Group 5

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**DataFlow Submission**

The model breaks up the different operation into entities to operate like functions. The operation works the same as the functions used for the behavioral model, but with a few nano second delay. The different entities where the bulk of the work is being done, works mainly on combinational logic, signal assignments and generate statements. The individual “function entities” all link together in another entity called “blackbox”. This entity does all of the encryption and decryption steps, where key\_controller generates the round keys. Both of those entities, blackbox and key\_controller meet in another entity called encrypt\_decrypt. This entity handles both key generation and encryption, using a counter and internal registers to manipulate the data.

The main entity loops through 20 states, each state does exactly one operation. There are 4 states for each loading process, and 4 states to output. State 15 is where a signal activates the separate state machine, the encrypter\_decrypter, and remains in that state until data is ready for output.

Some constraints moving from behavioral to data flow are timing and accuracy of the signal assignments. In the behavioral model we could reliably get output in 2 clock cycles after encryption started. In the current data flow model, we currently witness erratic behavior and fail to get consistent output to match the behavioral model. There is a test bench for behavioral with assert statements to show behavioral’s functionality, and another test bench for the data flow architecture that mirrors the same process and assert statements but with different amounts of clock cycles in between encryption and output.

Mix\_columns, shift\_rows, sub\_box, blackbox, and key\_controller have all been tested and are fully functional, though in the main entity and encrypt\_decrypt there are issues with state triggering not lining up.