

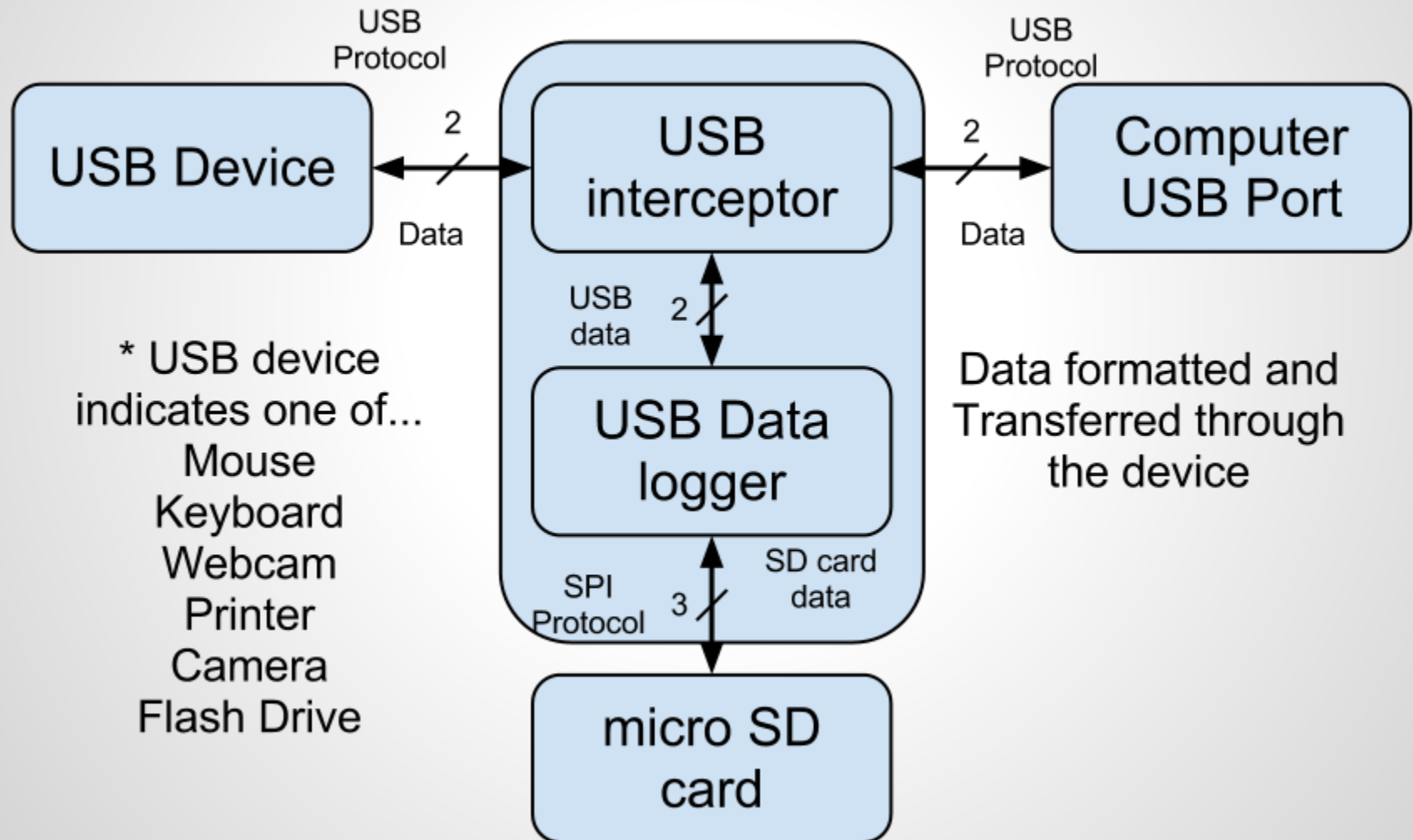
USB Data Logger

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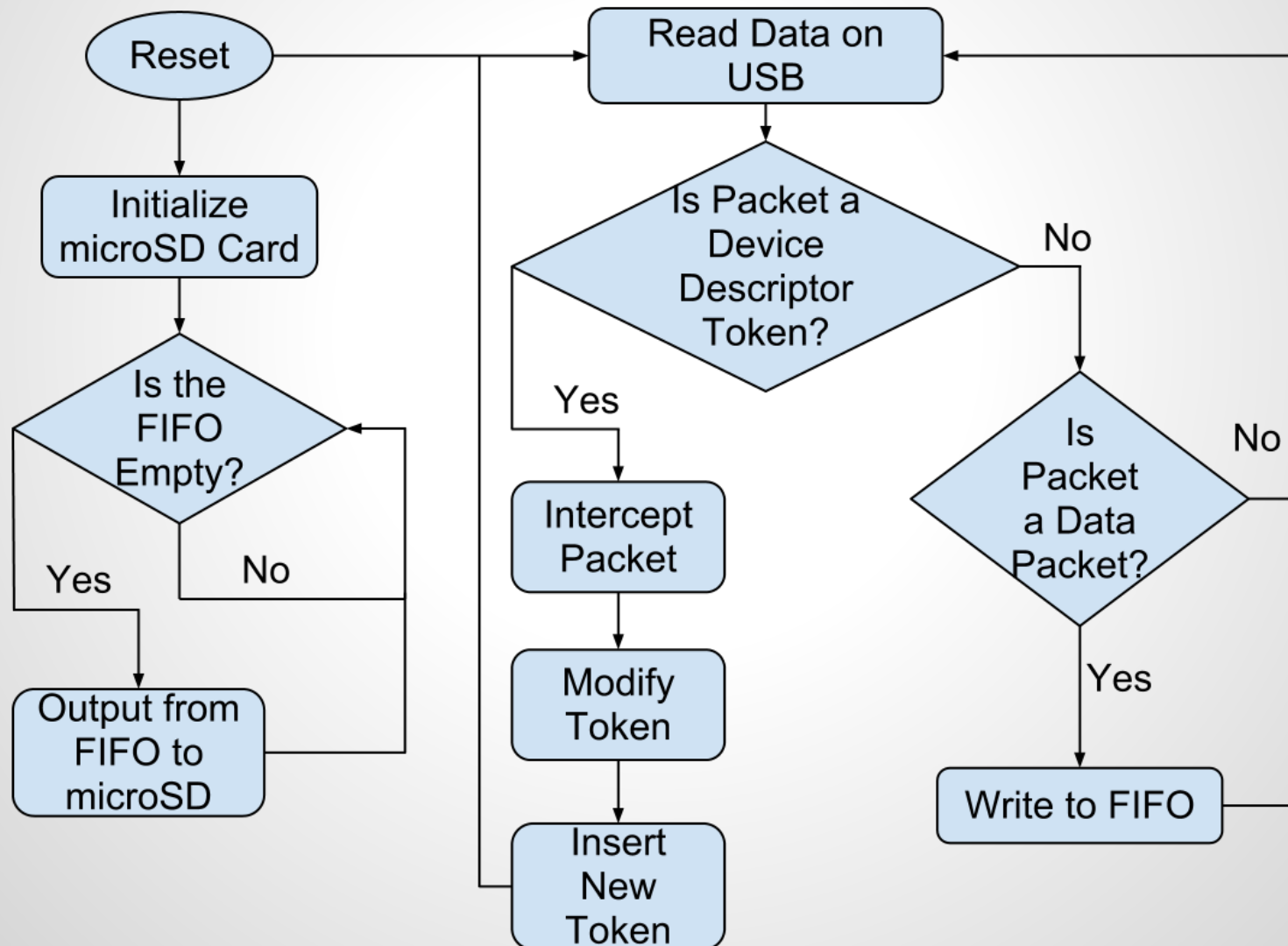
Data Logger Functions

- Tracks all bytes being transferred to or from a USB device
- Transparent during communication
- Modifies all USB 2.0 or 3.0 handshake bytes to make the device run at USB 1.1
- Records all data bytes to a pre-initialized microSD card

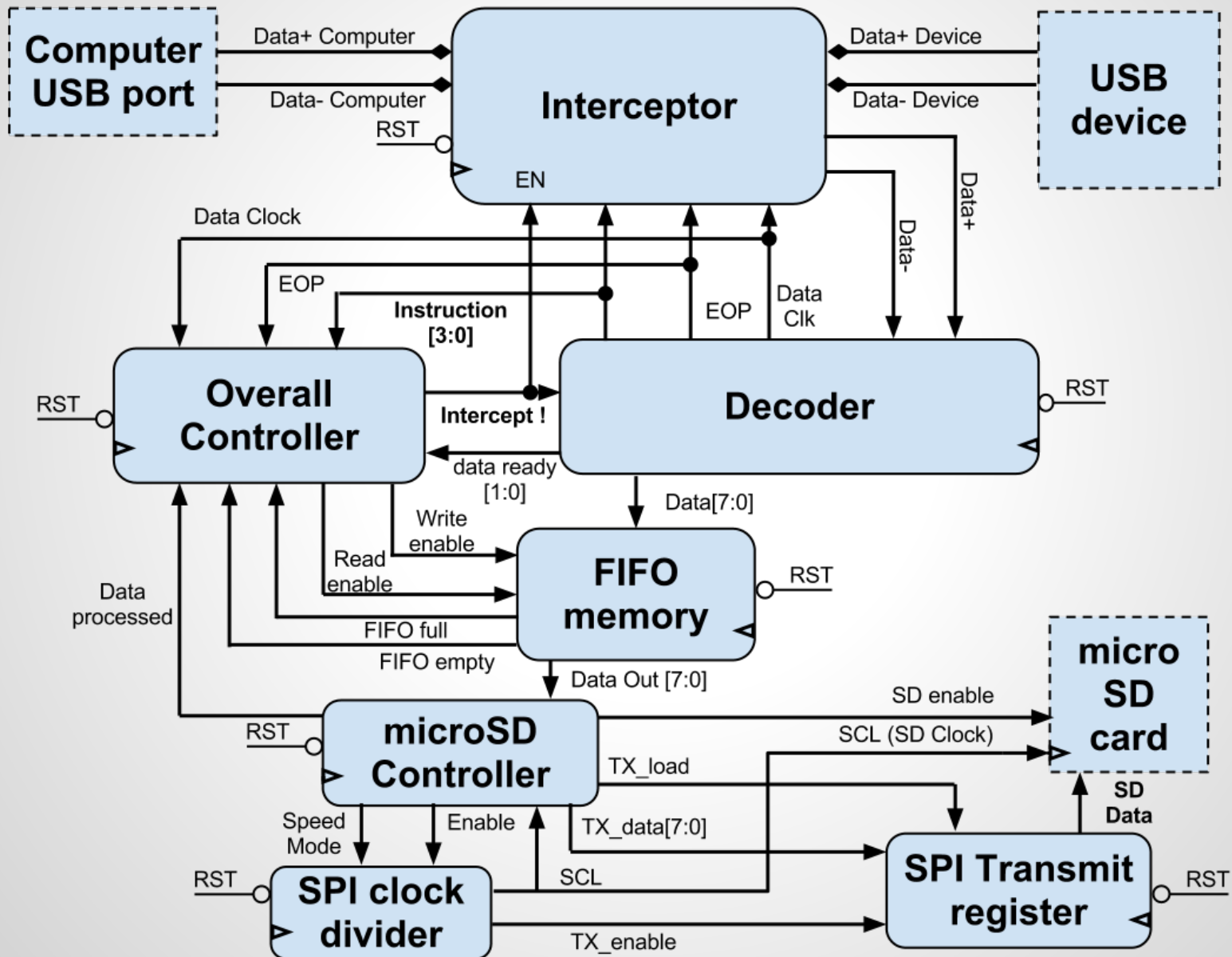
Data Logger Usage Diagram



Operational Timeline



Data Logger Top-Level Architecture

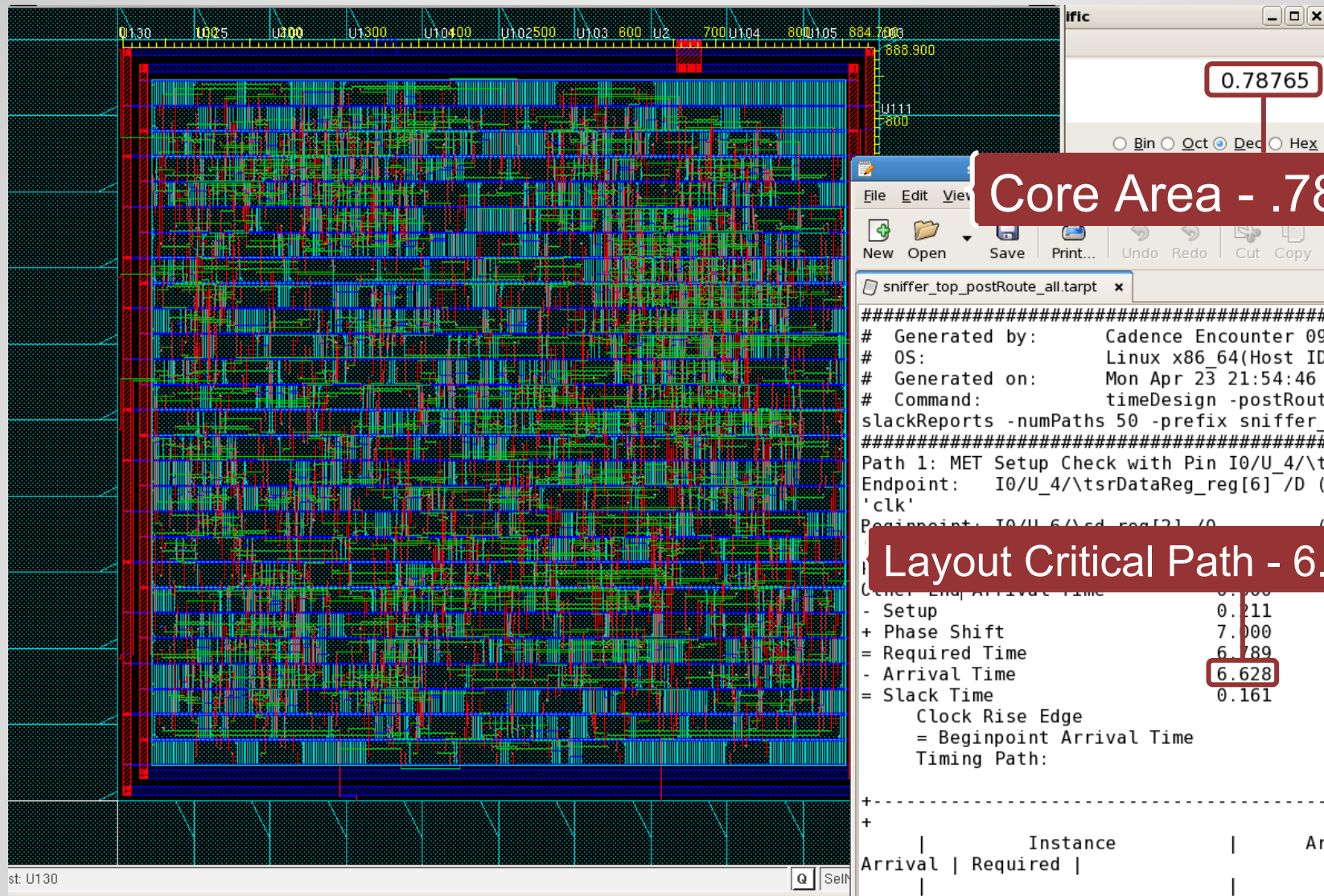


Generic Success Criteria Results

- Test benches exist for all top-level components
- Data Logger synthesizes successfully
- Source and mapped versions behave identically with no timing errors
- A layout has been produced and passes geometry and connectivity checks.
- Design complies within most budgeted targets.
 - 11 pins
 - 140 MHz clock rate (7 ns)
 - 12 Mbps through USB, 50 Mbps through microSD
 - Core area too large at $.787 \text{ mm}^2$ (vs $.257 \text{ mm}^2$)
 - Total area, however, hits target at 2.25 mm^2 precisely (vs. 1.97 mm^2 original calculated).

Data Logger Criteria Results

- Correctly writes data to external microSD card
- Remains transparent when reading data from USB
- Recognizes token packets
- Modifies USB Protocol token to version 1.1



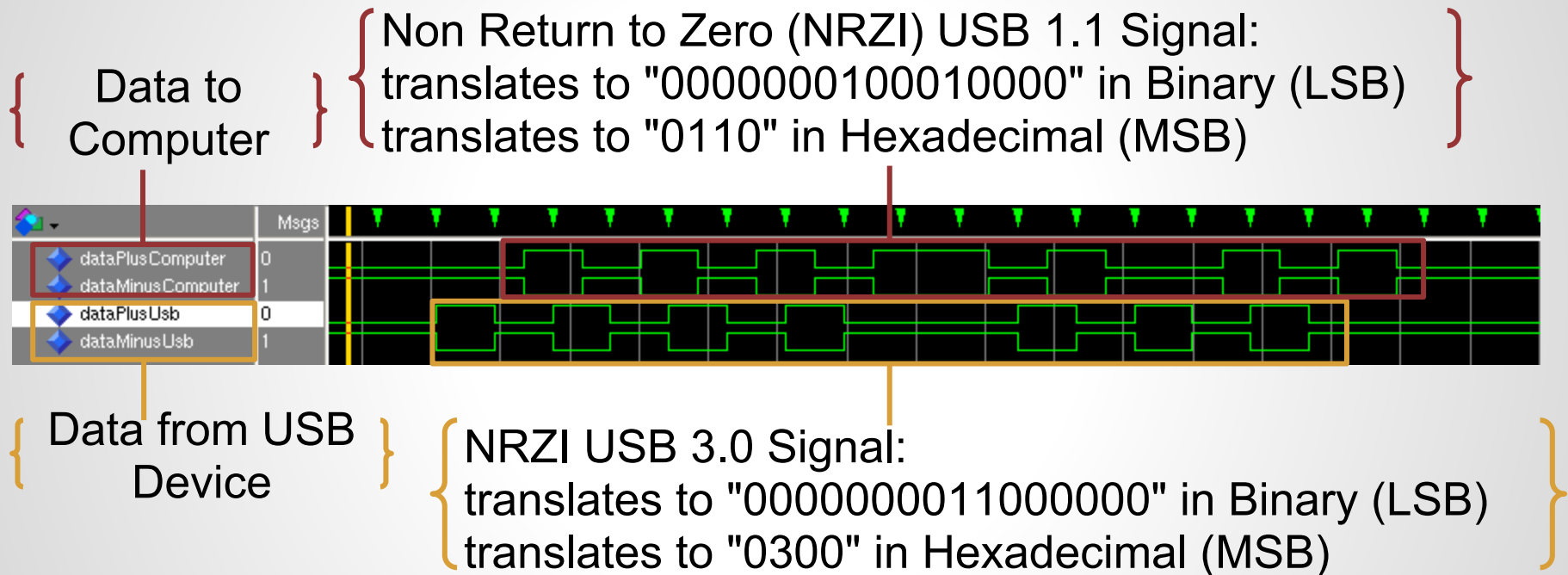
Layout, dimensions, and delays as generated by Encounter

Synthesis Critical Path: 1.78 ns

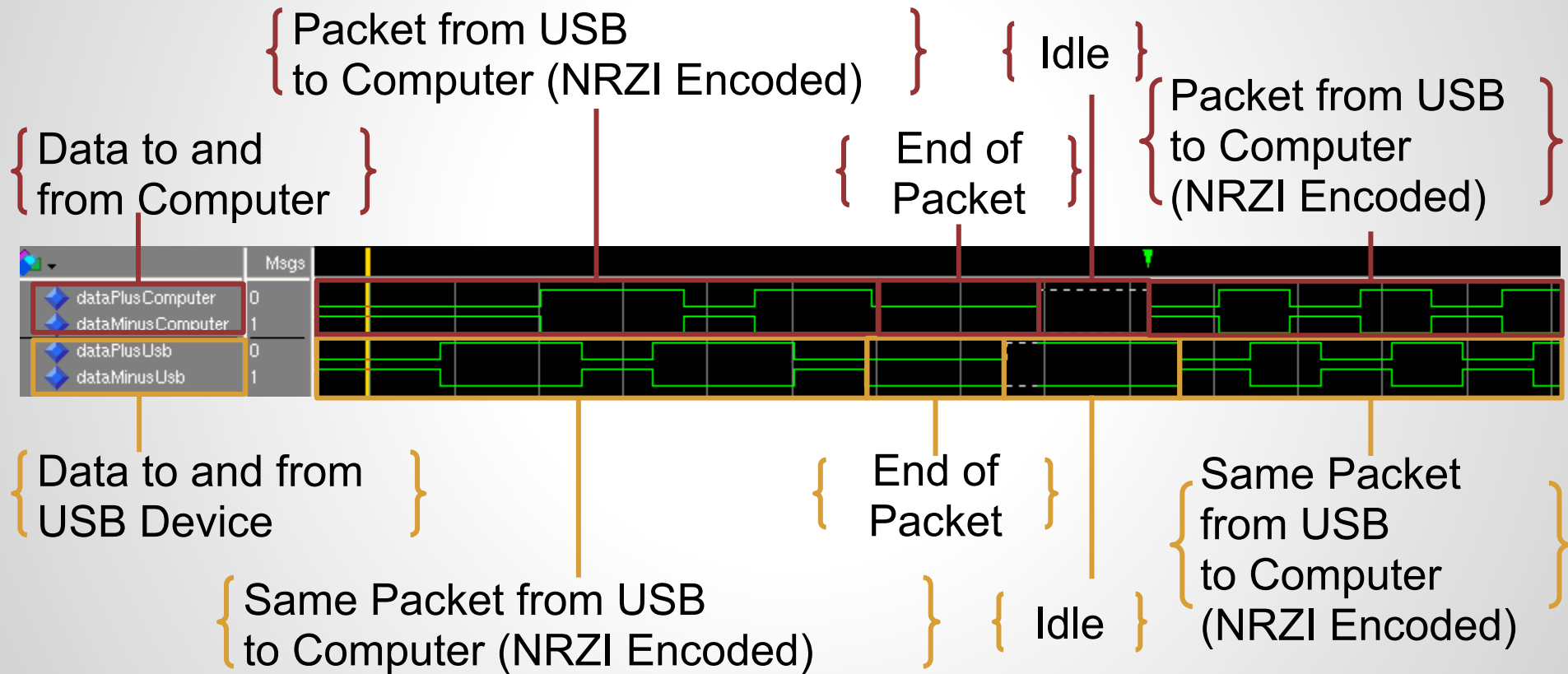
Budgeted Critical Path: 4.3 ns

Total Area: 2.25 mm²

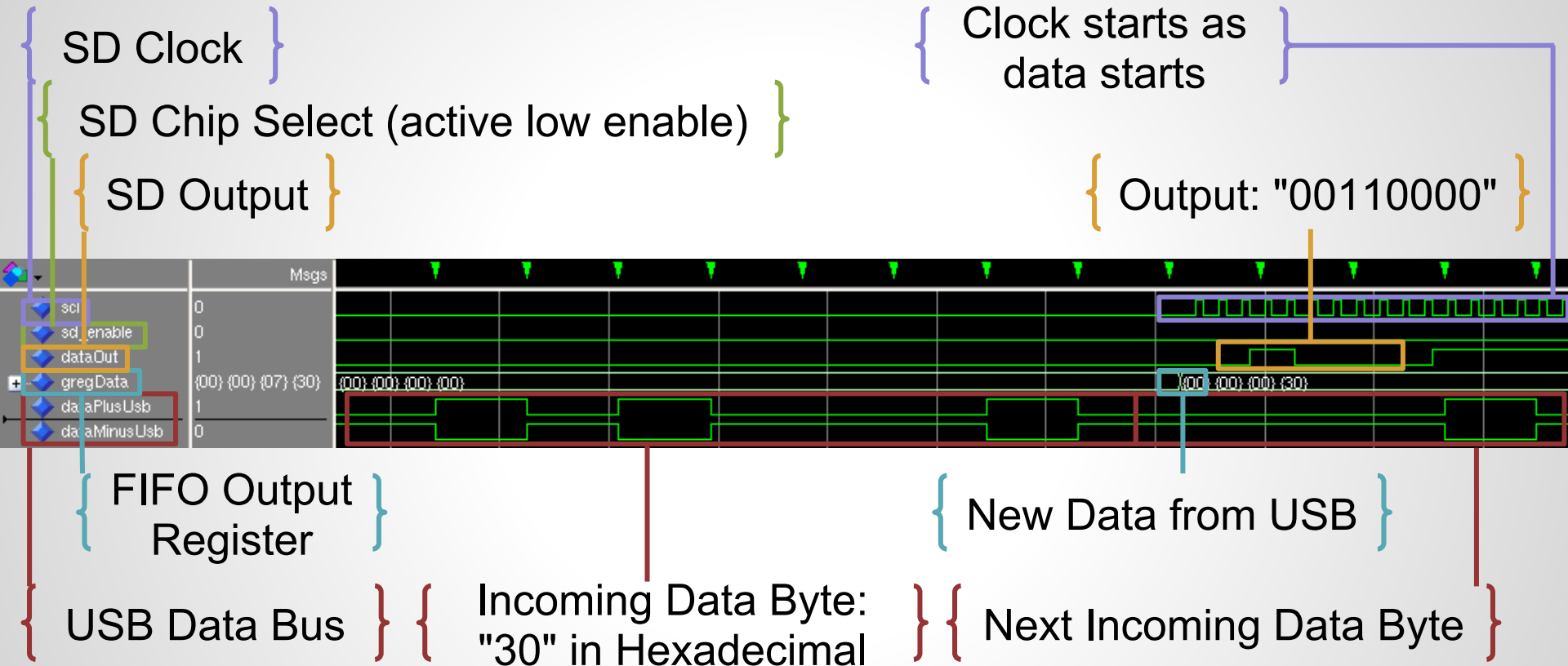
Test Results: USB 3.0 Modification



Test Results: Transparency



Test Results: Output to microSD card



Data Logger Project Conclusions

- Tri-States are inconvenient
- microSD initialization is long
- Interception could be re-designed
- Component blocks could interact more cleanly

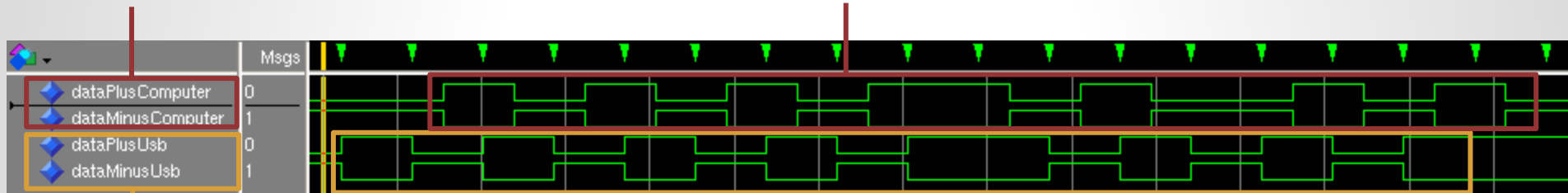
Discussion

Questions, Comments, Concerns

Test Case: USB 2.0 modification

Data to
Computer

Non Return to Zero (NRZI) USB 1.1 Signal:
translates to "0000000100010000" in Binary (LSB)
translates to "0110" in Hexadecimal (MSB)



Data from USB
Device

NRZI USB 2.0 Signal:
translates to "0000000001000000" in Binary (LSB)
translates to "0300" in Hexadecimal (MSB)

Test case: USB Token Recognition

