Pipeline with Data Forwarding

Solving Data hazards
Loop:

sub X9, X9, 4

cbz X9, endLoop

add X10, X9, X19

add X11, X9, X23

ldur X12, [X10, #0]

ldur X13, [X11, #0]

add X12, X13, X12

stur X12, [X10, #0]

b Loop

dEndLoop:
Unavoidable data hazards

• lw data to immediately following instruction
  – one cycle stall
• ALU to immediately following branch
  – one cycle stall
• lw to immediately following branch
  – two cycle stall
• Stalls need circuits to freeze PC and to place 0’s in control line registers
HAZARD Control freezes appropriate instructions in place by not allowing writes to pipeline registers and zeroes control pipeline registers to create bubble.
Data Hazards

Loop:  
sub X9, X9, 4  
cbz X9, endLoop  
add X10, X9, X19  
add X11, X9, X23  
add X11, X9, X23  
ldur X12, [X10, #0]  
ldur X13, [X11, #0]  
add X12, X13, X12  
stur X12, [X10, #0]  
b Loop

endLoop:  
Can we reorder code to fix??
Reordered

Loop:

sub X9, X9, 4
add X10, X9, X19
cbz X9, endLoop
add X11, X9, X23
ldur X12, [X10, #0]
ldur X13, [X11, #0]
sub X9, X9, 4
add X12, X13, X12
stur X12, [X10, #0]
b Loop

dendLoop:

No longer a problem
HAZARD Control freezes appropriate instructions in place by not allowing writes to pipeline registers and zeroes control pipeline registers to create bubble.