Dandin Chronicles 2.4

A Different Kind of World,
A Different Kind of Company:
How Software Defined Radios Change
The Rules

Why SDRs?

We're going to be seeing a race to see what wins, cellular architectures or ad-hoc networks.

A Different Kind of World, A Different Kind of Company

CEO Dewayne Hendricks on software defined radios and how they change the rules

A software-defined radio is what we call a cognitive radio. It's a radio that thinks. It runs software. Software defined radios are not science fiction any more.

One of Dandin's pushes has been for a more open spectrum management paradigm, or a decentralized spectrum management paradigm, where the devices themselves figure out how best to operate.

The best way to describe it is that we're moving toward ad-hoc packet radio networks. This is something new for the industry.

What you see right now is a cellular architecture, which is a centralized mechanism. You have devices, and they talk to these access points; there's a hierarchy, and it goes back into the wired infrastructure.

The ad-hoc networks are different, in that every entity in an ad-hoc network is a peer. The radios all talk to each other. We're going to be seeing a race to see what wins, cellular architectures or ad-hoc networks.

If you look at the Internet, the Internet's all about ad-hoc networking—the Internet comprises all these networks of networks. Networks can come and go. If you think about how you should do wireless IP, you should do it that way also. It makes more efficient use of the spectrum.

If you want to get out to a mode where you're not locking spectrum down like we do now, and treating it like property, then you've got to take this decentralized step.

If radios can cooperate in building a network together, the distance you'd have to transmit is very, very short, so you don't have radios blasting all over town. Radios blasting all over town cut down on spectrum reuse.

We feel that ad-hoc networking would be much more efficient. It would allow you to have lower power, which would increase the battery life in the use of these kinds of devices as opposed to cellular.

It's all about peering, in that if you're an equal peer, you should be able to talk to other peers around you.

Incumbents who have paid for their spectrum like real estate will take a dim view of this, because it's a direct attack on their hegemony.

Conceivably if these radios are implemented, somebody could come in and piggyback on "their" frequency.

Dandin, along with EDUCAUSE in our filings last year on the Tribal Lands Notice of Proposed Rule Making, asked for the FCC to do a proceeding on software defined radios. On March 17 they announced a Notice of Inquiry on software defined radios (http://www.fcc.gov/Bureaus/Engineering_Technology/News_Releases/2000/nret0004.html). A Notice of Inquiry is the first step to doing some rule makings on these things. It allows the government to collect information. You can bet there'll be people coming in on this pro and con.

Incumbents who have paid for their spectrum like real estate will take a dim view of this, because it's a direct attack on their hegemony; conceivably if these radios are implemented, somebody could come in and piggyback on "their" frequency.

Dandin's going to file comments; EDUCAUSE is going to file comments; TAPR's going to file comments on this.

I think for us is to try to show what you can really do with software defined radios in the United States is just going to be an uphill battle.

. We're going to take the approach that the TDR-900 is a software defined radio. We're going to start taking that and walking along that space, to see how we can develop it into an open standard—essentially a way of doing ad hoc networking, inside or outside the amateur radio service.

Or outside the country, in a place like Tonga where you can really take this thing out for a walk and see what it'll do.

FCC Chairman Kennard: "With all the new wireless products out there we are running out of spectrum."

Why SDR?

Software defined radios, including Dandin's own TDR-900, and their potential benefits

The FCC today asked for public comment on a new generation of radio equipment under development that can be quickly reprogrammed to transmit and receive on any frequency within a wide range using virtually any transmission format. This programming capability could allow a single device to transmit in the various cellular, PCS and other wireless services used in the United States and worldwide.

In a Notice of Inquiry approved today, the Commission stated that introduction of this new technology, referred to as "software defined radio" (SDR), has the potential to change the way users can communicate across traditional services. These changes could promote more efficient use of spectrum, expand access to broadband communications for all persons and increase competition among telecommunications service providers. The Commission sought comment on how SDR could affect a number of Commission functions in the future, including spectrum allocation, spectrum assignment and equipment approval.

… In a software defined radio, functions that were formerly carried out solely in hardware, such as the generation of the transmitted signal and the tuning and detection of the received radio signal, are performed by software that controls high-speed signal processors. Because of the ability to be easily reprogrammed, a software defined radio could be programmed easily to operate over a broad range of frequencies, bandwidths and transmission standards.

—FCC press release, March 17, 2000

When, on March 17, the FCC expressed a sudden—and largely unprecedented— interest in the state of software defined radio, Chairman William E. Kennard was blunt in describing what drove the agency to this epiphany: "The tremendous success of wireless has come at a price. With all the new wireless products out there —the mobile phones, the devices for wireless Internet, Palm Pilots and two-way pagers — we are running out of spectrum."

The Commission's historic, and still ongoing, policy with regard to radio spectrum was to subdivide the spectrum like so much real estate, auctioning off bandwidth in each locality to interested providers. In practice, while some frequencies are

Hendricks: "With the highway system, we're drivers, we're licensed, and we're supposed to know the rules of the road, as it were. So why not let the radios know the rules of the road?"

reserved to noncommercial use, the successful bidder for a bit of commercial spectrum will have to engage in much creative cream-skimming to recoup the investment. For that reason, wireless service providers are not drawn to areas that lack enough users to maintain a profitable system.

Meanwhile, in the more saturated areas (e.g. Silicon Valley), wireless devices are proliferating so quickly, along with services that support them, that clogged airwaves pose an imminent threat. The FCC, portraying itself as running out of spectrum to auction, is scrambling for alternative approaches, and finding one in SDR.

Long a subject of military and civilian research for a variety of applications, software defined radios are so called because they use software to perform functions historically performed by discrete electronics. Beyond this, explains Dandin CEO Dewayne Hendricks, the software behaves in a cognitive fashion, configuring itself according to changes in its circumstances. "It's like what you have with the highway system," he says, "where we're drivers, we're licensed, and we're supposed to know the rules of the road, as it were. So why not let the radios know the rules of the road?

"A radio will know where it's operating in physical space, and say, 'Well, I'm in Montana. Well, there's nobody here, so I can now do this.' Or, 'Oh, I'm in New York City. Wow! There are a lot of people around here so I need to use a different kind of etiquette.' The industry term for this is SDR: software-defined radio.

For a rudimentary example of this sort of functionality in today's world, he points to the multi-mode cellphone. "In a cellular system in an area like ours where there's six service providers and they're using different technologies, you might be able to do a dual-mode phone, and I've seen a few triple-mode phones. In this area you have TDMA services, AMPS services, CDMA services, and there's Nextel— what if you wanted to have a phone that could cover every carrier in your region?

"The idea behind is that you use something called reconfigurable logic, which will allow you to electrically change the characteristics of the phone. It's all software driven so the phone can take on a new personality and operate in these different modes."

Still, implementation of the concept is painfully slow— Hendricks points to a brainstorm that's been around forever and still isn't realized: "If you had this really multi-mode phone, you could say, 'I want to call my friend Zeke.' And then the phone would figure out, 'Well, I have access to these six different service providers, so given the time of day and given where

Kennard: "SDRs can make all spectrum users — from average consumers to police, fire and EMS workers who need to talk to each other — more productive and efficient."

I am, what's the cheapest way to make this call?' And then the phone would figure out which service to use and configure itself to operate on that service and make the call. This is all done transparently to you, and all you do is wait for the ringing to happen and the phone to be picked up.

"But I heard this five years ago, and it doesn't exist yet."

Conceivably in the wireless-networking field, for example, software-defined radios could provide a more appropriate way of handling spectrum than the present approach, in which incumbents jealously guard their pricey real estate and operators in the unlicensed bands face pesky restrictions, such as the 1-watt power restriction on Part 15 devices—whether they're operating in Death Valley or Silicon Valley.

Dandin's TDR-900 radio, developed in conjunction with TAPR (Tucson Amateur Packet Radio), illustrates some of these options. " The TDR-900 is a software defined radio," Hendricks explains. "It's a frequency hopper; we're going to put software in that will allow it to work under the amateur radio rules in the 900 MHz band, but it will also be able to operate as a Part 15 unlicensed device with a different set of software. We could put other software in that thing to make it hop anywhere within the range the RF board on that radio would allow, and use any rules we want to in terms of how to hop or not to hop. We could say, 'Park here and transmit.'"

The FCC's Kennard applauded the potential benefits of SDRs in a variety of situations: " I view this proceeding on Software Defined Radio as another critical step in the development of a more fluid spectrum market. Software defined radios are smart devices that can make good use of underused spectrum. They can operate as a cell phone one minute, a PCS phone the next, a taxi dispatch radio later on and a two-way pager after that. They can literally bridge the gaps created by differences in frequency and transmission standards. In this way, they can make all spectrum users — from average consumers to police, fire and EMS workers who need to talk to each other — more productive and efficient.

For these potential benefits to be realized, Hendricks says, the FCC's regulatory stance must change considerably; otherwise there's little incentive to create a market.

"In a software-defined radio, there are fewer discrete components; the radio becomes more software. It will really just be sort of a computer, where the only active components necessary will be to interface this computer to the RF environment.

Hendricks: "You can do some very interesting things, if you have a new spectrum management paradigm. "But if you have the old paradigm, it's like, well, why bother? "

"Those kinds of radios, because of Moore's Law, are going to be pretty cheap. They're just compute engines, pretty much, and we know how to do those pretty darn well. The radios will have a longer useful life as mobile devices because they use power more efficiently.

"When you add cognition to that kind of capability, you've got a radio that's like nothing known to man at this point, and you can do some very interesting things, if you have a new spectrum management paradigm.

"But if you have the old paradigm, it's like, well, why bother? What do you need a radio that has all this flexibility for if nobody will let you on their turf?"