In spite of the efforts taken to construct a completely synchronous system, it is impossible to control the timing of the entire worldwide SONET/SDH telecommunications network with one perfect time reference. When large SONET networks interoperate, their clocks are likely to be derived from different primary reference clocks (PRCs). Although the errors between PRCs are small, the frequency of these different reference clocks will drift with respect to each other and cause plesiochronous differences between the various segments of the world's SONET networks. To accommodate for the less than perfect characteristics of clock sources, some buffering that will account for timing imperfections must be built into the interconnection between large segments of SONET telecommunication networks that are referenced to different stratum 1 clocks [35, 36, 37, 38].

3.4 SONET Design Requirements

The components used to transport SONET traffic must be chosen to pass the imbalanced A1 and A2 bytes that are transmitted at the beginning of each frame without contributing excessive signal distortion. The number of synchronization bytes increases by N, the multiplication factor of the multiplexer. The STS-1 frame synchronization symbol transmits only one A1 byte followed by one A2 byte; however, the STS-12 frame synchronization signal transmits twelve A1 bytes followed by twelve A2 bites. Unfortunately, the same scaling applies to the SONET STS-192 frame that transmits a synchronization signal containing 192 bytes of F6 hexadecimal with a 75% duty factor, which is immediately followed by 192 bytes of 28 hexadecimal with a 25% duty factor. The long strings of imbalanced bytes that are used to synchronize SONET STS-48 and STS-192 frames have physical layer implications that must be considered when designing optical fiber communications links. The remainder of Section 3.4 as well as Sections 3.5 and 3.6 describe a few of the key factors that must be accounted for when developing OC-48 and OC-192 optical communications systems.

3.4.1 SONET Capacitive Coupling Networks

The long strings of repetitive high and low duty factor synchronization symbols that must be sent at the beginning of the North American STS-192 or international STM-64 frames are the dominant source of the stress that causes deterministic jitter in SONET systems. To avoid excessive amplitude distortion and phase distortion, the high-pass corner frequency of the DC blocking AC signal coupling networks used in SONET applications must be designed to pass the low-frequency spectral components introduced by the A1 and A2 synchronization bytes. To avoid excessive amplitude and phase distortion, the time constant (τ_n) of the coupling capacitor network shown in Figure 3–20 should be roughly 20 to 24 times greater than the 154 ns time interval of the repetitive A1 and A2 sync bytes transmitted at the beginning of every STS-192 or STM-64 frame. Additional details about the relationships described in Figure 3–20 can be found in Appendix D3.

$$(24)(t_{SYNC}) \geq \tau_n \geq (20)(t_{SYNC}) \quad \text{where } t_{SYNC} = 154 \text{ ns} \qquad \textbf{(Equation 3–22)}$$