Subcarrier Multiplexing: An electrical source signal (TV, cellular phone etc.) is first mixed with a high frequency signal (subcarrier). In the case of multiple source signals, we assign a different subcarrier frequency for each source signal. Then the sum of subcarrier multiplexed (it is called frequency division multiplexed access) signals are used to modulate the light output of the laser to the fiber.

Advantages over other optical signal transmission methods: In TDMA, CDMA, or WDMA, the modulating signal is usually a binary, fixed rate signal. If we had preferred to use them we would have to make extra processes on the input signals, since they are mostly small bandwidth analog signals. (Like digitizing the signals and putting them in a TDMA form for capacity efficiency)

Applications: Cable TV is the most famous application, where 80 broadcast and cable TV channel signals (in NTSC AM/ Vestigial Side Band format) are easily transmitted over fiber using SCMA. Currently cable companies are employing hybrid systems (fiber for transmitting TV signals, coax cable for transmitting video on demand command/ control signals). Yet the trend towards all digital data, video transmission enforces the usage of Quadrature Amplitude Modulated source signals (in which original input signals are M- ary signals) rather then AM/ VSB signals.

Passive Optical Network for Personnel Communication Systems, is another application that is yet to be implemented. In a cell, or area of the whole operation (usually 100m diameter) all the PCS units communicate over a Remote Base Unit centered in that cell. The phone signals are received by that unit, and transmitted over a fiber line (photonic backbone) to a central base unit that takes care of the whole processing and traffic functions. The incoming call to the cellular phone is handled in the same manner. By this application the wireless frequency bandwidth will be used much more efficiently (less interference), and the hand units will get smaller.

Passive Optical Network for wireless networks, is another demonstrated application that has still some obstacles to overcome, like higher capacity.

Problems: In SCMA, we have some limitations however. One is the Carrier (optical light) to the Noise power Ratio constraint that comes from the classical communication theory. In SCM usage we can’t lower the CNR ratio less than 45 – 55 decibel in order to receive an acceptable demodulated channel. The lasers have limited optical powers, and also there are some noise terms arising. Relative Intensity Noise is a major problem, and it is due
to nonlinear responses to the modulation; in internal modulation it is the clipping noise of the laser, in external modulation it is the nonlinearity of the modulator. Another factor is *Intermodulation Distortion*. Nonlinear responses in the optical system result in second \((fs1 \pm fs2)\) and third \((fs1 \pm fs2 \pm fs3)\) order beating frequency terms in the received electrical signals, so we can’t put too many subcarriers in a fixed total subcarrier bandwidth. These terms are known as Composite Second Order (CSO), and Composite Triple Beat (CTB) respectively, and they are proportional to the total modulation power. (Number of channels times the average subcarrier power). *Stimulated Brillouin Scattering*, is simply reflection of a percentage of optical power back in the fiber, so limiting the injected power, is a minor limit today.

**Conclusion**: The application of passive optical networks in wireless networks seems to needs some more study and technological advancement, but its usage in cellular phone systems looks possible and has been demonstrated with the current technology. Analog cable TV is leaving its place to QAM 64 or 256 ary transmission. As the EO interfaces get cheaper, and the modulation bandwidth and power are increased, SCM will find much more usage.