Bridging the wireless divide in rural India
by John Winn, Executive Vice President, Business Development, Vanu, Inc

The cost of building, operating and maintaining wireless infrastructure in rural India creates a steep entry barrier for new competitive operators. India recently approved the sharing of all the physical network infrastructure components by multiple operators; this can reduce telco expenditures by more than 50 per cent. Shared infrastructures force operators to use the same technology and features. By using software defined radio for shared networks, costs are reduced but each operator can use its own technology, applications and services.

Wireless communication is transforming the economic and social landscape of developing countries throughout the world. The availability of mobile phone service in areas without any previous communication infrastructure has led to a new wave of local entrepreneurs and created greater access to health and educational services. In India, where nearly half the population is self-employed, small business owners with mobile phones are able to grow their businesses by making advanced arrangements with buyers and sellers. A study conducted by Robert Jensen, a Harvard University Economics professor, tracked fishermen off the coast of Kerala in southern India. He found that when they invested in mobile phones and used them to call prospective buyers, their profits went up by an average of eight per cent while consumer prices in the local marketplace went down by four per cent.

A mobile phone is no longer considered a luxury in India, but rather a necessity, akin to water and electricity. While having access to mobile technology in the developed world may save a few minutes time and inconvenience, in developing countries it can save days of travel time, connect individuals to healthcare information and advice, or provide advance notice of life-threatening disasters, such as drought, floods, and storms. Having a mobile phone has not only proven to be an immensely valuable business and social tool, it has also provided fixed identity points to populations that often face the threat of displacement due to natural disaster or political conflict. It is no wonder that even Indian families with the lowest of incomes are making investments in mobile phones.

India is the fastest growing wireless market in the world today, currently adding nine to ten million subscribers per month. In comparison, China adds about six to seven million subscribers per month, and the US adds one to two million. According to India’s Telecoms Regulatory Authority, at the end of April 2008, India had 264,012,939 wireless subscribers, surpassing the US as the second largest wireless network in the world. Despite this explosive growth, the majority of mobile phone users are still within urban areas. The estimated wireless penetration in India is about 25 per cent in urban areas, but only two to five per cent in rural areas. With 70 per cent of the population living in rural areas, it is clear that the benefits of mobile phone service have yet to reach the vast majority of the 638,000 villages that comprise rural India.

Building out wireless infrastructure in rural India has proven to be challenging. In countries such as the US, each wireless service provider would simply build out their own network. However, this option is not affordable in India. The average revenue per user (ARPU) in India is amongst the lowest in the world, and will likely be even lower in sparsely populated rural areas. Because revenue potential is so low, if each service provider were to build out its own network using traditional technologies, it would be very difficult for the providers to earn a return on their investment. In addition, the remote location of many rural villages makes network operations and maintenance very expensive.

To address these challenges and to facilitate the expansion of wireless coverage, the India Department of Telecommunications approved the use of shared active infrastructure in March 2008. Active sharing of infrastructure allows multiple wireless operators to share all the components of the physical infrastructure, including base tower station, microwave radio equipment, switches, antennas, transceivers.
for signal processing and transmission. It is estimated that infrastructure sharing will bring down the overall expenditure of telecom companies by more than 50 per cent. Newly licensed wireless operators can share the infrastructure of existing players and be able to launch new services within a short time. An outsourcing vendor or tower owner can make an upfront investment in building new infrastructure and then earn a substantial return on investment by leasing out space to other operators. These operators, in turn, achieve substantial operational savings due to sharing, while their capital expenditure requirements become almost negligible.

While sharing of infrastructure is the best solution to accelerate the expansion of wireless coverage in underserved areas, it also poses challenges. Most sharing methods require that each operator use the same technology, roadmap, and features. This results in a significant loss of competitive differentiation amongst the operators and fewer service offerings for customers. It is important to have a healthy competitive environment where operators compete to offer value to the end user. The challenge is how to achieve this without resorting to traditional infrastructure approaches, which have proven to be prohibitively expensive.

A new solution to this challenge is the sharing of active infrastructure through software defined radio (SDR). SDR implements the entire radio access network (RAN) as portable application-level software running on standard processors and operating systems. No waveform-specific processing occurs in hardware; all of the signal processing occurs in software running on the processor. Because the RAN runs as application software, multiple instances can run on the same system at the same time. Virtual Machine technology ensures that each running RAN has its own guaranteed allocation of processor capacity, memory, and bandwidth. Each running RAN application is considered a virtual RAN.

This unique approach offers the same cost-reduction benefits of traditional sharing methods, while also allowing for competitive differentiation. Multiple virtual RANs are supported on a single physical RAN platform. These individual RANs can offer carrier branded services, can be configured differently, and can be upgraded independently. Each operator can therefore decide on what technology and services will best serve their customers without having to offer the same services as their sharing partners. Customers benefit from true competition among operators.

Although operators share common hardware components, each operator still maintains independent control over the configuration of their virtual RANs. They manage their resources just as they would manage the same resources in a network built for each operator’s exclusive use. Operators can stop, modify and restart resources without affecting the services of the other operators sharing the infrastructure. A supervisory application intercepts all configuration requests sent by a virtual RAN and assures that each virtual RAN uses only the resources it is allowed. Virtual private network (VPN) technology isolates each operator’s data flows from the others’, assuring that each operator’s RAN communicates only with that operator’s core network components.

In addition to making competitive differentiation in shared active infrastructure possible, SDR provides unmatched flexibility and several other cost-saving benefits to wireless providers. A software-only portable design runs on commercial off-the-shelf servers, rather than expensive proprietary hardware. The ability of SDR to remotely monitor and perform diagnostics on the network reduces operating expenses. Capacity can be added via software downloads rather than site visits, which is especially important in difficult to get to remote areas. New voice and data upgrades are also readily available through remote software downloads and do not require costly hardware upgrades.

The benefits of communication technology should be available to all communities, especially those that are least developed. By approving innovative infrastructure solutions, India has truly taken the lead in bridging the wireless divide between urban and rural areas. These significant steps forward serve as an example to the rest of the world regarding how to address the communication infrastructure challenges faced by rural communities and allow them to make important social and economic advances.

**Figure 1:** With Software Defined Radio, wireless standards and network signal processing functions are implemented entirely in software.

**Figure 2:** With Software Defined Radio, wireless standards and network signal processing functions are implemented entirely in software.