Simulation and Modeling of an ADSL Modem - Channel Model and Receiver Initialization

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Channel Model

✔ Model transmission over copper cable
  – Linear shift invariant (FIR) filter
  – Crosstalk - additive colored noise
✔ Modeled as synchronous data flow (SDF)
Receiver Initialization

✔ Subcarrier detection
  – Handshake signals
  – Pilot phase for phase locked loop

✔ Input power estimation for gain control

✔ Channel delay estimation
  – frame synchronization during initialization

✔ Channel and signal to noise ratio estimation
  – Channel equalization (without cyclic prefix)
  – Bit loading (with cyclic prefix)
Modeling Strategy

✔ Front End
  - Synchronize sample input and output
  - Buffer input samples to achieve variable delay
    • Frame synchronization
    • Enable/disable cyclic prefix

✔ Back End
  - Frame synchronize transmitter and receiver
    • One iteration handles one frame of input/output
    • Simultaneously switch to cyclic prefix mode
Modeling

✔ Model ADC/DAC as one SDF block
  – force synchronized operation
✔ Dynamic dataflow for input data buffer
✔ Back End
  – Processing in SDF blocks
  – Dataflow controlled by boolean logic
    • Boolean dataflow
  – Finite state machine embedded in SDF block
Modeling

✔ Front End
  - Requires dynamic scheduler
    • dynamic data management

✔ Back End
  - Annotated static schedule (SDF, BDF & FSM)
  - All computation intensive units in SDF

✔ Increase in signal processing delay
Results

Channel Response

Channel Length: 256
Cyclic Prefix: 16

Shortened Channel Response
Conclusions

✔ Deliverables:
  - Channel model for ADSL transmission
    • User definable parameters
  - Model for ADSL receiver during initialization
    • Statically schedulable except for dynamic data management
    • Dynamically compute optimal settings