Network Discovery

Institute for Telecommunication Sciences (ITS)

- Real time assessment of wireless infrastructure for emergency communications.
- Wireless link measurements

Wireless communications networks are evolving away from a simple one-to-one correlation between frequency band and communications channel. A wireless network user's communications channel consists of an aggregation of physical and logical sub-channels. Each sub-channel controls some aspect of a wireless network access session. For example, a typical wireless cellular call must complete a complex series of negotiations between the handset and a base station before allowing a user access to the network. Control channels, once established between a base station and mobile user, facilitate call setup, advanced service requests, air interface resources management and real-time wireless traffic measurements amongst a myriad of other functions.

In contrast to wired networks, wireless networks exhibit an ephemeral and dynamic relationship between services and resources. At each transaction, the measurable RF and network parameters will change depending on the demands of that particular transaction. It is essential to investigate both of these domains, radio and network, in order to understand the network behavior i.e. simple RF power measurements alone are inadequate.

Network management protocols insure that RF spectrum is used effectively and efficiently in real time. The low level (data link and network layer) protocol messages that are exchanged between handsets and network contain a wealth of information about the network, but this information is not often readily available. ITS has developed a nascent capability to examine the interaction between link layer messages and radio resources. This capability provides crucial information for Federal emergency communications planning activities in addition to advancing publicly available network characteristics data.

ITS' tools can analyze wireless networks by collecting network protocol messages and physical RF link measurements to identify wireless network behaviors such as usage patterns, channel resource allocation and network topology. This multifaceted viewpoint is necessary, since many emerging wireless network architectures rely on spread spectrum techniques to increase user density. Without this real time information about the air interface and the network interface, parameters like channel occupancy would not be obtainable. For instance, in IS-95 networks, the paging channel has to be decoded to gain access to the Walsh code domain which is required to measure traffic channel activity. A similar problem exists in GSM networks, where frequency hopping sequences and time slot allocations from control channels are needed to identify user activity. These kinds of measurements are not possible without examining the integral connection between network protocols and radio resources.

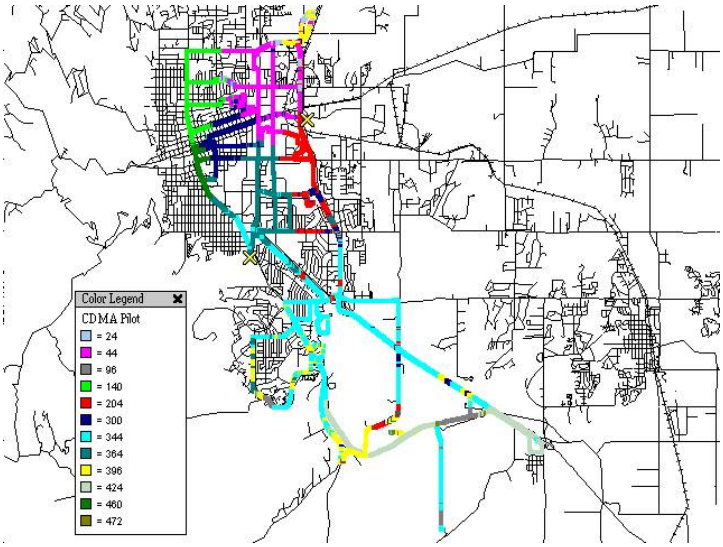

Figure 1. Reception Map for Boulder County IS-95 Base Stations.

ITS has the capability to peer into wireless networks by using unique tools and techniques that unify the complex relationship between the software and hardware infrastructures of wireless networks. These tools can be used to identify the behavior of wireless infrastructure topologies on a real time basis.

Figure 1 shows a recent study of IS-95 base station activity in the Boulder County area. The different colors indicate the predominant base station selected by the handset during that portion of the drive test. Base stations are identified by information derived from the paging channel.

Figure 2 indicates the dwell time at each base station during the drive test. ITS has the capability to decode and process a broad range of parameters that are available in low level messaging for all U.S. cellular and PCS technologies.

Figure 3 shows a measurement of power levels from various CDMA base stations. The green bar represents the best candidate among the base stations sensed by the test system.

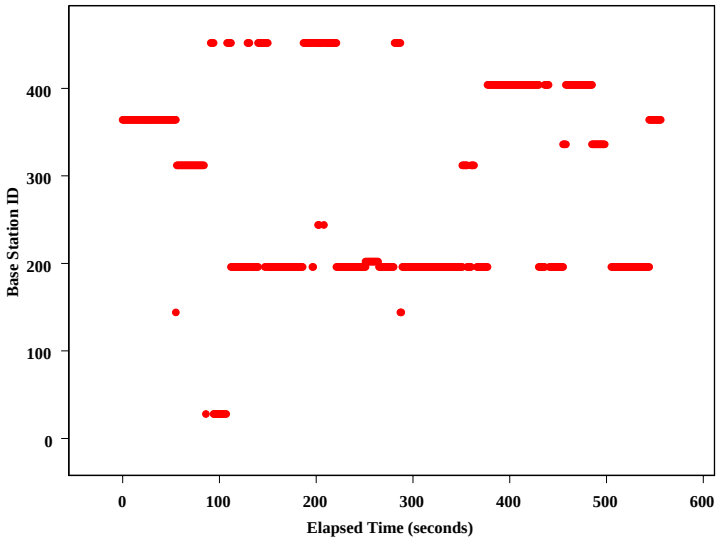

Figure 2. Variation of IS-95 Base Station versus Time.

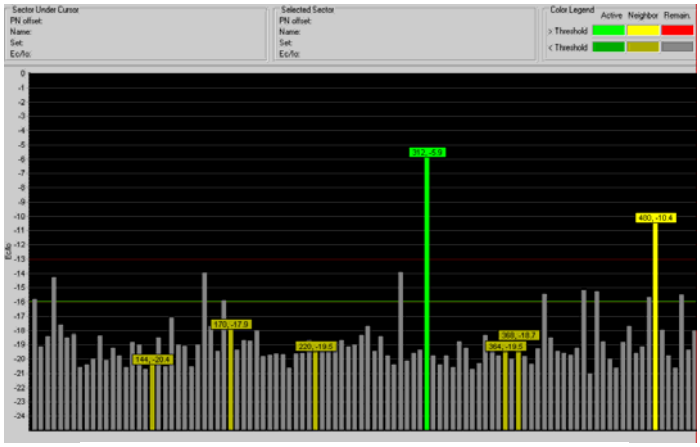

Figure3. CDMA base station activity plot.

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