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**Components of a Pulse Code Modulation (PCM) Encoder**:

**Sampling:** This component captures the amplitude of the analog signal at regular intervals, known as sampling points. The purpose is to discretize the analog signal into a series of samples that can be quantized and encoded digitally.

**Quantization:** Quantization assigns digital values to the sampled analog amplitudes. It involves dividing the range of possible analog values into discrete levels and assigning each sample to the nearest level. The purpose is to represent the analog signal with a finite set of digital values.

**Encoding:** Encoding involves converting the quantized samples into binary code words. Each binary word represents a sample value. The purpose is to create a digital representation of the analog signal that can be easily transmitted, stored, and reconstructed.

**Multiple Paths in a Network:**

Having multiple paths between pairs of stations in a network offers several advantages:

**Redundancy:** If one path fails due to a link failure or congestion, the network can automatically reroute traffic through an alternate path, ensuring continuous connectivity.

**Load Balancing:** Multiple paths enable the distribution of traffic across different routes, preventing congestion on any single path and optimizing network performance.

**Fault Tolerance:** In the event of a network component failure, having multiple paths ensures that communication can still occur, maintaining system reliability.

Improved Performance: By providing multiple options for data transmission, networks can adapt to changing conditions and select the most efficient path for each transmission, enhancing overall performance.

**Carrier Sense Multiple Access (CSMA):**

CSMA is a protocol used in network communication where stations listen to the network before transmitting to avoid collisions. Stations check if the channel is idle before sending data.

CSMA/CD (Carrier Sense Multiple Access with Collision Detection):

In CSMA/CD, stations continue to listen to the network while transmitting data. If a collision is detected (i.e., if another station is transmitting at the same time), the transmitting station stops transmission, waits for a random period, and then retries.

**CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance):**

In CSMA/CA, stations use techniques to avoid collisions altogether rather than detecting them after they occur. This is typically achieved by waiting for a random period before transmitting to reduce the likelihood of simultaneous transmissions by multiple stations, thereby minimizing collisions. Additionally, techniques like Request to Send/Clear to Send (RTS/CTS) may be used for further collision avoidance.