CS423: Lecture 5, Finish Clock Recovery and Transmission Media

George Varghese

September 6, 1995
Why Synchronous Transmission

• For Clock Recovery, receiver must know when to start its receive clock (phase). Then can sample the line at periodic intervals at the same rate as sender clock with some help from transitions in data.

• In asynchronous, receiver gets locked in phase when the voltage goes from low to high (start bit). Need to have fairly large idle time between characters for receiver to get locked in phase for each character; slows transmission and limits it to low rates.

• Two overheads to start bits: extra bit but also extra time needed for reliable detection. (Starting up receiver clock is expensive)

• In synchronous, we put a large number of start bits at the start of a large number of data bits. This allows the startup overhead to be amortized.
Getting locked in phase

- In asynchronous you get in phase by a single 0 to 1 transition. Not very reliable in the presence of noise.

- In Manchester, you get in phase by sending a preamble or group of start bits of the form 010101 in which the only transitions are at mid bit; easy to recognize and get locked in phase.
Phase Locked Loops

Receiver Sampling Clock

Observed Transitions in Data

- Once you lock in at the start of a data unit, you can rely on accuracy of receiver clock frequency (as in asynchronous). Can’t do that if data unit is large (as in synchronous).

- Could try resetting receiver clock on every observed transition. Susceptible to noise. Better to use more gradual adjustment.

- Phase Locked Loops measure phase difference and speed up or slow down receiver clock to reduce phase difference. Commonly used.
Eye Patterns

0 1 0 1 0 1 1

0 1 0 1 0 1

Superpose to get eye pattern

• In a perfect system, we will have a well-defined eye. Should sample at center of eye. Nice visual test of line quality.
"SYNCHRONOUS" TRANSMISSION

Upto 12000 Bits

Lots of Start Bits
(Preamble)

Lots of Stop Bits
(Postamable)

same as asynchronous except larger frame sizes. It requires better clock tolerance and more sophisticated coding.
Evaluation Criteria

Coding Efficiency (Real Bits/Coded Bits)
Signal to Noise Ratio
DC Balance
Implementation Complexity
MULTIPLEXING (SHARING)

TIME DIVISION MULTIPLEXING (TDM)

FREQUENCY DIVISION MULTIPLEXING (FDM)
BASEBAND CABLE (e.g. ETHERNET)

- High bandwidth (10-100 MHz)
- Hard to tap, expensive to Install
- Small Distance (1 - 3 km without repeaters)
FIBRE OPTICS

Huge Bandwidth (10 Million Mhz!)

Almost Impossible to Tap
Point-to-point
Secure
Excellent Electrical Isolation
Thin and Easy to Install
Optics still expensive
Unidirectional
MICROWAVE

Avoids Right of Way
May be cheaper than installing cable
Reasonable Bandwidth
Has problems with Rain
Upto 100 km distance
SATELLITE

Avoids Right of Way

Good Bandwidth (500 Mhz)

World Wide

Large Latency

Antenna Cost

READING ASSIGNMENT: Section 2.2