Symmetricom

Remote Track and Hold Card for Remote DCD Systems

APPLICATION NOTE

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Introduction

Precise phase alignment and high stability during holdover periods is the foundation for a solid synchronization network infrastructure. In order to maximize uptime, critical network services like SS7 (Common Channel Signaling Systems CCS7), Cross-connects, STPs, ATM and SONET require state-of-the-art clock technology to meet these critical phase and stability requirements.

Symmetricom's Remote Track and Hold Card™ (RTHC) introduces a sophisticated clock technology that provides extended holdover capability to any DCD remote shelf. This improved holdover capability is essential during maintenance activities or emergencies, proving it as an effective 'firewall' mechanism to protect the synchronization network.

Remote Systems

Medium and large size central offices (CO's) may contain one or more remote shelves. These shelves serve as an extension of the CO master Building Integrated Timing Supply (BITS) systems and may be located in any floor within the same building or, in another building within 1,500 cable feet (450 m.) away from the master shelf.

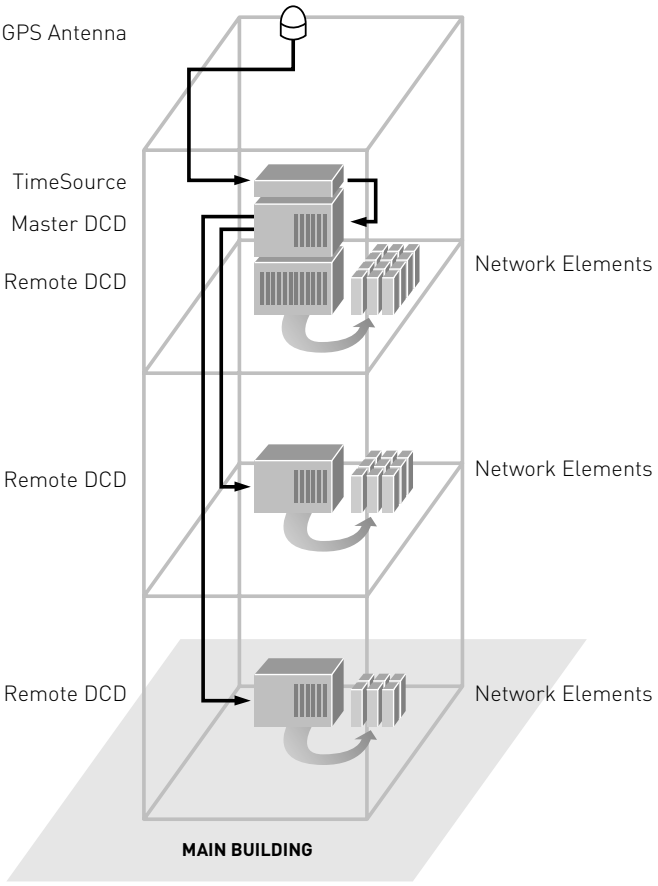

FIG.1 Remote configuration

In order to maintain phase alignment with the master BITS system, the remote shelves are connected via twisted-pair cables carrying an 8/64 KHz composite clock (CC) signal. Two CC signals are used for redundancy purposes.

Currently, the main threat to the remote systems is the loss of CC reference signals. This can be due to accidental cable cuts or during regular maintenance activities. If the CC inputs are lost, the remote shelf will lose all its outputs, affecting all network elements connected to it.

Even though a total output failure can be avoided by installing clock cards in the remote shelf, the currently permitted clocks for this application are not sufficient to maintain phase alignment and frequency stability. Until now, only ST3 clocks could be used in remote shelves, since they can maintain phase alignment to the CC reference signals, but this legacy ST3 technology doesn't have the capability to run in holdover for more than two minutes before losing CC phase alignment.

Remote Track and Hold Card

Symmetricom's RTHC card works as a firewall that isolates the remote shelf from any external reference problems. During normal operation, the RTHC card will stay phase aligned with the CC reference inputs. In the event of an accidental reference cut or degradation, the RTHC card will provide precise phase alignment and high stability during holdover.

Using an improved high stability double oven quartz oscillator combined with Symmetricom's SmartClock® technology, the RTHC card maintains phase and frequency on CC and DS1 signals for over 12 hours without significant degradation. The double oven oscillator isolates the internal high stability quartz from external temperature factors, and the SmartClock technology improves the holdover performance over time.

FIG.2 Symmetricom's Remote Track and Hold Card

Each RTHC card fits in one Clock Input (CI) slot on any DCD-ST2, DCD-400, DCD-519 or DCD-523 shelf. Since the RTHC card provides inputs and holdover capabilities, no additional input or clock cards are required in the shelf. Two RTHC cards per remote shelf are recommended for redundancy.

Effective Firewall

When a CC reference cable is cut, it may not be possible to easily identify the "tip" and "ring" cables without the use of sophisticated test equipment. With the legacy equipment, reversing the cables can result in devastating effects for the central office, since all the NEs will take a 180 degree phase hit. When two or more CC inputs feed a remote system with RTHC cards, the cards will detect a 180 degrees phase reversal. If this occurs, the RTHC card will invert the phase of the reversed CC signal to avoid any service outages. A Loss Of Alignment (LOA) feature will indicate the misalignment, so that proper actions can be taken. All this without a single hit to the network.

Differences between CC reference signals of more than 1.5 msecs are notified to the operator. These differences can be due to difference in cable lengths or due to signals coming from different sources. In any case, the RTHC cards will indicate potential problems in the synchronization network that may have more serious consequences if left unresolved.

In the event of a reference failure caused by maintenance activities or while cutting over from legacy synchronization equipment to new equipment, the RTHC card will protect the DCD remote shelves from any timing hit or loss of signal. In the event of a loss of signal, the RTHC clock card will enter holdover and maintain phase alignment and frequency stability within $x10^{-10}$ for over 12 hours.

Performance Monitoring

Monitoring your synchronization signals performance is critical to maintain a solid firewall. The RTHC card can monitor the performance of the office synchronization signals and can detect problems before they impact the network. Performance parameters like MTIE, TDEV, average frequency and MDEV, can help detect premature synchronization degradations, allowing the maintenance group time to respond to any developing synchronization problems.

Application Example

Re-mastering an office

One of the most important applications of the RTHC card is protecting remote shelves while re-mastering a central office with a new timing signal generator. Even though the MOPs will define a hitless process, the risks of an operational error during the MOP could degrade the service of some NEs. The limited holdover of the existing ST3 clocks leaves no room for error during an MOP.

The diagrams on page four show a transition process to a new master timing signal generator ensuring that the remote shelves won't be affected. Once RTHC cards are installed in the remote shelves the transition will be secure.

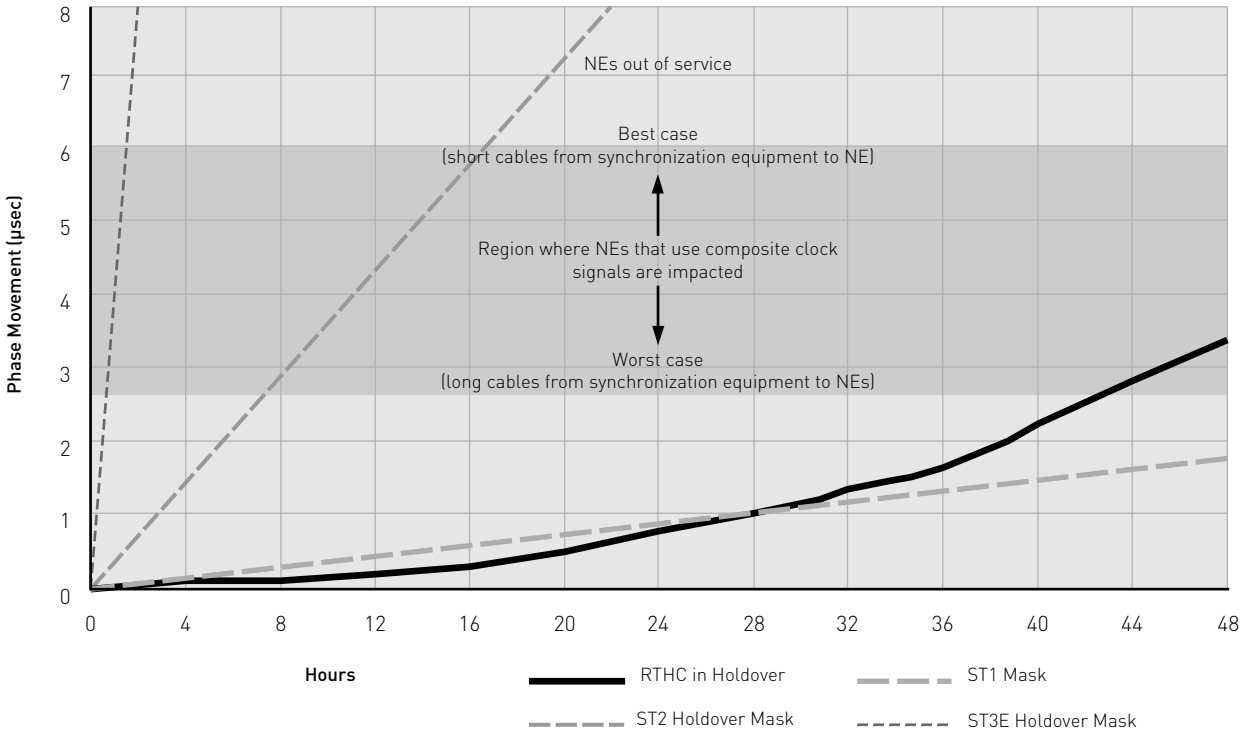

FIG.3 Typical RTHC performance during holdover

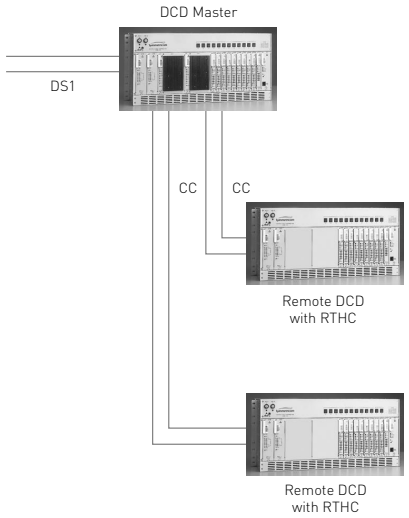

Figure 4A

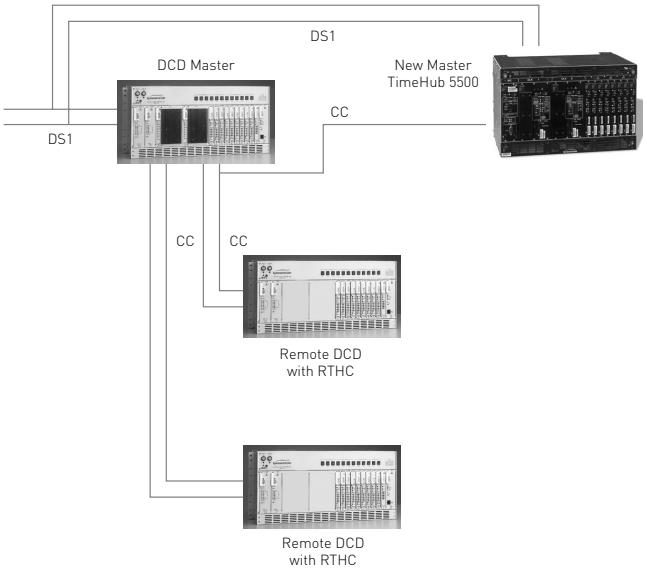

Figure 4B

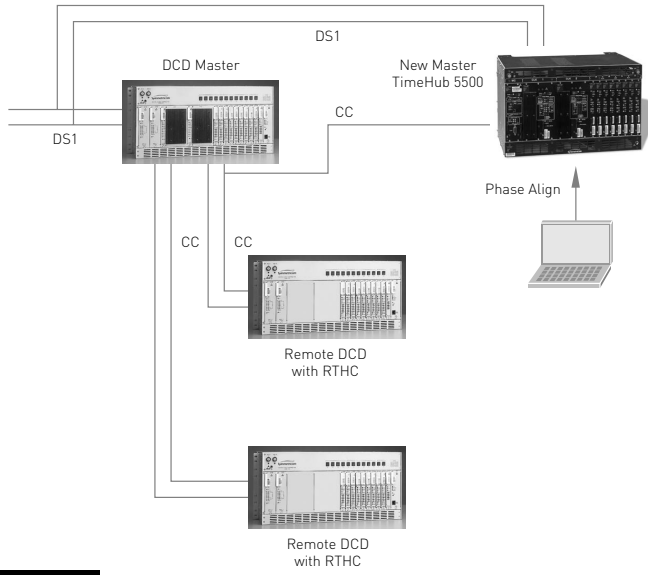

Figure 4C

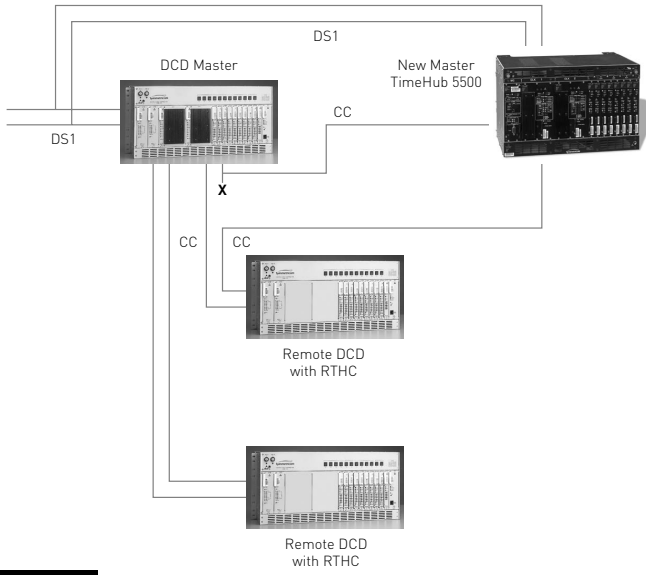

Figure 4D

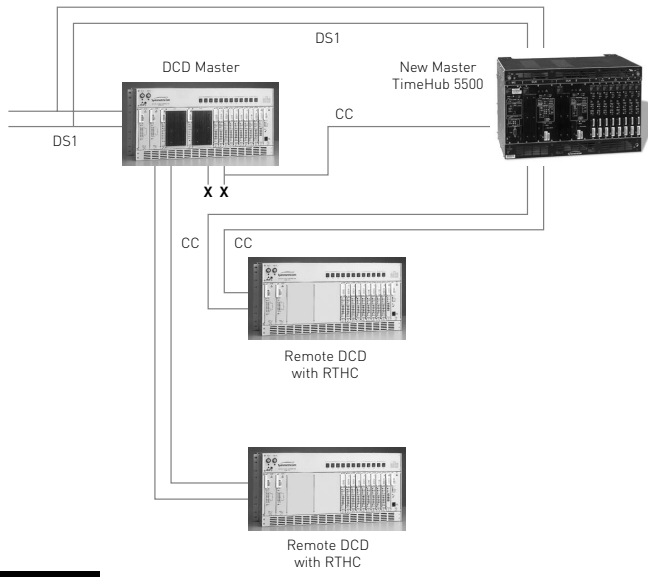

Figure 4E

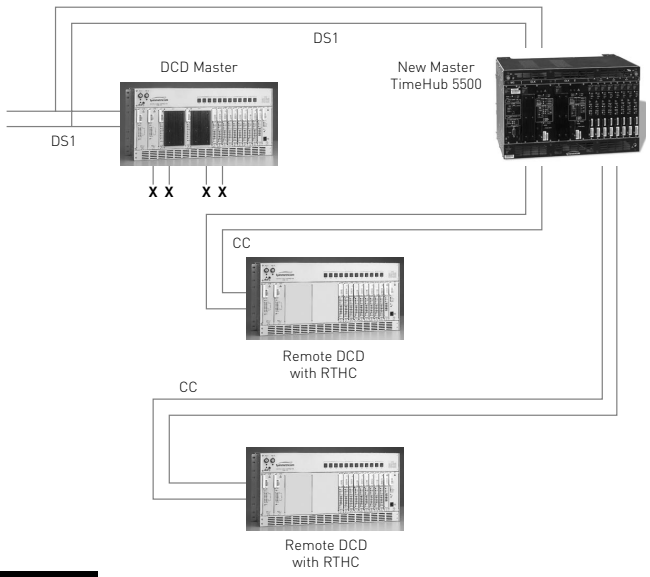

Figure 4F

Figure 4A shows a typical DCD master system driving DCD remote shelves via CC signals. Two signals are used to each shelf for redundancy purposes

In Figure 4B a new timing signal generator (TimeHub 5500™) will replace the old master system. In order to do that the TimeHub 5500 needs to be phase aligned with the existing master. Two DS1 inputs are connected to the same DS1 signals used as the office references. The TimeHub CC input is connected to a CC output of the current master, in order to use it as the phase reference and align the TimeHub outputs to this phase. In this step the tip and ring terminals of the TimeHub should be connected to the Tip and Ring signals coming out of the current master shelf.

The next step is to force phase alignment of the TimeHub 5500. As shown in Figure 4C, a special command is sent to the TimeHub system to align the output phase with its CC input's phase. This alignment will cause the TimeHub outputs to move into phase with that of the existing master shelf.

In addition to acting as the remote shelf clock, the RTHC also protects against improper CC references as illustrated by the following steps. Remove the standby CC input to the first remote shelf and connect it to the TimeHub 5500 CC output. If the new reference is in phase with the active reference, the RTHC card will qualify it after a few seconds and won't generate any alarms. If the input is out of phase by more than 1.5 microseconds the RTHC will indicate this condition by a front panel LED. This will require identifying why the signal is out of phase and will avoid any phase hits in the next step. If the signal is 180 degrees out of phase the RTHC will generate a LOA alarm in which case, the tip and ring should be reversed at the remote shelf input. In the case of the RTHC card switching to the new input signal, for example, because of a glitch or open cable, the RTHC will maintain the correct phase at the output of the remote shelf, saving the NEs connected to this remote shelf from going out of service (see Figure 4D).

Once the new reference signal is checked to be free of problems, the remote shelf is switched to select the new signal. The reference still connected to the old master shelf is now in standby. The user can disconnect this reference and connect it to another TimeHub CC output. Again, the RTHC clock card will indicate the usability of this new signal (see Figure 4E).

The procedure can be repeated for other remote shelves in the office (see Figure 4F). If desired, the old master shelf can be converted into another remote shelf, or using an appropriate MOP it can be removed. This will complete the re-mastering procedure of the central office.

Conclusions

Symmetricom's RTHC card is an effective 'firewall' that protects legacy DCD remote shelves from accidental CC reference cuts, inadvertently reversal of reference tip and ring wires and other phase changes and anomalies between CC references. In addition, the RTHC card provides an excellent holdover performance allowing the remote shelves to lose reference input signals for several hours without affecting the performance of any NE connected to the shelves.

The RTHC card also protects the remote shelves while cutting over to new technology BITS systems. An example on how to re-master an office with TimeHub 5500 has been presented.

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