Terabit Switching and Security Enhancement in a WDM/TDM Hybrid System

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Summary

Development in the WDM technologies has made multi-wavelength optical sources and components available [1-3]. By combing WDM mux-demux and fast electro-optic switches, a fast configurable WDM add-drop filter can be obtained. This enables using WDM with TDM in a way that each TDM time slot is also wavelength multiplexed. Hence introducing a second dimension for switching in addition to the time dimension. This also alleviates the demanding requirement on TDM as the switching throughput increases.

The number of channels that can be supported in a WDM/TDM hybrid switching system is the product of the number of time slots and the number of available wavelengths. We have done preliminary analysis on the system throughput. It shows that switching with tera-bit throughput and capable of supporting ten thousands of channels at more than 100 megabit per channel bandwidth is possible. This will be important for supporting future bandwidth-hungry applications such as video on demand.

Using fast configurable wavelength add/drop filters, we can also design a spectrally encoded code division multiple access (CDMA) system [4] in which each channel transmits on a combination of different wavelengths to enhance the security. Encryption has been conventionally used to for secure communications. However, in time critical applications such as voice and video transmissions where the tolerance to delay is low, encoding method at the physical level is necessary to ensure the throughput and delay requirement.

Another possibility offered by fast configurable WDM add/drop filters is a fast wavelength hopped system. In stead of coding in the spectral domain only as in spectrally encoded CDMA, each user hops its wavelength from time to time to make eavesdropping of the signal difficult. As in conventional fast radio frequency hopped CDMA systems [5], each bit is divided into many chips and a different wavelength is used for each chip. Bit symbols of different channels are multiplexed using appropriate wavelength hopping patterns to minimize crosstalk. An example is the prime codes. In order to reconstruct the signal bits, the receiver hops in synchronous with the transmitter. By combining the wavelength dimension and time dimension coding, the security of the system can be made very high [6]. In addition, because of the use of multiple wavelengths in the system, the throughput will be much better than pure time-hopped CDMA systems.

We will present implementation considerations of the above described systems and give the comparison on the throughput and security sides.

References

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