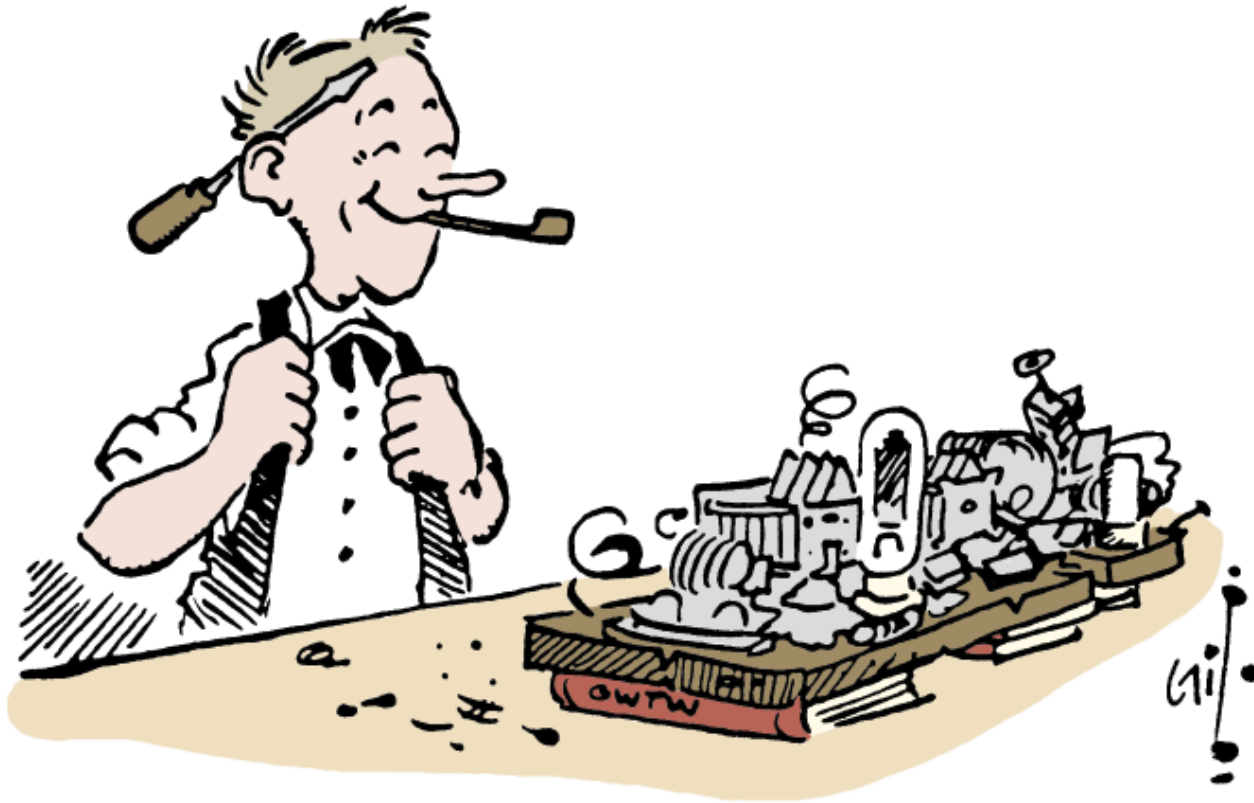


Homebrew D-STAR



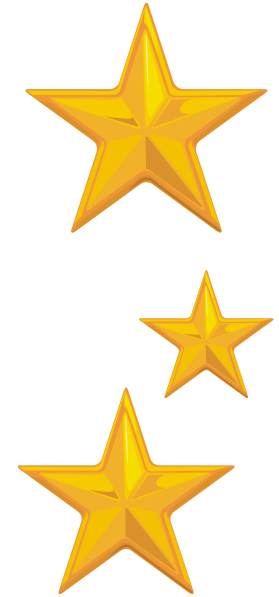
**Jim Moen – K6JM
12 October 2013
Pacificon
Santa Clara, CA**

Artwork by
"Gil" Gildersleeve
W1CJD

Buy "Gil - A Collection
of Classic Cartoons
from QST" at the ARRL
store

What I'll talk about

- **Digital Voice and D-STAR**
 - DV and CODECs
 - Linking repeaters and reflectors
- **Hotspots**
 - What are they and what can they do?
 - Homebrew: Set up your own Hotspot
- **What's new in D-Star?**
 - Tiny computers like Raspberry Pi, BeagleBone Black
 - Various D-Star boards to work with these tiny PCs
 - New Software and hardware approaches



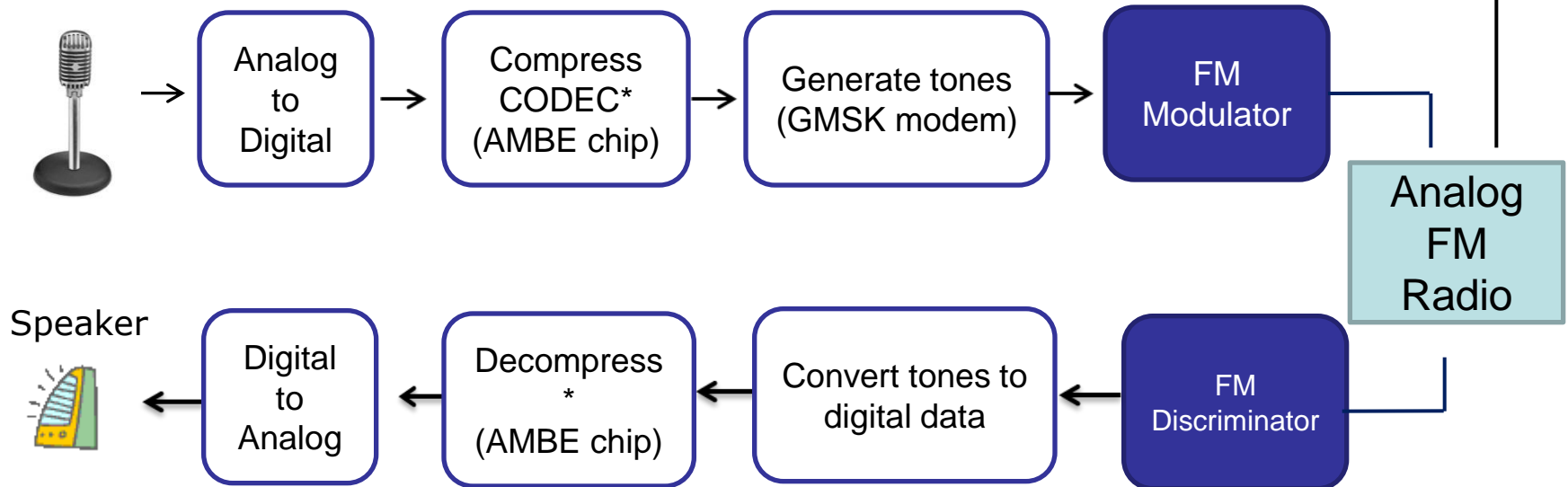
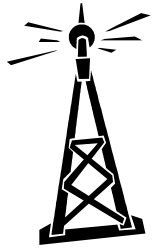
What is D-STAR?



- ✓ **D**igital **S**mart **T**echnology for **A**mateur **R**adio
- ✓ **P**rotocol **s**tandard for Digital Voice & Data
- ✓ **O**pen **s**tandard facilitated by JARL
- ✓ **I**COM has built D-STAR radios
- ✓ Most radios use 144MHz/440MHz/1.2 GHz
- ✓ ICOM 7100 & 9100 add D-Star to HF bands
- ✓ Uses **GMSK** (Gaussian Minimum Shift Keying) with FEC (Forward Error Correction)

Digital Voice Radios

Using D-STAR as an example



*CODEC: Compression/DECompression algorithm

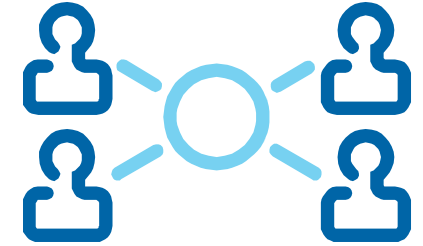
- D-STAR uses the most popular proprietary CODEC: AMBE
 - High quality, low bit-rate algorithm - Adds \$25 to cost of radio
 - Used for serious DV: commercial, military, P25-II
- CODEC2 is Open Source, used by FreeDV – freedv.org
 - CODEC2 is becoming popular for HF DV
 - Hopefully will become popular for VHF/UHF

What's good about D-Star?



- Clean audio, no static
- Callsigns & messages on radio screen
- D-STAR network links repeaters and reflectors around the world
- Let the system find another ham (callsign)
- Can send small data files (spreadsheets, “emails” & forms for EmComm, etc.)
 - On 1.2 GHz, can send larger files

What's fun about D-STAR?



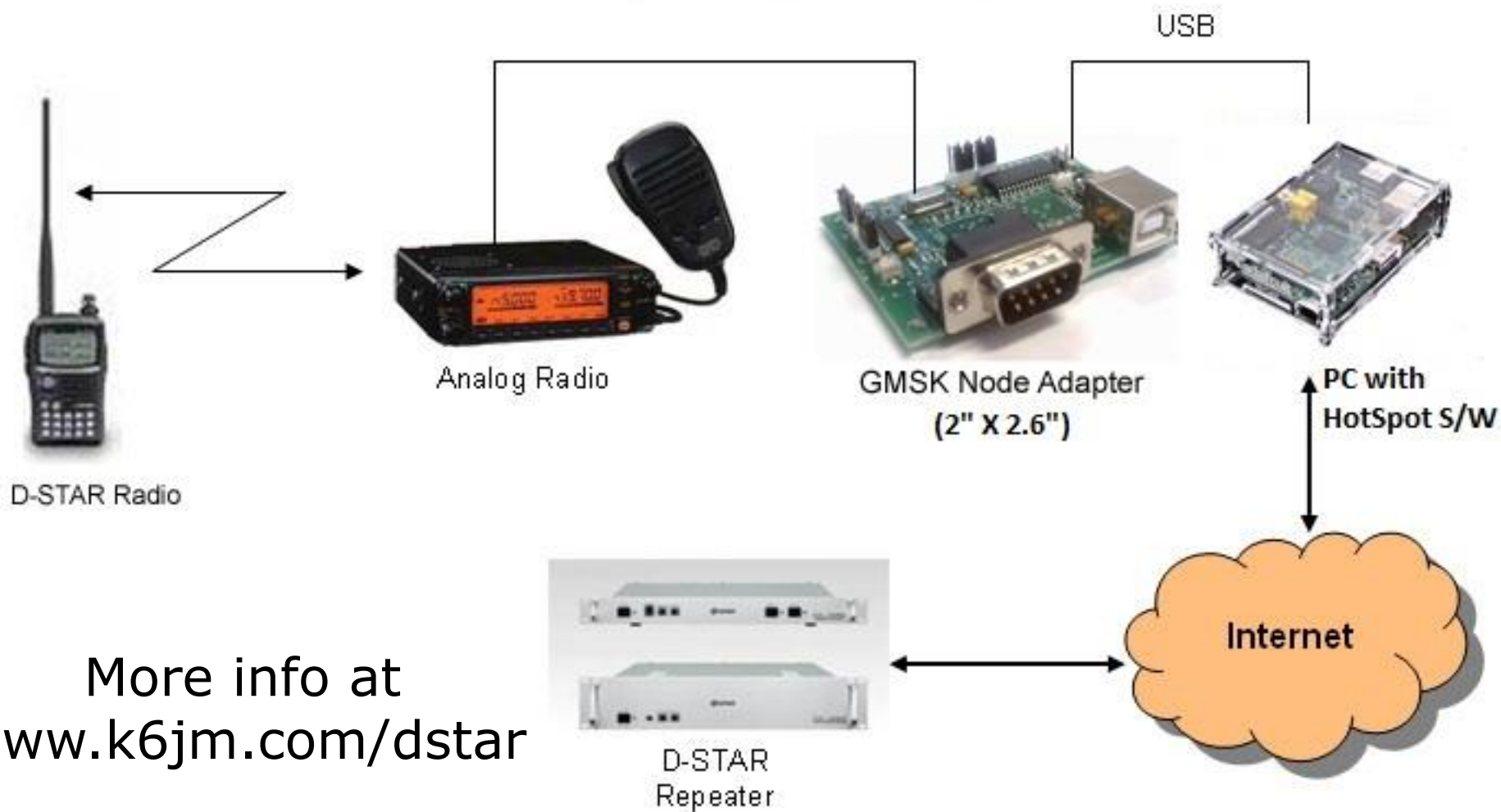
Answer: The D-STAR Network

- You can connect repeaters to other repeaters
Or to “Reflectors” (Conference Servers)
- Access hundreds of reflectors, 1000s of repeaters and hotspots
- You can build your own inexpensive D-Star compatible Hotspot or Repeater
And that can connect to reflectors around the globe

Is ICOM the only D-Star Supplier?

- ICOM makes great D-Star radios for DV/DD
 - Including 2820, 31A, 51A as well as 7100 & 9100 HF/VHF/UHF
- Internet Labs offers DV Dongle, DVAP & much more, like the newly announced DV Pi
- Hams are extending D-Star with DIY projects
 - GMSK Modems to create inexpensive HotSpots & Repeaters using analog FM radios
 - Software (mostly free) to extend D-Star functions
 - D-Star Adapters to add D-Star compatible DV to analog radios
- This is now a highly active and creative area
- Multiple vendors are extending D-Star

What's a HotSpot?



More info at
www.k6jm.com/dstar

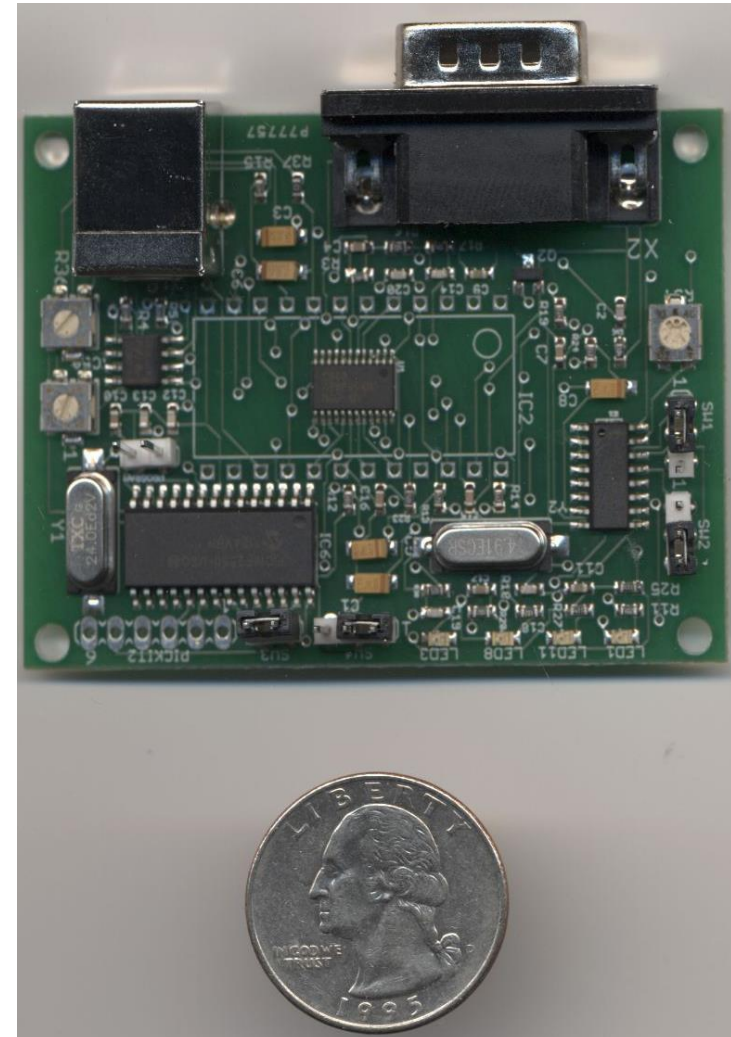
Why HotSpots?



- **Brings D-STAR network to your neighborhood**
 - If your QTH has no RF access to a D-Star repeater
 - Or (like my QTH) is in a multipath shadow
 - Or you want to link to whatever repeater whenever you want
 - Or you need extra power for extra range
- **It's an interesting Do It Yourself project**
- **What is needed?**
 - Modem (many available for D-STAR)
 - Computer (e.g. Raspberry Pi computer for < \$50)
 - Analog FM transceiver that supports 9600 Packet
 - Software (free)

Just what is a GMSK Modem?

- **Converts digital signals to tones for transmitter**
- **Converts received tones to digital again**
- **Decodes the gmsk protocol (headers, routing info)**
- **Does NOT decode or generate Digital Voice stream**
- **Can be used with DV Dongle and PC mike/speakers to add DV to analog radio**

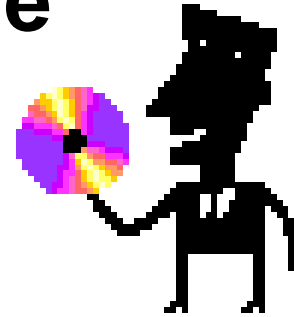


GMSK Modem Sources

- **Fred van Kempen PA4YBR**
 - www.dutch-star.eu Provides “mini hotspot” boards, firmware and software.
- **Matrix Circuits & MoenComm**
 - www.moencomm.com distributes boards based on PA4YBR’s design, comes with DUTCH*Star firmware and tools.
- **Satoshi Yasuda 7M3TJZ/AD6GZ**
 - d-star.dyndns.org/ Designed the first Node Adapter. Also produces firmware and tools.
- **DVRPTR Project**
 - shop.dvrptr.de/ Uses DSP firmware for GMSK modem function. Provides software. They plan to offer new boards with embedded AMBE chip.
 - www.dvrptr.net/ Offers DVRPTR Version 1 board
- **PAPA System (coming soon)**
 - www.papasys.com/index.php?pageid=gmskboards
GMSK boards to work with Raspberry Pi and Aduino micro computers

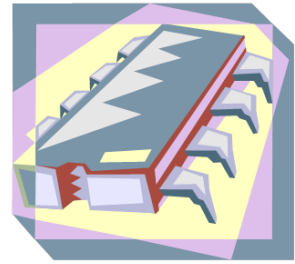


HotSpot/Repeater Software



- **DVAR Hot Spot – Mark McGregor KB9KHM**
 - First and still most popular
 - Easy to configure
 - Supports DPlus linking
- **WinDV – DUTCH*Star – Fred van Kempen PA4YBR**
 - DPlus, Dextra, DCS linking, ircDDB Gateway & Callsign Routing
 - DPRS-APRS interface
 - Works with GMSK Modem, DVAP, DV Dongle
 - DTMF commands over RF and more...
- **GMSK Repeater & ircDDBGateway – Jonathan Naylor GK4LKX**
 - Windows and Linux
 - DPlus, DExtra & DCS, ircDDB and CCS Callsign Routing
 - STARnet Digital
 - Full function, yet fits on a small Linux pc like Raspberry Pi
- **DVRPTR Control Center**
 - Works with DVRPTR boards
 - DPlus, DExtra, DCS, ircDDB Gateway & CCS Callsign Routing
- **G4ULF NI-Star – David Lake G4ULF**
 - Creates Repeater compatible with ICOM Repeater/Gateway
 - Works with all G2 Gateway Add-on Apps
 - Learn more from Rich Timpa – KC6OBJ – the next presenter

What's new in D-Star?



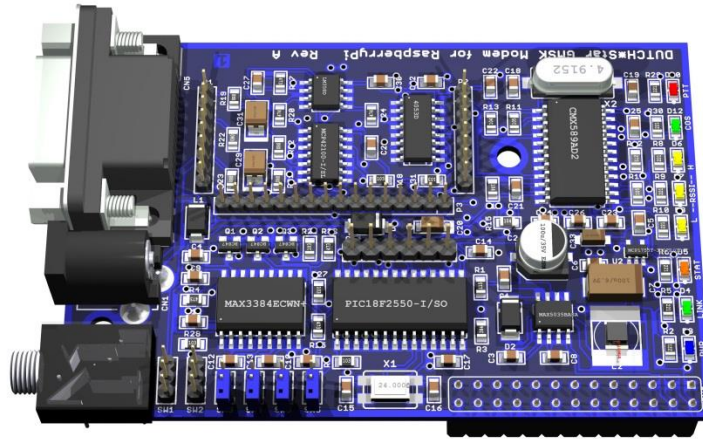
- Small, or even tiny computers to run networking software
 - Raspberry Pi has become super popular –developed as educational tool
 - \$35 plus SD card, power supply & cables
 - Another step improvement in lowering cost of DIY projects
 - Runs Linux
- Boards that plug into the Pi
 - DV Pi – Internet Labs (DVAP, DV Dongle). Basically a AMBE chip on a board, with control and RX/TX audio from Android device (tablet, smartphone)
 - DUTCH*Star Pi GMSK board
 - PAPA System GMSK Boards
 - For Arduino, like normal GMSK board, but less expensive
 - For Pi, an inexpensive add-on GMSK board (under development)
- DSP-based modems (DVRPTR project)
- More Open Source software

Raspberry Pi



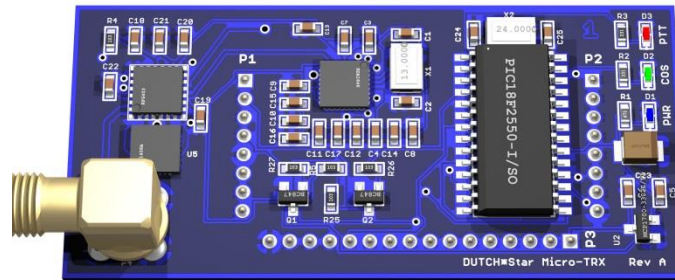
- Credit-card sized single board Linux computer
- \$35, \$50 with extras
- Hams are using for Hotspots and Repeaters
- G4KLX and FreeStar software
 - DUTCH*Star DV Node for Linux/Mac under development
- Easy to setup:
 - SD card images – burn, configure and go
 - Use right away, then begin to learn more Linux
- I have installation notes that I'll share
 - Email me: jim@k6jm.com

DUTCH*Star Pi GSMK Modem



- Tiny, fits on Raspberry Pi's GPIO pins (SPI bus)
- Runs on 3.3v, won't overload Pi's power system
- Stackable (e.g. 2 boards for multiple radios)
- Has GSMK chip & DUTCH*Star firmware
- Can add micro RF transceiver board

DUTCH*Star Pi Transceiver Board



- Fits on Pi GSM Modem board
- Creates tiny, low power full-featured Hotspot
- No cables
- Under development

DVRPTR Project



- German team led by Jan DO1FJN designed DSP style board and Open Source firmware
- Fewer dedicated chips, software does the work
- V1 board had GMSK Modem functions
- Add-on board had AMBE code chip for D-Star
- Control Center pc software
- Jan left team – V2 board similar but not widely available
- V3 board launching now from Germany
- V1 board still available, now from Canada
- Powerful idea, but low-cost Pi pulls design in new direction

Shameless Plug



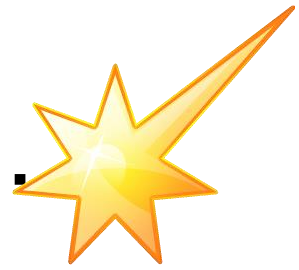
MOENCOMM

DIGITAL AMATEUR RADIO



- www.moencomm.com
- I sell the Star*Board GMSK Modem
 - Build your own Hotspot or D-Star compatible Repeater
 - Includes DUTCH*Star firmware
 - Normally \$119 plus S&H
 - Great support 😊
- Check out booth (across from ARRL)
 - Special show prices

When I Wish Upon a Star...



- D-Star has traction/infrastructure and will stay as a popular DV technology. DMR will too.
- Where should Ham Digital Voice go next?
- My answer: CODEC2
 - Open Source, easy to embed in projects
 - If one manufacturer made CODEC2 DV radios, there'd be an explosion of creative add-on functions
 - These things take time. Enjoy D-Star now!

Summary



- D-Star is moving beyond original ICOM vision
- This stuff is fun and we can all do it
- Lots of support available
 - Getting Started: www.k6jm.com/dstar
 - Yahoo Groups:
 - gmsk_dv_node
 - dstar_development, pcrepeatercontroller, ircddbgateway
 - gmsk_dv_modem
 - DVRPTR
 - Vendors' sites:
 - MoenComm K6JM www.moencomm.com
 - Fred van Kempen PA4YBR www.dutch-star.eu
 - Satoshi Yasuda 7M3TJZ/AD6GZ d-star.dyndns.org/
 - DVRPTR: shop.dvrptr.de and www.dvrptr.net