Regarding Fusion

Category: Fusion
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Some thoughts about Fusion, digital modes, and the future.

Fusion uses the lower layers of the P-25 architecture. Modulation, transport, framing, etc. The primary differences revolve around what's in the packet. For example: The use of call signs instead of unit IDs. So Fusion shares most of P-25. FWIW, Fusion is also very similar to DMR. The primary difference is that it doesn't use TDMA – jamming two separate channels into the space of one.

P-25, DMR, NXDN(Kenwood), IDAS (Icom), and Fusion use the same vocoder. D* uses a much older and obsolete vocoder.

Fusion and D* have been optimized, although differently, for Amateur Radio. DMR, NXDN, and IDAS have been optimized for commercial services, like taxi cabs. P-25 has been optimized for government services, like police departments.

Fusion was actually designed by Motorola in that period of time that Motorola owned Yaesu. This benefits Fusion since the vocoder and the signal processing firmware are pretty much the same as what Motorola uses in their radios. (Believe me, not all signal processing firmware is designed the same!) Thus, the performance of Fusion is pretty darn good. Add to that an additional layer for FEC provided by Yaesu's modification to P-25, and the performance of Fusion is better than all the others. (D* is substantially worse than the other protocols.)

What we see from this is that most of the communication industry has evolved around the same technologies even though the systems are not directly compatible with one another. This is why it is

so easy for a hotspot to translate between DMR, P-25, NXDN, IDAS, and Fusion. But is this the best we can do?

No. Digital performance could be much better. C4FM already blows away FM with superior range and capability, but it was intentionally limited – to work with FM/PSK transmitters and receivers like those used with FM.

FM is a non-linear system thus it does not transmit all the information it could in the available bandwidth. Linear systems, such as OFDM, can provide higher bit rates lower error rates, better resistance to fading and multipath, amongst other things. The problem is OFDM requires linear amplifiers and thus is not compatible with all the FM/PSK transmitter and receiver designs.

Personally, I'd like to see OFDM as an option for digital's future.

But all digital systems could be made better by some enhancements at the repeater site. The use of multiple, diversity receivers incorporating very low-level discrimination could improve receiver sensitivity by as much as 10 dB. That means HT would perform almost as well as a mobile rig with no changes required of the user. Having multiple diversity receivers at various locations around a city could mean that a low power HT would work virtually anywhere in that city. Sadly, there doesn't seem to be a market for doing such things. (This technology is well understood and used by your cell phone.)

One last note. Several attempts have been made to build multi-protocol radios incorporating DMR, Fusion, D*, FM, and others into a single unit. Should be simple, right? But we have yet to see such radios on the market. If we did, they wouldn't do Fusion as well as Yaesu, or D* as well as Icom, or DMR as well as Motorola. Why? Protocols are damn hard to get right. They are even harder to get working really, really well where they take

into account all the things that can go wrong with data transmission. (Hotspots try to do the conversion, but never work as well as going “native”.)

I would argue that the amateur community should focus on those systems designed for Amateur Radio. Ultimately those will be easier to use and better suited for the job. (Police departments and taxi cabs should not use Fusion!) A good user experience is critical if digital, any digital, is to become generally accepted.

One last note: Nothing prevents Icom from building a Fusion radio. Every last little detail about Fusion is public information, particularly since most of it comes from P-25 – for which Icom builds radios. The only proprietary aspects of Yaesu’s system are WiRES-X and IMRS.

Purchasing amateur radios that do digital help support the future of digital by encouraging companies to develop more and better digital features. Buying commercial Chinese radios just helps the Chinese economy.