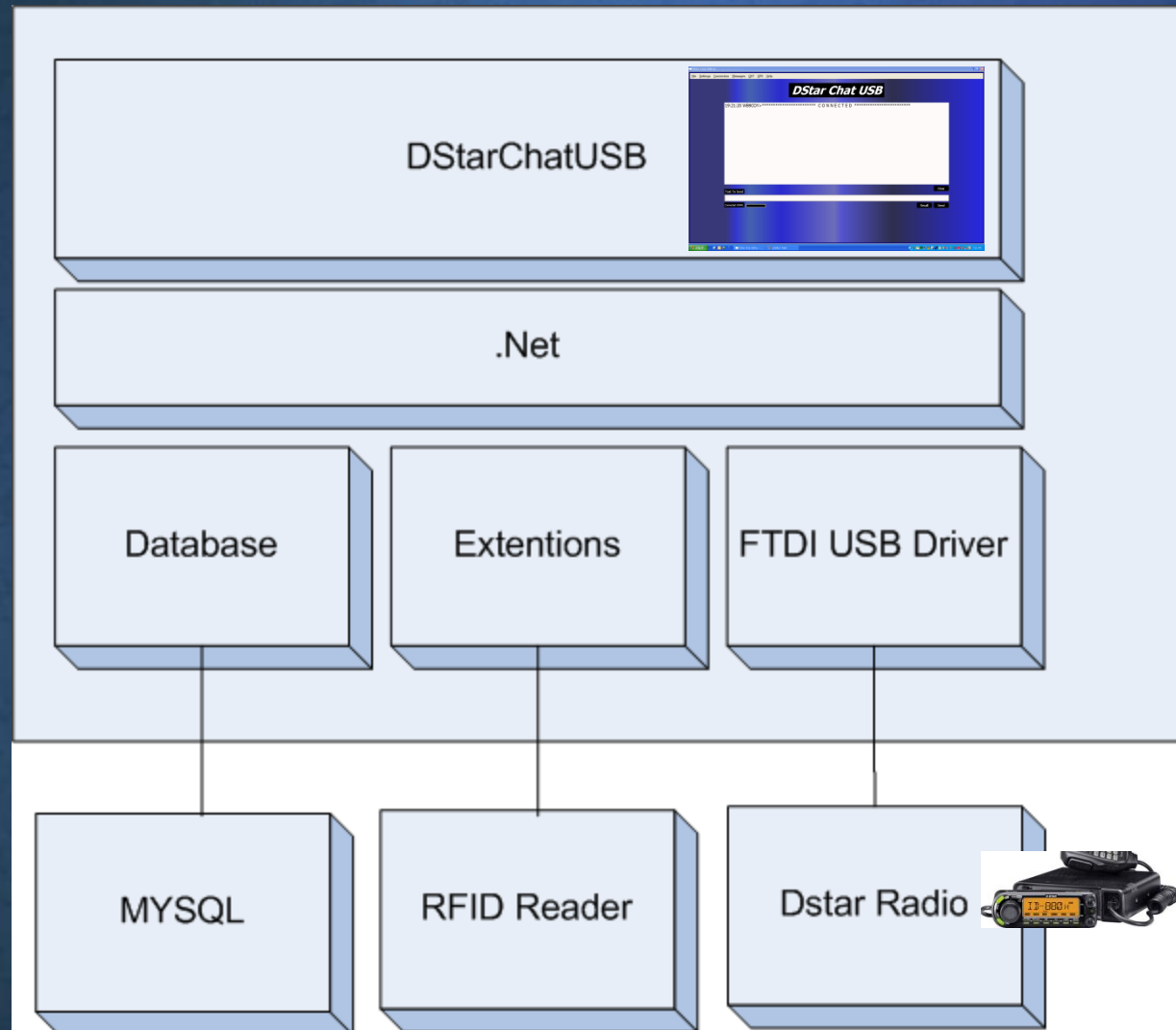- Same base user manual used for all extensions

Basic Software Core

Basic Software Stage

Basic Software Race Admin

SMTP Mail Services