

## **Introduction**

The challenges facing cellular telephone switching station manufacturers today reflect those facing the entire electronic systems industry: to provide increased logic capability in a small form factor that is extremely reliable, easy to upgrade and cost competitive. Lattice Semiconductor's family of In-System Programmable (ISP) logic devices can assist in virtually every stage of product design, manufacturing and field upgrades.

## **The Lattice ISP Advantage**

In-System Programmability provides the ability to program and reprogram logic devices directly on the printed circuit board using a single 5-volt supply and TTL signals.

Lattice's ISP products are revolutionizing telecommunication system designs by allowing designers to define and develop systems with capabilities previously unachievable. With Lattice ISP products, hardware is as flexible and easy to modify as software. Hardware functions can be programmed and modified in real time to expand product features, shorten system design and debug and enhance product manufacturing ability. But

most important, ISP products provide the means to complete field upgrades efficiently and cost effectively.

This application note demonstrates how several cellular switch manufacturers have successfully differentiated their products and gained a competitive advantage through the use of Lattice ISP products.

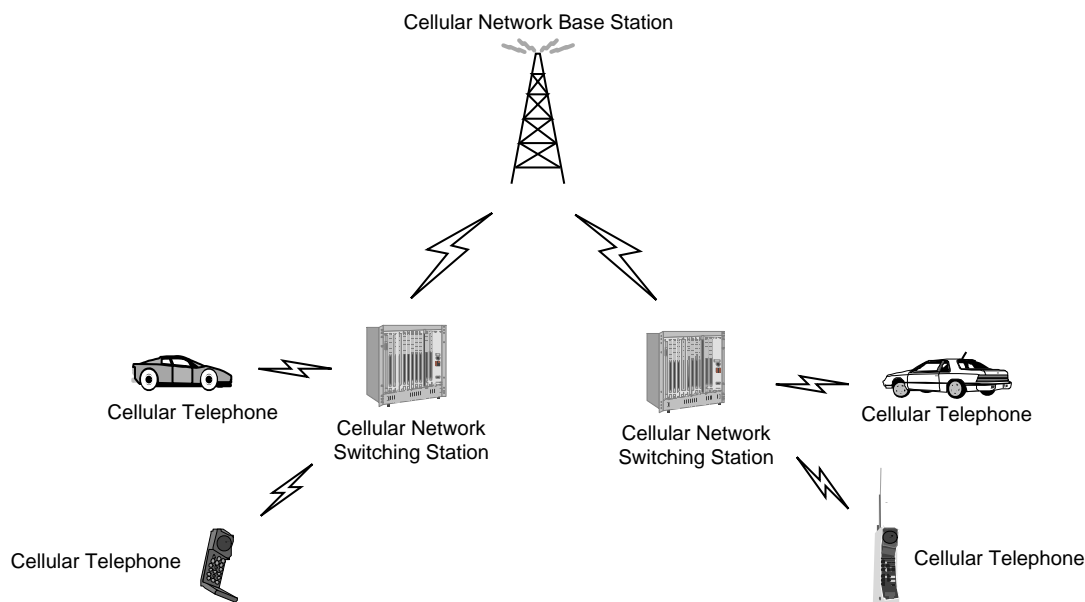
## **Switching Station Application**

A cellular telephone network consists of a base station, multiple switching stations and a cellular telephone that is always moving within a geographical area (Figure 1).

Switching stations handle communications processing duties and call routing between individual cellular telephones and the base station. As the cellular telephones move within the coverage area, the switching stations must recognize the transmissions to and from the cellular phones and route them through the network to complete the telephone connection.

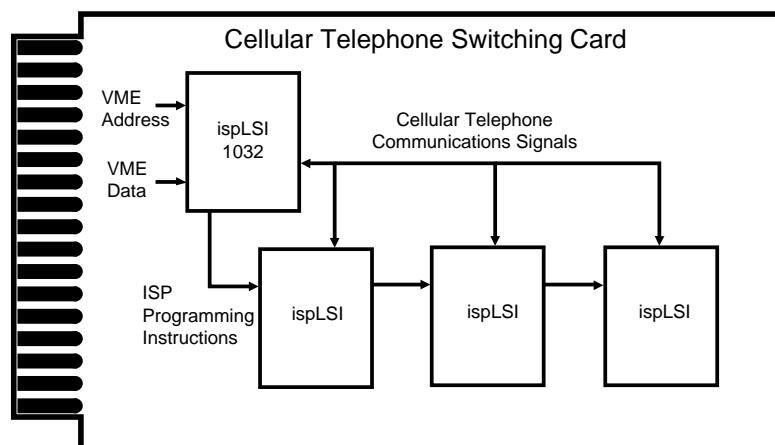
Because the cellular telephones are constantly moving, a cellular telephone network must be dynamic and complex. Switching stations must adapt to the different load and functions present in the system.

**Figure 1. A Cellular Telephone Network Showing the Call Routing Duties of Switching Stations**



# Lattice ISP in Cellular Switching Stations

Figure 2. Decoding Communications Signals and ISP Programming Signals from the VME Bus



One example of a leading edge design for switching stations comes from a major cellular network manufacturer using a SPARC embedded processor and multiple cellular telephone switching cards on a VME backplane. This design allows each switching station to be configured to meet the needs of the area it covers. In addition to the expandability inherent in the VME bus architecture, the switching cards must adapt to varying communications and routing priorities. Using Lattice ispLSI® devices, network designers were able to cover a broad range of network tasks with simplified hardware configurations.

With ispLSI, switching cards can be reconfigured or upgraded remotely rather than pulled from the field for service.

Each cellular communications switching card contains several ispLSI devices performing communications processing duties and one dedicated ispLSI device used to store the board ID, perform VME address decoding and control the programming of the rest of the ispLSI devices on the switching card. Production time and cost are reduced by initially programming and testing the ispLSI devices using automatic test equipment after board assembly.

Once installed on the board, any ispLSI device used for communication functions can be programmed via the VME backplane by either the SPARC processor, a network connection or remote telephone connection. The programming routines are fully commented, platform independent ANSI C source code that can be easily adapted to any ispLSI application. In addition, each

board has an ispDOWNLOAD™ cable connector allowing on-site programming as needed.

Programming of communications components via the VME backplane by the SPARC processor, the network connection or the telephone is handled by addressing the board to be programmed and sending serial programming instructions. A Lattice ispLSI device serves as a VME address decoder for both communications signals and ispLSI programming instructions. Figure 2 illustrates the decoding of VME address and data lines into cellular telephone switching signals for communications and ispLSI programming signals for board configuration changes.

All necessary programming is done via five TTL level logic interface signals. These five signals drive the on-chip state machine which controls loading of instructions and data into the device. The communications devices are daisy-chained together allowing all devices to be programmed at once with the same set of programming signals. This simple programming interface eliminates the need for generating high voltage programming signals on the circuit board as well as reducing the number of signals needed for programming.

The ispDOWNLOAD cable allows on-site programming of any and all ispLSI devices on the board, if needed. A jumper selects programming of the dedicated programming control ispLSI device or the communications processing ispLSI device chain. On-site programming can be done with a laptop computer in seconds, even for long chains of devices. Fast programming of large ISP daisy chains is possible with the use of Lattice ispTURBO

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download software which programs a chain of devices in the same amount of time it takes to program the largest device in the chain.

## **Summary**

Cellular telephone network designers have taken advantage of Lattice Semiconductor's ISP products to boost the performance and reduce the cost of their cellular phone systems. System upgrades, design fixes, and configuration changes to cellular switching stations can all be handled remotely and in real time to meet changing cellular network requirements. Production costs and lead time have been reduced by using ISP devices programmed after board assembly. System flexibility, impossible with conventional programmable logic devices, can be achieved using in-system programmability.



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