

A Brief History of the Mobile Communications Technology Adoption Cycle

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Abstract

Mobile communication technology has been evolving since the first Motorola two-way FM systems became available in 1941. The most interesting and important hallmark of this evolution has been the gradual decoupling of the mobile transceiver from the central base system. This decoupling began well before the digital era, and is especially interesting due to the role that Nextel (previously 'Fleet Call'), played in the maturation of these decentralized applications.

This evolution of mobile units became a revolution when Nextel offered two-way radio PTT services by subscription. The availability of this Direct Connect service obviated any need for a subscriber to be associated with a central base station, but still allowed calling to groups and logically defined central dispatch; Nextel created a way for mobile subscribers to eliminate the need for central base station or repeater system ownership *and licensing*.

The final act in this revolution was the advent of mobile data. The ability to assign public, private and other forms of system-wide addressability, created an entirely new communications model.

The transition was not always smooth sailing. But the reader will see a parallel to the ThruDispatch model, where the same transition from captive fleet models of central voice applications were liberated from the bounds of system ownership, so is ThruDispatch a similar model of liberating end-users from the central data dispatch model.

I. First FM Systems used by NJ Police and ITOA (Independent Taxi Owners Association)

the first *two-way* fleet FM systems debuted in the public service domain. The Ft. Wayne NJ police were thought to be historically the first municipal department landed by the Motorola sales force – there is some debate on this point. Municipalities had access to the most advantageous tower locations via owned lands, roof-top building sites, and eminent domain.

The second notable commercial two-way system was purchased by ITOA in Boston. This not-for-profit trade association innovated a new model in taxi ownership – the medallion membership model. The Boston medallion pool has historically been very limited since its inception, and the entry barrier for smaller or single taxi owners was nigh impossible to overcome. In the late 1950's, ITOA began to offer its dispatch and re-badging program to independent taxi owners. These independents would submit a private vehicle for re-lettering and painting, and installation of a two-way radio. ITOA would then use its system to enable these private owners to work under ITOA's services. ITOA also aggregated smaller taxi companies who owned their own medallions, but found the cost of installing two-way equipment prohibitive.

There was uproar from the larger owned fleets that ITOA was competing unfairly – but the model eventually prevailed, and now many taxi companies offer re-badging and radio rental programs to independents.

The common thread is that in the late 1950's, all FM two-way systems were single channel systems with one license holder per channel in the sub 50 MHz bands. As demand increased, the FCC started to re-allocate services from sub 50 MHz commercial to the VHF spectrum, and often insisted that combined services host multiple licensees on the same simplex systems. The FCC did not think through the ownership issues- this would come much later.

At the time, a new or used car in the 1950's might cost \$150-1000; a mobile radio from Motorola, RCA, or EF Johnson might cost \$500+. The base station and tower might total \$10,000. It was a capital intensive

proposition and something had to be done.

II. Shared Simplex Systems and Closed Repeaters

As the sub 50 MHz services started to crowd, the FCC's frequency allocation committee, already overburdened, started to demand that where possible, licensees would be assigned to share existing channels. Municipalities and State governments were the first logical choices, as they owned common equipment and facilities.

Co-channel interference was a real issue on low-band systems. One of the first such statewide systems on 38-44 MHz was the Massachusetts State Police. This system, with its antenna high atop Mt. Greylock, could be heard throughout the entire eastern United States under optimal atmospheric conditions. This propagation was unneeded, and unnecessary. Co-channel services in other geographic areas were being interfered with. Similar problems plagued commercial low-band, single licensee systems.

The temporary answer came with the sub-audible PL (Private Line) system. PL was anything but private, but did allow receiving equipment on the same channel to only hear the intended service. The transmission of the sub-audible tone was decoded and selectively opened the intended fleet's squelch system. This was a fleet wide solution, and did not enable individual unit addressing, which was to come much later.

PL solved some co-channel problems, and allowed more than one fleet to at least not hear the other fleets operating on-channel – but did nothing to overcome the operational limitation of only one mobile unit being able to transmit at any given time. If a base or mobile operator failed to monitor the channel, by temporarily defeating the PL operated squelch, there could be a 'dual' or simultaneous transmission.

The decade of the 1960's brought increasing growth to the mobile radio, and new services were springing up on the VHF and UHF bands. The closed repeater was one phenomenon.

A repeater is a base station that may serve one or more channels and fleets. The method used is to re-broadcast low-power mobile transmissions at a higher power on a shifted output frequency. The same limitations existed for single fleet unit licensing according to number of mobile units per fleet, service type, etc.

Repeaters allowed the downsizing of the mobile unit, which could now operate at lower power, and theoretically could allow many systems users to share the cost of siting and operations. There was one problem, however – the FCC had no laws in place to allow collective ownership of a commercial repeater, and there was certainly no precedent for an independent, entrepreneurial business model for such an enterprise of commercial ownership. Hmmmm...what to do?

Many systems owners circumvented the licensing problem by becoming a commercial licensee and granting access to other licensees on the channel(s), forming so-called non-profit 'repeater associations'. This became such ubiquitous theme, that even the mobile equipment manufacturers started to incorporate such entities. BAPERN and NEMLEC¹ were the first partnerships between Motorola and Massachusetts law enforcement agencies – granting access to certain external licensees and commercial users on these very large UHF repeaters. The FCC was way behind the curve and had to do something to regulate not just the spectrum, but the multiple user model.

Enter SMR...Specialized Mobile Radio.

III. SMR, Trunked 800, and the advent of Syntor-X

The FCC was losing control of the situation; private repeater system operators, often in concert with the mobile manufacturers (Big M, EFJ, RCA,). There was an explosion of repeaters and roof-top space, especially on high-rises, was getting very contentious. Business were sprouting up like weeds to own antenna site locations, provide equipment and systems design, and just make more money.

¹ Boston Area Police Emergency Radio Network, North East Mass Law Enforcement Communications

I was there, just out of technical school with a four year trade ticket and FCC second class operator/technician license - I was working at a 2-way radio shop!

The FCC's answer to this Wild West crowding of the band-plan and private ownership of two-way sites and systems was.....to legalize it!! Thus was born SMR – Specialized Mobile Radio Services.

There was no perceptible change other than the legalities at first; it was now permissible to buy and own an SMR systems and to sell access to any sub-licensee. The first major technical innovation to address the congestion issue was the trunked repeater system.

The first trunked systems operated on the newly minted 800 MHz bands, and Motorola was the first to introduce the Syntor-X family of base station repeaters and very expensive mobile radios. Other manufacturers would soon follow.

Trunked systems enable the re-use of radio spectrum by allowing fleet radios sharing the same mobile code to migrate to an idle channel; this was done with the first microprocessors in both the central repeater box, and in the mobile radios. It worked almost too well. Private SMR operators were squeezing as many users onto a system as they could get away with – the busy tone was becoming a new and common phenomenon. This was occurring even on 30 channel systems.

The data channel that tied together the SMR fleets had piqued the interest of some SMR business owners. At the time, all voice traffic was in the analog domain - but the control data was....digital.

Motorola had fought the FCC to get the right for trunked police systems to be able to phone patch – connect to the PSTN – which was not technically illegal, just the automated call setup required an RCC, radio Common Carrier, license. If a call was setup by a dispatcher at headquarters, that was permitted, but if the call was automatically initiated by the mobile unit, that was RCC territory,

The RCC lobby, populated by the just born Baby Bells and a few private operators, were hell bent to stop this madness. The problem was that it is politically unpopular to try and stop the cops from doing their job, and phone access, whether needed or not, was a topic of discussion.

This didn't stop Motorola, who promptly made I-Call, the ability to initiate a land-line call, a reality. For the cops at least, this was great. The private SMR's were licking their collective chops....

I smell money. At this time, before the reign of cellular, the state of the art in mobile phones was the IMTS system. A Motorola IMTS 'Pulsar' phone cost \$6,000.00 in 1982 dollars. The Boston IMTS systems, one operated by NE Telephone, the other by a private RCC, had maybe 14 channels total to service 4000 users. The capital investment to erect and operate an IMTS system was approximately five million dollars, and the licensing hurdles were enormous. There was never a third RCC IMTS in Boston.

The SMR companies would not be denied the right to offer public phone over trunked 800 MHz radios. Fleet Call - now know as Nextel, had seduced Craig McCaw into placing a very large amount of capital into this endeavor.

IV. Fleet Call buys up everything with McCaw's money, Becomes Nextel, Data is the Next Horizon

The culmination of the trunked repeater revolution, the fight for allowing automated PSTN call set-up from fleet radios – at first by police – and the rising tide of digital communications, was preceded by Fleet Call's buying spree of every single SMR site they could get their hands on.

Fleet Call's grand vision was to 1) allow private trunked radios to access the PSTN under Fleet Call's license – sort of a phone company model, and 2) to build a fully meshed N-Tier network connecting all of Fleet Call's SMR sites. The rest would fall into place as fully digital terminal devices came into being.

They were correct. The network evolved as an all analog trunked system, from which a subscriber could make 2-way radio fleet calls, and to make land-line calls while in your home repeater area. Roaming was as

yet unheard of other than in IMTS. Cellular radio was in early development at this time.

But even at this early stage, national and large regional fleet users could make wide area trunked two-way calls, over the Fleet Call frame relay back-bone – all transparently, like a regular radio.

Now, subscribers could have a fleet of two-way radios and PSTN access without owing an SMR license or sub-service license. This was the precursor to Nextel as we know it today.

Fleet Call and McCaw saw the potential for digital voice communications and data services before anyone. They now owned an impressive transnational digital network back-bone, thousands of rooftop sites, and already had a million radio users.

They needed a new system. A new iDENTITY.

V. **Big M makes New iDENTITY for Fleet Call.**

Fleet Call and Motorola jointly financed the all digital Integrated Digital Enhanced Network – and the rest is history. Fleet Call needed a new identity, and became Nextel.

Now the ‘Roger’ beep (and sometimes the busy tone), so common in the old Fleet Call days, is heard all over the streets of our nation. Some single Nextel users prefer the Direct Connect PTT service, as it is fast to connect, and in marginal conditions, has a better signal to noise ratio, and is less prone to loss of signal. And, you always have the phone if you need it.

The years 1990-2 were the real debut for Nextel, as they were transitioning the previously all analog fleet customers, and creating a new retail phenomenon as a cellular phone company. Nextel and Motorola were hand in hand with the digital iDEN network, and big M was also rolling out AMPS – the new analog cellular standard. They had all the bases covered.

But on the data side, Nextel was even ahead, conceptually, of Motorola.

There, was however, a problem: Nextel had inherited its 800mhz allocation from the days of its Fleet Call heritage of running on the Motorola Syntor-X trunked repeater systems. Although Nextel now owned a nationwide Frame Relay network for the carriage of voice and data between Cell sites, it had a untenable bandwidth tradeoff dilemma – more data channels meant less analog bandwidth, decreasing call quality, there was no magic way out, even using all the available technology tricks of flex-bandwidth management, data compression, etc. the Sprint Merger was not even a twinkle in its father’s eye.

Nextel knew that its bandwidth and channelization was, in effect, fixed for now. They also knew that other cellular systems would be coming on-line with fatter data channels. They had some time, but not an infinite amount of time, it was the Mid 90’s, and GSM, CDMA, and other digital standards were about 2 years from encroaching.

They made a very wise decision preemptively: “let us start now, to define the best development tools for our future data partners, and to build out the best data sales and partner catalog we can muster. Let the network sort itself out, we will be ready for the increased speeds and bandwidth when it comes”.

Concurrently, they started beating on Big M to start planning on better phones that could, eventually, run java apps; it was a cold gamble and it paid off. Who knew about java then in 1994?

Now the preferred business platform for wide area data is Nextel, in spite of having not quite the best network throughput. But the tools are there, and the network latency is better than many existing higher bandwidth networks, which is often more important than total throughput in many mobile applications.

Brilliant!

VI. Not the best data network, but the best solutions partner

Nextel's alchemy has made dross into gold. By providing the best tools and absolutely the best national data support and sales team, they trounced Sprint in most of the developer and VAR based catalog solutions – just beat them over the head – bang !@!\$#\$%^&\$.

Sprint had a bigger, badder, faster wireless data network, and a corporate orientation that made smaller solutions seem impossible. The ante in Sprint's mind was 10 million for direct support, or a VAR on the order of EDS. Fools.

Meanwhile, back at the ranch, the public service constituency was panicking over losing control of their procurement cycle to Nextel, which was cheap and reliable. A newer secure digital repeater system from Big M or an Erickson EDACS system is on the order of 3-112 million. So the power brokers were worried.

And, they have kept their fiefdoms fairly intact...they created a new entity called APCO to standardize secure digital fleet systems. APCO is a disaster. There have been scandals galore over non-performing APCO systems.

The watchdogs want to know: "What was your thinking when you spent the public's money on this crap, when you could have leased Nextel's, and owned a good analog trunked system to boot?"

"duhhhhhhhh".....

VII. They all lived Happily Ever After – except for APCO

I will end this monograph with the following points:

- More public radio systems users will transition to or supplement with Nextel for voice and mobile data
- The Sprint Merger, set to be fully executed and enmeshed by 2007, will bring unheard of mobile network services to the Nextel constituency
- The Nextel data army of sales, applications, and developer support, will do for Sprint what it was never able to – roll out better and grander services to all types of small and medium clients
- ThruDispatch will be the first mobile data services portal to de-couple central live routing from the data services side, and will make mobile work-flow management the de facto way to do business-to business dispatch.
- After being proven on the Nextel, and then the Nextel/Sprint networks, ThruDispatch will be a sought after property for all of the major wireless network carriers – via license, acquisition, or partnership.