Symmetricom

Reducing Churn in GSM Networks

Synchronization of Base Stations Improves Call Hand-Off Performance

Summary

- **Reducing user churn is a key priority for wireless carriers**
- **Dropped calls due to failed network hand-offs is a major contributor to user churn**
- **Synchronization of base stations is a proven and efficient method to improve call hand-off performance**
- **Field trials have demonstrated up to a 25% reduction in dropped call rates**

Reduction of user churn is a key business driver for wireless network operators. Carriers focus on improvement of network performance, efficiency of customer support, and introduction of advanced service bundles to bolster customer retention rates in today's fiercely competitive marketplace. For wireless network operations and engineering staffs, this means improving network coverage and hand-off performance to reduce dropped call rates – a key contributor to user churn.

Three of the key reasons users cite when canceling service from one provider to switch to another are dropped calls (failed hand-offs), dead spots (poor network coverage), and poor customer support (problems not solved). While improving customer support is beyond the scope of this paper, improving network performance so customers do not need to call to complain is not.

Carriers have invested heavily to complete their network coverage and eliminate dead spots. The network has evolved today to the point where coverage is virtually ubiquitous, and dead spots are fast becoming a problem of the past. Carrier performance differentiation is shifting from completeness of coverage, to stability of the network, and users are particularly sensitive to dropped calls.

The Role of Synchronization in Call Hand-offs

Synchronization has a direct impact on the ability of a network to provide efficient service and is therefore a foundation of digital mobile communications. GSM and CDMA networks deployed today are dependent on strict synchronization of the base stations to facilitate call hand-offs. CDMA, in fact, calls for inclusion of a GPS synchronization receiver in every base station to provide a common time-of-day reference for call hand-offs. GSM, while not dependent on a time-of-day reference, requires that the base station frequency synchronization be accurate to better than 50 ppb (50 parts-per-billion). One reason for this seemingly tight bound is related to handoff of a mobile between two base stations. When the hand-off occurs, the potential frequency difference could be as much as 100 ppb and this manifests itself as a Doppler shift equivalent to vehicle speeds of approximately 100 kph. The inability of the mobile to react rapidly to this apparent Doppler shift will result in a dropped call.

Network Operator	Churn Rate	Technology
AT&T Wireless	3.4%	GSM (TDMA)
T-Mobile USA	2.8%	GSM (TDMA)
Cingular	2.7%	GSM (TDMA)
Sprint	2.3%	CDMA
Verizon	1.5%	CDMA

FIG.1 User churn rates (Source: ABI Research Q2-2004)

Most GSM base stations deployed today recover their synchronization from the leased line backhaul (T1/E1) feed. This works very well as long as the backhaul facility provider maintains accurate and stable synchronization. The problem is that there is no assurance of the quality of synchronization on the backhaul facility, and this is completely outside the control of the wireless operator. They are dependent on the backhaul provider, and this is becoming more and more risky in today's deregulated environment. Timing perturbations or transients on the backhaul lines can translate to shifts in the transmit frequency of the base station and dropped calls.

Precision synchronization improves network reliability, efficiency, and performance.

A fast and efficient way for wireless operators to take control of the synchronization of their base stations to reduce dropped calls is to install simple GPS based retimers at the BTS site. The retimer reclocks the backhaul line to remove any timing transients before they can negatively impact the transmitter and cause dropped calls. The retimer is stratum one traceable through its internal GPS receiver. Figure 2 shows a typical installation at a GSM BTS site. Recent field trials have demonstrated a 25% reduction in dropped calls after installation of retimers at the BTS sites. Wireless carriers seeking to reduce user churn should look to retiming troublesome backhaul feeds to address dropped call problems.

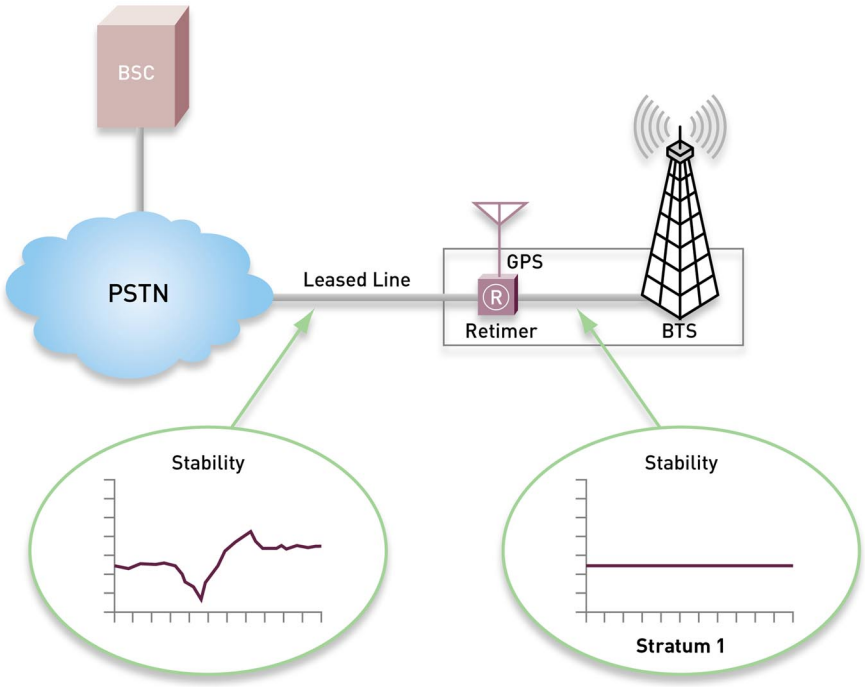

FIG. 2 Retiming at the BTS allows the transmitter to lock its carrier frequency to a stratum one reference signal, improving call hand-offs. This prevents timing viruses and transients increasingly present on the backhaul facility from negatively impacting BTS performance.

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