



Software-Defined Radio

Vanu® Software Radio vs Firmware Radio

Traditional Infrastructure Doesn't Meet the Needs of Rural Carriers

Traditionally, wireless infrastructure manufacturers have developed single-standard networks to address cellular coverage needs. These dedicated networks require extraordinary financial investments and a long lead time to generate positive financial returns. Each time a new technology and standard has emerged, carriers have had to make another large investment to build a new network. Each wireless standard has required its own dedicated radio access network (RAN), mobile switching center (MSC) and team of field service installers. For a rural carrier, dependent on a relatively small subscriber base and roaming agreements with nationwide carriers, this presents a tremendous challenge. Most rural carriers can't economically justify the implementation of a dedicated network for each standard they wish to deploy.

Rural carriers need a way to cost-effectively adopt—and profitably operate—multiple standards using their existing spectrum, towers, antennas, shelters, and other infrastructure. Furthermore, traditional outdoor macro network designs do not provide financially viable solutions for effective in-building enterprise and home coverage, the fastest growing wireless environments today.

With Software Defined Radio (SDR), upfront equipment costs can be substantially lower than traditional equipment suppliers. Moreover, SDR enables multiple standards to operate simultaneously within a single base station platform. Additionally, new standards or additional system capacity can be downloaded remotely via the Internet to each base station so costly site visits are significantly reduced. Finally, if the SDR is implemented using Software Radio technology, the rural carrier can select from a wide range of hardware configurations to meet a full array of RF coverage requirements including: outdoor macro, enterprise, residential and disaster recovery.

Different Types of Software Defined Radios

The terms Software-Defined Radio and Software Radio are often used interchangeably. It is valuable to distinguish the two. SDR describes an overall technology within which there are two design approaches, **Firmware Radio** and **Software Radio**. Most wireless infrastructure manufacturers today use a Firmware Radio approach. Their systems depend heavily on dedicated digital signal processors (DSP), field-programmable gate arrays (FPGA) or other low-level reconfigurable processing engines such as a system-on-a chip (SOC) with an array of hundreds of DSPs. The “software” built to implement various communications standards in these SDRs is actually firmware: low-level embedded code tied to the particular processor and board for which it was written. Software Radio differs significantly from Firmware Radio in that almost all signal processing functions are implemented in portable high-level code. In today's Software Radio systems, general-purpose processors running standard operating systems support the signal processing functions. The resulting systems are far more flexible and economical than Firmware Radio systems, because they eliminate hardware lock-in.



Hardware lock-in is characteristic of Firmware Radio. The manufacturer's investment is tied to a particular hardware platform. With each passing year, the platform falls farther behind the performance available with state-of-the-art components. The manufacturer cannot quickly deliver hardware improvements to customers because it is so expensive to re-implement the communications standard for a new processor or board.

Software Radio eliminates hardware lock-in. The manufacturer can move the software implementing wireless communications standards to a range of platforms and can introduce new platforms inexpensively. This provides direct and significant benefits to carriers. Because the manufacturer can quickly and cost-effectively adopt improved components or entire platforms as these appear in the commercial marketplace, the carrier always gets the best available price-performance when an order is placed. Furthermore, because the manufacturer can amortize its software investment across markets that require different hardware platforms (eg, urban, rural and in-building), the initial cost to the carrier is reduced.

The Benefits of Vanu Software Radio

The Software Radio approach to SDR, using portable software on standard hardware, provides powerful benefits to rural carriers looking to upgrade to new digital and broadband networks. A few of these advantages include:

- ***Software Radio easily supports simultaneous operation of multiple wireless standards*** – In the same way that an IT server runs multiple and different applications, a Software Radio solution can support all current standards (GSM, CDMA, iDEN, etc) and has the ability to remotely download new standards as they are introduced. Multiple standards can operate at the same time within a single base station (BTS). While this capability is theoretically feasible for Firmware Radio designs, in practice the firmware design approach has made it extremely difficult for manufacturers to implement simultaneous multi-standard operation. With Software Radio, in contrast, it is straightforward. Simultaneous operation of multiple standards, in turn, provides ongoing benefits to the carrier. It reduces site rental and electrical utility costs due to a smaller BTS footprint with fewer hardware requirements. It reduces backhaul costs through sharing of IP-based backhaul links across multiple standards. It reduces administration and maintenance costs through managing only a single system for the multiple standards. Finally, the carrier can dynamically reallocate resources (e.g. spectrum, transmit power) among standards as the customer load changes.
- ***Software Radio uses an open standards approach to hardware*** – Unlike Firmware Radio which is limited to the specific hardware that it's designed for, Software Radio can use any off-the-shelf platform, ranging from cost-effective high volume servers to high-reliability environmentally tolerant systems. This avoids locking the carrier in to a single source of supply, a situation that is typical when acquiring base stations from traditional wireless infrastructure manufacturers.



- **Software Radio enables the carrier to tailor call capacity per cell site** – Firmware Radio uses custom hardware designs that are tied to specific capacity levels. Software Radio gives carriers access to a great diversity of off-the-shelf servers, enabling the carrier to select the precise capacity desired for current needs or planned growth. There is no need to “over-buy”.
- **Software Radio delivers improved price-performance over time** – With Firmware Radio, each product is tied to a particular hardware platform that is used throughout the product’s lifecycle. That platform quickly becomes obsolete over time. Software Radio, using standard servers, actually improves in price-performance over time, due to Moore’s Law improvements in the underlying server platforms. As the carrier expands its network, newer sites or site capacity expansions always exploit the latest advances in computing capabilities.
- **Software radio reduces site visits and speeds deployment** – If standards growth or system capacity increases were planned when the hardware was purchased, carriers can add new wireless standards or increase traffic channels quickly via remote software downloads from a single location. Costly cell site visits are significantly reduced and new wireless standards and additional channels can be added to multiple sites within hours instead of weeks. Faster deployment means quicker revenue realization.