RISC-V ISA

Additional information

RISC-V ISA is divided into extensions

I	Integer instructions (frozen)
E	Reduced number of registers
M	Multiplication and Division (frozen)
A	Atomic instructions (frozen)
F	Single-Precision Floating-Point (frozen)
D	Double-Precision Floating-Point (frozen)
C	Compressed Instructions (frozen)
X	Non Standard Extensions

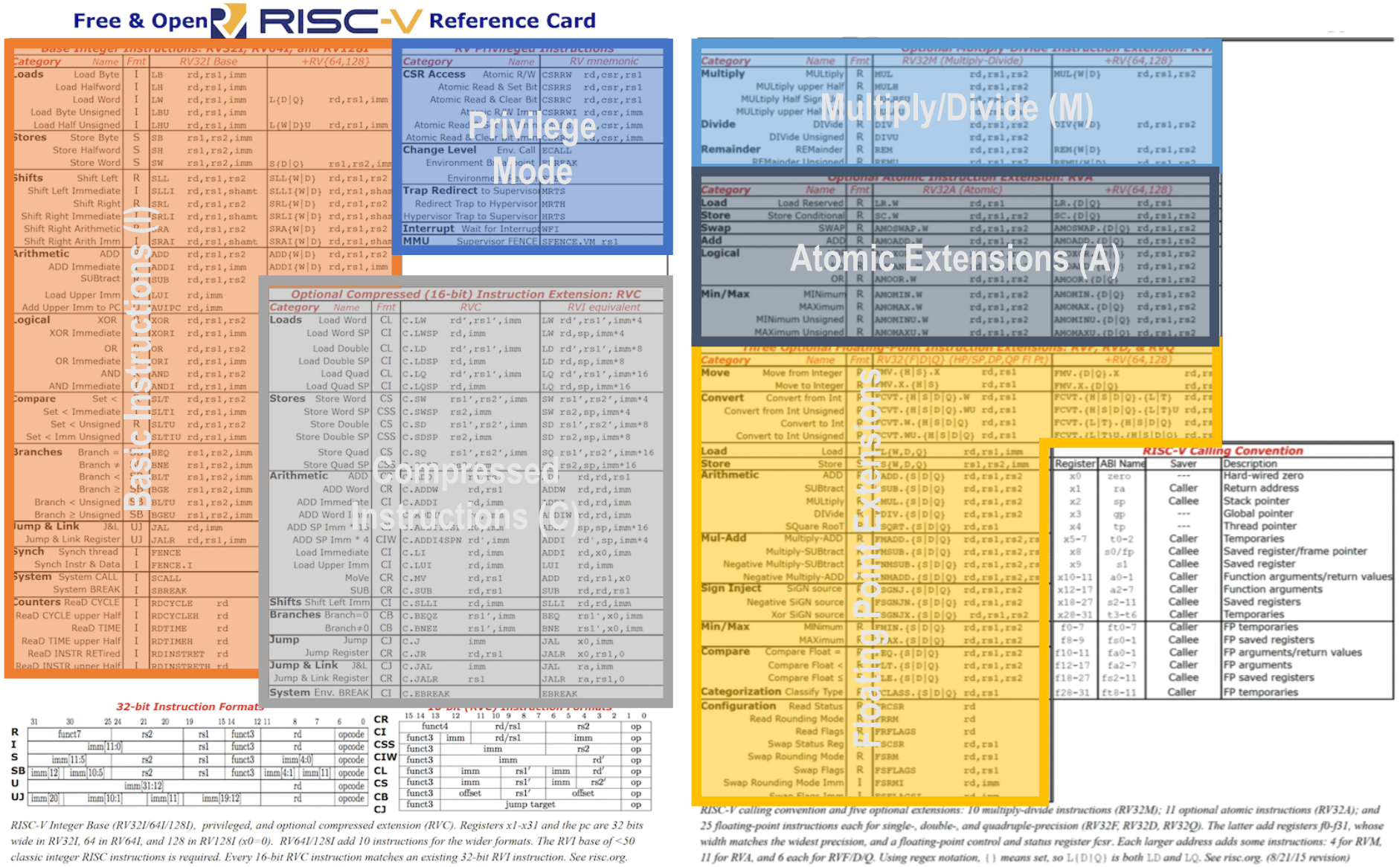
- Kept very simple and extendable
  - Wide range of applications from IoT to HPC
- RV + word-width + extensions
  - RV32IMC: 32bit, integer, multiplication, compressed
- User specification:
  - Separated into extensions, only **I** is mandatory
- Privileged Specification (WIP):
  - Governs OS functionality: Exceptions, Interrupts
  - Virtual Addressing
  - Privilege Levels

Work continues on new RISC-V extensions

- Foundation members work in task-groups
- Dedicated task-groups
  - Formal specification
  - Memory Model
  - Marketing
  - External Debug Specification

Q	Quad-precision Floating-Point
L	Decimal Floating Point
B	Bit Manipulation
T	Transactional Memory
P	Packed SIMD
J	Dynamically Translated Languages
V	Vector Operations
N	User-Level Interrupts

Reduced Instruction Set: all in one page



RISC-V Integer Base (RV32I/64I/128I), privileged, and optional compressed extension (RVC). Registers x1-x31 and the pc are 32 bits wide in RV32I, 64 in RV64I, and 128 in RV128I (x0=0). RV64I/128I add 10 instructions for the wider formats. The RVI base of <50 classic integer RISC instructions is required. Every 16-bit RVC instruction matches an existing 32-bit RVI instruction. See risc.org.

RISC-V calling convention and five optional extensions: 10 multiply-divide instructions (RV32M); 11 optional atomic instructions (RV32A); and 25 floating-point instructions each for single-, double-, and quadruple-precision (RV32F, RV32D, RV32Q). The latter add registers f0-f31, whose width matches the widest precision, and a floating-point control and status register fcsr. Each larger address adds some instructions: 4 for RVM, 11 for RVA, and 6 each for RVF/D/Q. Using regex notation, {} means set, so L{D|Q} is both LD and LQ. See risc.org. (8/21/15 revision)

Encoding of the instructions, main groups

- Reserved opcodes for standard extensions
- Rest of opcodes free for custom implementations
- Standard extensions will be frozen/not change in the future

inst[4:2] / inst[6:5]	000	001	010	011	100	101	110	111 ($> 32b$)
00	LOAD	LOAD-FP	*custom-0*	MISC-MEM	OP-IMM	AUIPC	OP-IMM-32	$48b$
01	STORE	STORE-FP	*custom-1*	AMO	OP	LUI	OP-32	$64b$
10	MADD	MSUB	NMSUB	NMADD	OP-FP	*reserved*	*custom-2/rv128*	$48b$
11	BRANCH	JALR	*reserved*	JAL	SYSTEM	*reserved*	*custom-3/rv128*	$\geq 80b$