

MicroHAMS Digital Conference 2009

**Past Present, and
Future of Digital
Amateur Radio**

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Or...

**Everything I Needed To Know
About Broadband Wireless
Internet Access...**

I Learned From Amateur Radio Digital Communications

aka Packet Radio

I' m a recovering technology writer

- My specialty was... is... Broadband Wireless Internet Access
- My base knowledge of wireless... and TCP... and digital communications...
- All came from Amateur Radio

Over The Years, I Was Amazed...

- At how much of my knowledge of Packet Radio was applicable
- How much “they” got wrong
- That I knew was wrong (Cisco infamous quote)

Packet Radio started in the early 1980's

- There's a huge knowledge base out there
- That's largely lost on current "Digital" Amateur Radio activities
- We've been reinventing Digital Amateur Radio over the last decade
 - Slowly...
 - Imperfectly

Now We're About To Start On A New Era Of Amateur Digital

- D-Star is getting a real toehold now
- Amateur Digital Communications is getting sophisticated enough to be of interest in emergency communications again
- We're getting over the "Packet Radio Fetish" and embracing TCP/IP, web, and networking
- New generations of Digital Hams will emerge, because D-Star is good enough to interest them
 - "128 Kbps", TCP/IP, Plug and Play / Off The Shelf

And I' m A Little Surprised...

- At how much of our “tribal knowledge” of Digital Amateur Radio Communications isn' t being applied
- Partly my fault... our written knowledge base of Digital Amateur Radio Communications is largely offline
- Or at least not on the web... which is to say, inaccessible to the vast majority of new hams

**So... I thought it might be fun to
share some of what I learned from
Packet Radio, and how I applied
it in my writing about Broadband
Wireless Internet Access**

Physical Layer 101 - SNR

- In the end, it's about how much signal... and how much noise... makes it to the receiver
- You can play a lot of tricks with protocols, modulation techniques, channel access techniques, processing
- But in the end... it boils down to SNR
- It is astonishing how few in the wireless industry get this simple fact

Physical Layer 101 - Antennas

- See above... antennas are the single biggest factor in SNR
- Followed closely by feedlines... ideally, lack of feedlines
- Huge breakthrough in the BWIA industry when systems migrated from
 - Radios in the rack, antennas on the tower
 - Modulator in the rack, transverter / power amp on the tower with the antennas
 - Entire radio on the tower, within a couple of feet of the antenna
 - Hams should do that too

Physical Layer 101 - Antennas (cont.)

- Hams get this pretty well... but...
- They pick not-great sites for systems because they're available / cheap / free
- Sometimes it's better to pay for a really good site
- It doesn't have to be paid out of individual pockets - there's money out there for Emergency Communications
- Or... go cellular... lots of antennas / systems spread out to provide wide coverage
- Google maps coverage plot - where doesn't a system have coverage?

Physical Layer 101 - Antennas (cont.)

- High, good sites have their advantages
- Easy for users to “aim at” with beams
- Hams can be flexible enough to use a hybrid high profile and cellular approach
- Unlike commercial systems - they’ re *either* high profile... *or* cellular... and *committed* to whichever *one* they choose

Physical Layer 101 - Repeaters

- Huge lesson we learned in building packet radio systems - digital repeaters work really, really well
- No hidden transmitters - all users systems knew when there was someone else was transmitting
- Full Duplex realtime throughput - not listen, buffer, retransmit like a digipeater
- Bit regeneration
- Repeaters like this are an incredibly effective use of a channel - very efficient, very few retries needed

Physical Layer 101 - Repeaters (cont.)

- But for digital these days, we build far more digipeaters than repeaters
- Repeaters are hard
- Repeaters are expensive
- We don't have any repeater pairs available
- Yes... Yes... Yes... and Yes... and I still think we should build digital repeaters rather than digipeaters
- One gripe I have with D-Star is that their high-speed "access points" aren't repeaters... and in my opinion, they should be.

Stuff Breaks

- Need to plan for it, build for it
- Really strive for reliability
- Monitor the site / system continuously, record data
- Have redundant equipment...
- On site, on hot standby if possible
- Preconfigured, tested, ready to pull off the shelf if not

Stuff Breaks (cont.)

- PCs can be reliable, but usually aren't
- They get killed by temperatures - they simply aren't spec'd for wide temperature variations
- They get killed by physical movement - not secured when the building shakes
- They get killed by bad power - PC power supplies really, really suck
- They get killed by gunk in the air filling up the fan vent after a year

Stuff Breaks (cont.)

- Use industrial power supplies
- Strap it down, whatever it is - you never know when it will move
- Use embedded PC boards or industrial PCs
- Try not to use fans because eventually they will clog and fail
- Try not to use hard disks - use solid state drives (not flash like CF - that will get killed from read/write cycles)
- Use a watchdog timer
- Remote power reset

Stuff Breaks (cont.)

- In an emergency, you might get a ride to the site on a helicopter with 10 minutes notice
- Have a checklist and organized supplies before you go
 - Spare equipment
 - Tools, parts, wire, connectors, flashlights, spare batteries, tape, etc.
 - Documentation, disks, passwords, configurations, etc.
 - Food, water, basics (like gloves)

The Tensions Of Dictatorship Versus Decentralization

- The most efficient form of government is a dictatorship
 - Preferably, benign
- But dictatorships are hard to do right, and benignly
- Amateur Radio has this unfortunate tendency with abuse of power
- I think that half the reason we started using TCP/IP over Packet Radio was so we could send email directly between each other and bypassing the BBS (almost always run by a control freak)

The Tensions Of Dictatorship Versus Decentralization (cont.)

- Some of the worst fights I witnessed were the “Packet parameter wars”
- They’ re probably still raging
- One recommendation I can make is to thoroughly document:
 - Recommended parameters / settings
 - Recommended technical specifications (minimum power)
 - Explain the reasoning *behind* the recommendations
 - Users may not agree with or follow the recommendations, but they’ re more likely to do so if they understand the reasoning behind them

The Tensions Of Dictatorship Versus Decentralization (cont.)

- Design systems to reduce the need for dictators to emerge
- Example - IP Addresses, subnet masks, gateways, etc.
- Make it as simple as possible:
 - Subnets for each system
 - DHCP
- Put a web server on each system, with a Wiki, a way to look at who's using the system, etc.
- Face to face meetings help a lot; faceless dictators seem more numerous

The Internet As Part Of An Amateur System

- Contrary to popular belief, the Internet *doesn't* go down
- Internet Access goes down... often...
- Edge of the disaster theory
- If you plan ahead... really plan ahead, you can use / rely on Internet
- ISPs in New Orleans stayed online during Hurricane Katrina, but only because of good planning and hard work
- Example - put your radios at the Westin Building, Fisher Plaza, or Boeing's old Kent facility that's now a fiber hub

The Internet As Part Of An Amateur System (cont.)

- But don't rely on Internet *Access* systems
- Especially personal / home systems
- *Especially don't rely on cellular Internet access systems*
- Cable systems are only good for 6 hours or so...
then the batteries on the poles are exhausted
- But... if it is working, use it opportunistically
- And be prepared to do so with “go packs” that
can plug into Ethernet, get an IP address, and
start routing between radio and Internet

The 9 Layer Model

- Layer 8 is the Financial Layer
 - All systems have to ultimately be paid for
 - But that's another discussion
- Layer 9 is the Administrative Layer
 - Systems don't manage themselves
 - Even Macs

Administrivia Matters

- Techies just don't appreciate that administrivia really matters
- If a system is going to be successful, it needs to have the administrivia attended to
- Ideally someone who's conversant with the technology, but is really good at managing the details
 - Keep the paperwork up to date
 - Do some basic Public Relations / Advertising for the organization / system
 - Pay the bills
 - Press the flesh
 - Write things down

Meetings Are Important

- In the Internet era, we think that meetings aren't all that necessary
- We have better methods for the mundane conveyance of information
- But meetings are important for the social context
- We aren't communicating between machines, we're ultimately communicating between people
- And knowing the person behind the keyboard is important and beneficial
- Vitally important for new Amateurs
- Publish the meetings widely

Make Room!

- For new users
- For youthful enthusiasm (like, hey dude...)
- New technologies
- Within our shared spectrum
- On our existing systems
- Systems that are *actually used*...
- Trump systems that are old and tired

Make Room! (continued)

- Make accommodations for access by users of inexpensive, low-performance, systems
- Write things up with the new person in mind
- How the system works
- How to build your system at home
- Names of people that would be willing to help

Make Room! (cont.)

- Ask for forgiveness rather than ask for permission
- Is the channel in use? No? Then use it!
 - Quiet channel time is a resource wasted forever
- If you have a better idea, don't get slowed down or deterred by those that don't get it
- You find kindred spirits by publishing what you're doing - publish, publish, publish (blogs, wikis)
- Bdale Garbee - wished he hadn't built the lesser system
- Always educate people that don't understand but are willing to learn...
 - But don't get deterred by other's lack of vision

One Last Thing...

Zero Retries

- Packet Radio Newsletter from the glory days
- In this new era of Amateur Digital Communications, I think it's needed again
- Obviously, digital distribution via Internet
- But same format - longer articles, monthly, photos
- Digital communications, emphasis (but not exclusive) to PNW
- I'll be Editor and a writer, but welcome contributions

Thanks!

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