

## NAND

Result of using Yosys to convert to NANDs for various softcores

| core name      | options          | NANDs  |                                   |
|----------------|------------------|--------|-----------------------------------|
| darkriscv      |                  | 50424  |                                   |
| glacial        |                  | 2063   |                                   |
| riscv_simple   | RV32I UNI        |        |                                   |
| riscv_simple   | RV32I MULTI      |        |                                   |
| riscv_simple   | RV32I PIPE       |        |                                   |
| riscv_simple   | RV32IM UNI       |        |                                   |
| riscv_simple   | RV32IM MULTI     |        |                                   |
| riscv_simple   | RV32IM PIPE      |        |                                   |
| serv           |                  | 3595   |                                   |
| picorv32       |                  | 34463  |                                   |
| non RISC-V:    |                  |        |                                   |
| core name      | options          | NANDs  |                                   |
| zpu_avalanche  |                  | 7900   |                                   |
| MiniCPU_SerPCU |                  | 1105   |                                   |
| MiniCPU_SerALU |                  | 1269   |                                   |
|                | PCU+ALU          | 2374   |                                   |
| MCPU           |                  | 425    |                                   |
| 6502 (nestang) |                  | 4881   |                                   |
| cray1          |                  | 303711 | Includes 9 hard_v_reg, 65 latches |
| j0 (gameduino) |                  | 20998  |                                   |
| j0             | no mult (16 stk) | 10616  |                                   |
| ukp (nestang)  |                  | 3961   | includes code ROM                 |

NAND

Baby 8 blocks

|                |     |
|----------------|-----|
| logic function | 26  |
| ALU            | 32  |
| datapath       | 445 |

## ice40

Result of synth\_ice40 in Yosys for various softcores

| core name    | options      | total cells | flip-flops | LUT4  | CARRY | TBUF | RAM40_4K |
|--------------|--------------|-------------|------------|-------|-------|------|----------|
| darkriscv    |              | 7777        | 2262       | 5176  | 339   | 0    | 0        |
| glacial      |              | 355         | 84         | 224   | 47    | 0    | 0        |
| riscv_simple | RV32I UNI    | 8273        | 1743       | 5801  | 441   | 32   | 256      |
| riscv_simple | RV32I MULTI  | 8362        | 1978       | 5682  | 446   | 0    | 256      |
| riscv_simple | RV32I PIPE   | 10272       | 2587       | 6910  | 487   | 32   | 256      |
| riscv_simple | RV32IM UNI   | 18611       | 1743       | 12698 | 3882  | 32   | 256      |
| riscv_simple | RV32IM MULTI | 18740       | 1984       | 12608 | 3891  | 1    | 256      |
| riscv_simple | RV32IM PIPE  | 20445       | 2595       | 13629 | 3933  | 32   | 256      |
| serv         |              | 450         | 201        | 241   | 8     | 0    | 0        |
| picorv32     |              | 2683        | 596        | 1678  | 405   | 0    | 4        |

non RISC-V:

| core name      | options          | total cells | flip-flops | LUT4  | CARRY | TBUF | RAM40_4K        |
|----------------|------------------|-------------|------------|-------|-------|------|-----------------|
| zpu_avalanche  |                  | 1651        | 272        | 1307  | 72    | 0    | 0               |
| MiniCPU_SerPCU |                  | 157         | 51         | 106   | 0     | 0    | 0               |
| MiniCPU_SerALU |                  | 176         | 49         | 127   | 0     | 0    | 0               |
|                | PCU+ALU          | 333         | 100        |       |       |      |                 |
| MCPU           |                  | 79          | 24         | 35    | 12    | 8    | 0               |
| 6502 (nestang) |                  | 936         | 123        | 754   | 59    | 0    | 0               |
| cray1          |                  | 37355       | 8510       | 25769 | 3057  | 0    | 19 9 hard_v_reg |
| j0 (gameduino) |                  | 942         | 67         | 782   | 91    | 0    | 2               |
| j0             | no mult (16 stk) | 590         | 65         | 445   | 78    | 0    | 2               |
| ukp (nestang)  |                  | 494         | 151        | 272   | 68    | 2    | 1               |

ice40

| Baby 8 blocks  | total cells | flip-flops | LUT4 | CARRY | TBUF | RAM40_4K |
|----------------|-------------|------------|------|-------|------|----------|
| logic function | 8           |            | 8    |       |      |          |
| ALU            | 36          |            | 28   | 8     |      |          |
| datapath       | 391         | 136        | 247  | 8     |      |          |

gowin

Result of synth\_gowin in Yosys for various softcores

| core name    | options      | total cells | flip-flops | MISC | ALU  | LUT   | MuxLUT | RAM16S4 |
|--------------|--------------|-------------|------------|------|------|-------|--------|---------|
| darkriscv    |              | 9032        | 142        | 176  | 355  | 5198  | 3105   | 56      |
| glacial      |              | 753         | 84         | 41   | 55   | 351   | 222    | 0       |
| riscv_simple | RV32I UNI    | 32136       | 1729       | 547  | 422  | 16926 | 12512  | 0       |
| riscv_simple | RV32I MULTI  | 17631       | 1964       | 515  | 461  | 9709  | 4982   | 0       |
| riscv_simple | RV32I PIPE   | 23066       | 2573       | 515  | 470  | 12540 | 6968   | 0       |
| riscv_simple | RV32IM UNI   | 94934       | 1729       | 547  | 6156 | 50099 | 36403  | 0       |
| riscv_simple | RV32IM MULTI | 85103       | 1964       | 515  | 6131 | 45825 | 30668  | 0       |
| riscv_simple | RV32IM PIPE  | 85506       | 2581       | 547  | 6209 | 45840 | 30329  | 0       |
| serv         |              | 1083        | 201        | 207  | 12   | 452   | 211    | 0       |
| picorv32     |              | 4039        | 567        | 411  | 424  | 2009  | 596    | 32      |

non RISC-V:

| core name      | options          | total cells               | flip-flops | MISC | ALU | LUT  | MuxLUT | RAM16S4 |
|----------------|------------------|---------------------------|------------|------|-----|------|--------|---------|
| zpu_avalanche  |                  | 3930                      | 272        | 104  | 78  | 2053 | 1423   | 0       |
| MiniCPU_SerPCU |                  | 167                       | 51         | 19   | 0   | 84   | 13     | 0       |
| MiniCPU_SerALU |                  | 407                       | 49         | 14   | 0   | 217  | 127    | 0       |
|                | PCU+ALU          | 574                       | 100        |      |     |      |        |         |
| MCPU           |                  | 187                       | 24         | 20   | 15  | 90   | 38     | 0       |
| 6502 (nestang) |                  | 1833                      | 123        | 41   | 68  | 1100 | 501    | 0       |
| cray1          |                  | 0 D latches not supported |            |      |     |      |        |         |
| j0 (gameduino) |                  | 2064                      | 35         | 78   | 112 | 1245 | 578    | 16      |
| j0             | no mult (16 stk) | 4250                      | 31         | 78   | 91  | 2163 | 1879   | 8       |
| ukp (nestang)  |                  | 986                       | 151        | 29   | 89  | 477  | 240    | 0       |

gowin

| Baby 8 blocks  | total cells | flip-flops | MISC | ALU | LUT | MuxLUT | RAM16S4 |
|----------------|-------------|------------|------|-----|-----|--------|---------|
| logic function | 34          |            |      | 26  |     | 8      |         |
| ALU            | 106         |            |      | 35  | 9   | 40     | 22      |
| datapath       | 193         | 8          |      | 87  | 9   | 57     | 28      |

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## cyclonev

Result of synth\_intel\_alm -family cyclonev in Yosys for various softcores

| core name    | options      | total cells | flip-flops | MISC | ALU | LUT  | M18x18 | M27x27 | memories | mem type |
|--------------|--------------|-------------|------------|------|-----|------|--------|--------|----------|----------|
| darkriscv    |              | 1891        | 162        | 178  | 365 | 1057 | 1      | 0      | 128      | mlab     |
| glacial      |              | 328         | 84         | 42   | 58  | 144  | 0      | 0      | 0        |          |
| riscv_simple | RV32I UNI    | 6795        | 1731       | 483  | 507 | 3946 | 0      | 0      | 128      | m10k     |
| riscv_simple | RV32I MULTI  | 7157        | 1966       | 456  | 581 | 4026 | 0      | 0      | 128      | m10k     |
| riscv_simple | RV32I PIPE   | 8428        | 2627       | 487  | 573 | 4613 | 0      | 0      | 128      | m10k     |
| riscv_simple | RV32IM UNI   | 10419       | 1731       | 485  | 701 | 7370 | 2      | 2      | 128      | m10k     |
| riscv_simple | RV32IM MULTI | 10620       | 1966       | 457  | 709 | 7356 | 2      | 2      | 128      | m10k     |
| riscv_simple | RV32IM PIPE  | 12127       | 2635       | 488  | 739 | 8133 | 2      | 2      | 128      | m10k     |
| serv         |              | 641         | 204        | 209  | 27  | 201  | 0      | 0      | 0        |          |
| picorv32     |              | 2322        | 608        | 413  | 431 | 868  | 0      | 0      | 2        | m10k     |

non RISC-V:

| core name      | options          | total cells               | flip-flops | MISC | ALU | LUT | M18x18 | M27x27 | memories | mem type |
|----------------|------------------|---------------------------|------------|------|-----|-----|--------|--------|----------|----------|
| zpu_avalanche  |                  | 1331                      | 272        | 109  | 79  | 871 | 0      | 0      | 0        |          |
| MiniCPU_SerPCU |                  | 139                       | 51         | 22   | 0   | 66  | 0      | 0      | 0        |          |
| MiniCPU_SerALU |                  | 167                       | 49         | 14   | 0   | 104 | 0      | 0      | 0        |          |
|                | PCU+ALU          | 306                       | 100        |      |     |     |        |        |          |          |
| MCPU           |                  | 93                        | 24         | 28   | 15  | 26  | 0      | 0      | 0        |          |
| 6502 (nestang) |                  | 704                       | 123        | 41   | 68  | 472 | 0      | 0      | 0        |          |
| cray1          |                  | 0 D latches not supported |            |      |     |     |        |        |          |          |
| j0 (gameduino) |                  | 558                       | 67         | 77   | 100 | 311 | 1      | 0      | 2        | m10k     |
| j0             | no mult (16 stk) | 540                       | 39         | 77   | 95  | 297 | 0      | 0      | 32       | mlab     |
| ukp (nestang)  |                  | 561                       | 155        | 31   | 100 | 275 | 0      | 0      | 0        |          |

## cyclonev

| Baby 8 blocks  | total cells | flip-flops | MISC | ALU | LUT | M18x18 | M27x27 | memories | mem type |
|----------------|-------------|------------|------|-----|-----|--------|--------|----------|----------|
| logic function | 34          |            |      | 26  |     | 8      |        |          |          |
| ALU            | 63          |            |      | 33  | 10  | 20     |        |          |          |
| datapath       | 149         | 8          |      | 86  | 10  | 29     |        |          | 16 mlab  |



xilinx

Result of synth\_xilinx -flatten in Yosys for various softcores (default family is xc7)

| core name    | options      | total cells | flip-flops | MISC | CARRY4 | LUT   | MuxLUT | DSP48 | memories | mem type               |
|--------------|--------------|-------------|------------|------|--------|-------|--------|-------|----------|------------------------|
| darkriscv    |              | 2506        | 150        | 281  | 68     | 1428  | 498    | 1     |          | 80 RAM32x1D+RAM32M(16) |
| glacial      |              | 298         | 84         | 44   | 15     | 139   | 16     | 0     |          | 0                      |
| riscv_simple | RV32I UNI    | 6581        | 1728       | 528  | 88     | 3469  | 736    | 0     |          | 32 RAMB36E1            |
| riscv_simple | RV32I MULTI  | 7371        | 1963       | 509  | 74     | 3969  | 824    | 0     |          | 32 RAMB36E1            |
| riscv_simple | RV32I PIPE   | 8534        | 2572       | 542  | 92     | 4508  | 788    | 0     |          | 32 RAMB36E1            |
| riscv_simple | RV32IM UNI   | 35014       | 1728       | 2514 | 2736   | 18378 | 9618   | 8     |          | 32 RAMB36E1            |
| riscv_simple | RV32IM MULTI | 35780       | 1963       | 2497 | 2722   | 18758 | 9800   | 8     |          | 32 RAMB36E1            |
| riscv_simple | RV32IM PIPE  | 35660       | 2580       | 2534 | 2742   | 18685 | 9079   | 8     |          | 32 RAMB36E1            |
| serv         |              | 650         | 201        | 207  | 4      | 212   | 26     | 0     |          | 0                      |
| picorv32     |              | 2447        | 572        | 657  | 97     | 1038  | 67     | 0     |          | 16 RAM32M              |

non RISC-V:

| core name      | options          | total cells | flip-flops | MISC | CARRY4 | LUT   | MuxLUT | DSP48 | memories | mem type                 |
|----------------|------------------|-------------|------------|------|--------|-------|--------|-------|----------|--------------------------|
| zpu_avalanche  |                  | 1307        | 272        | 105  | 21     | 754   | 155    | 0     |          | 0                        |
| MiniCPU_SerPCU |                  | 137         | 51         | 19   | 0      | 65    | 2      | 0     |          | 0                        |
| MiniCPU_SerALU |                  | 171         | 49         | 14   | 0      | 97    | 11     | 0     |          | 0                        |
|                | PCU+ALU          | 308         | 100        |      |        |       |        |       |          |                          |
| MCPU           |                  | 101         | 24         | 35   | 5      | 36    | 1      | 0     |          | 0                        |
| 6502 (nestang) |                  | 780         | 123        | 43   | 14     | 520   | 80     | 0     |          | 0                        |
| cray1          |                  | 25005       | 6803       | 1056 | 811    | 15406 | 661    | 11    |          | 257 RAM32x1D+RAMB18E1(1) |
| j0 (gameduino) |                  | 797         | 43         | 110  | 24     | 397   | 190    | 1     |          | 32 RAM32x1D              |
| j0             | no mult (16 stk) | 683         | 39         | 107  | 19     | 315   | 171    | 0     |          | 32 RAM32x1D              |
| ukp (nestang)  |                  | 527         | 159        | 71   | 25     | 213   | 58     | 0     |          | 1 RAMB18E1               |

xilinx

| Baby 8 blocks  | total cells | flip-flops | MISC | CARRY4 | LUT | MuxLUT | DSP48 | memories | mem type |
|----------------|-------------|------------|------|--------|-----|--------|-------|----------|----------|
| logic function | 34          |            | 26   |        | 8   |        |       |          |          |
| ALU            | 59          |            | 33   | 3      | 19  | 4      |       |          |          |
| datapath       | 131         | 8          | 86   | 3      | 30  |        |       |          | 4 RAM32M |