

SDR-Boston

Boston SDR User Group

NEWSDR'11

VOLK and GNU Radio

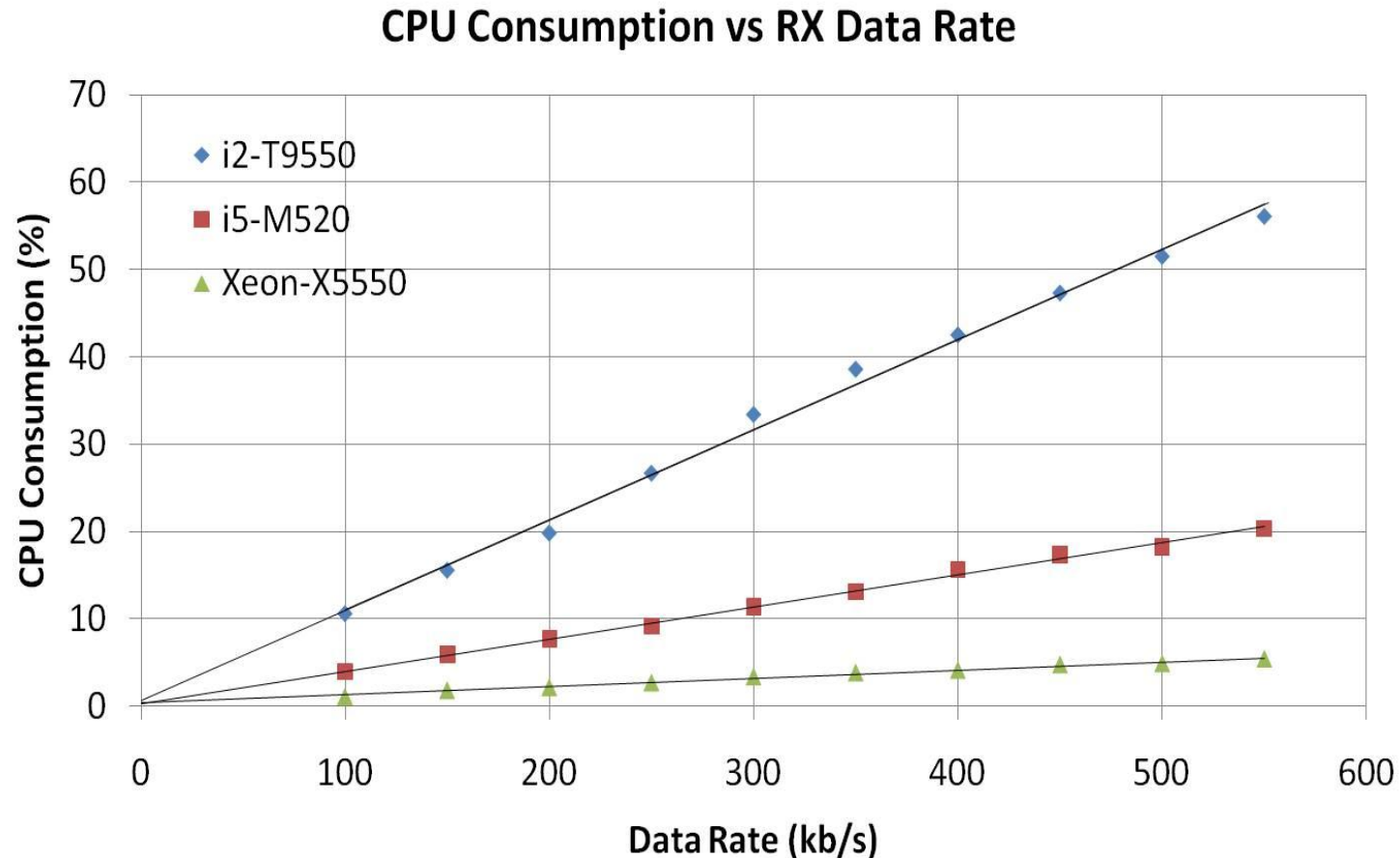
Tom Rondeau

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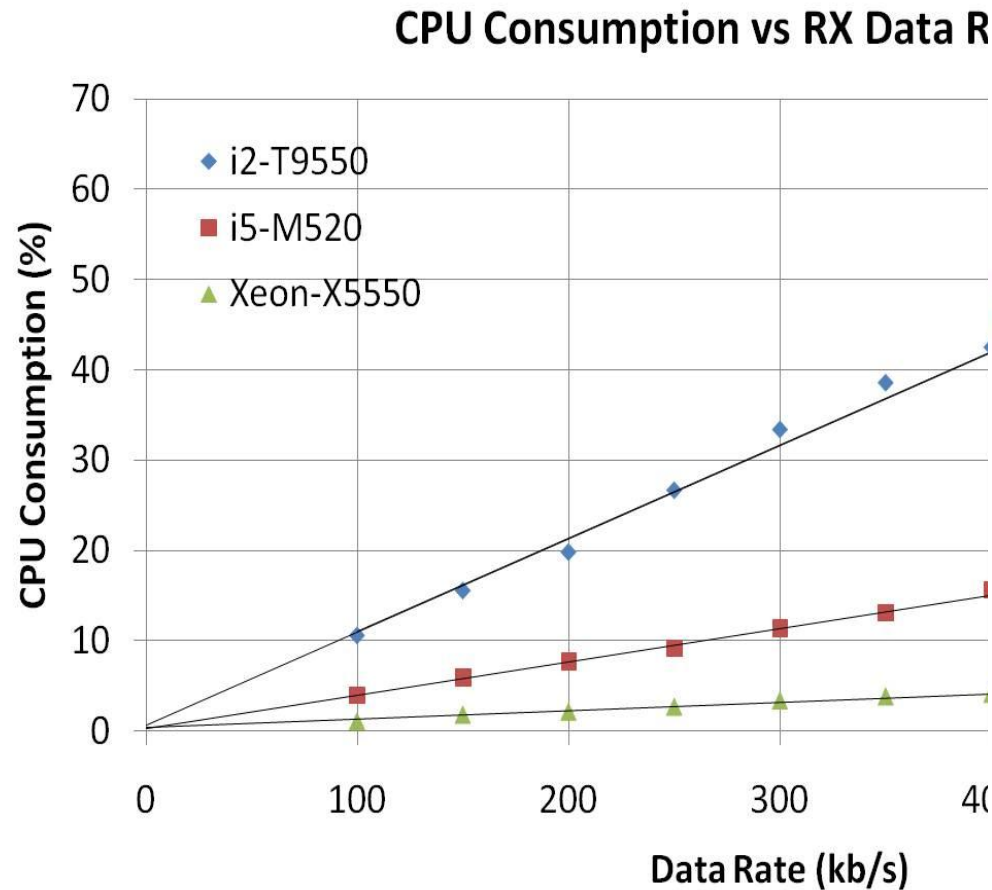
October 1, 2011

What's the problem we are trying to solve?



F. Ge, C. J. Chiang, Y. M. Gottlieb, and R. Chadha, "GNU Radio-Based Digital Communications: Computational Analysis of a GMSK Transceiver," IEEE GLOBECOM, 2011.

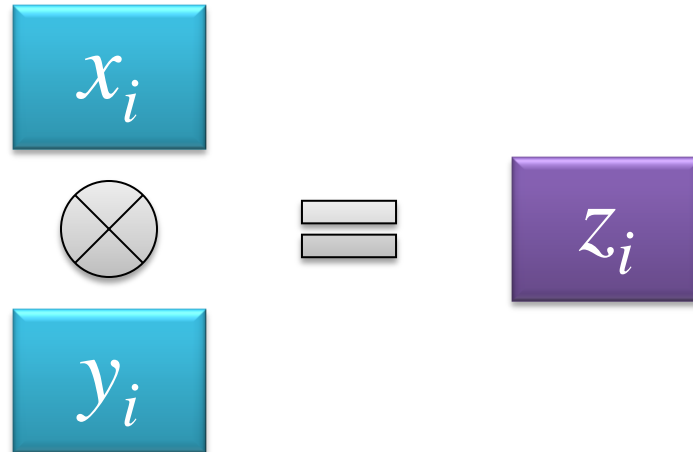
VOLK: Vector-Optimized Library of Kernels



Better than he was before. Better... stronger... faster.

Single Instruction, Multiply Data (SIMD) Basics

for i in $[0 : N]$ {

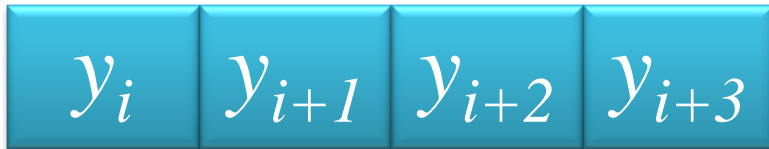
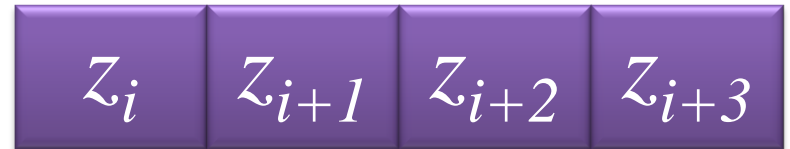
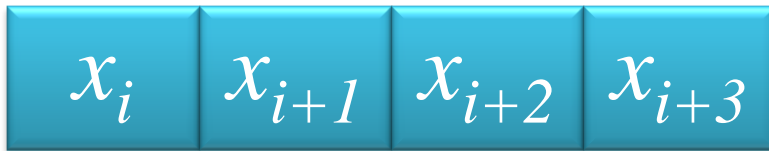


}

Traditional (scalar) math. Only one multiply.

Single Instruction, Multiply Data (SIMD) Basics

for i in $[0 : 4 : N]$ {

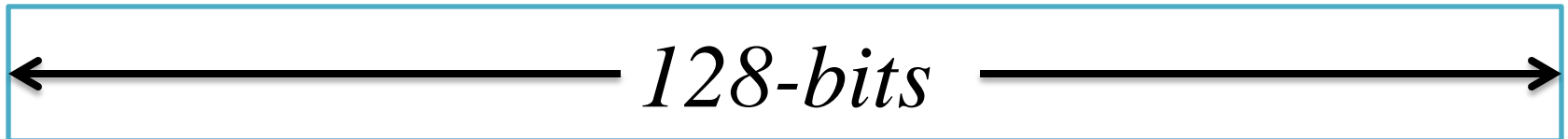


}

Vectorized math. One instruction does four multiplies

SIMD Registers in x86 chips

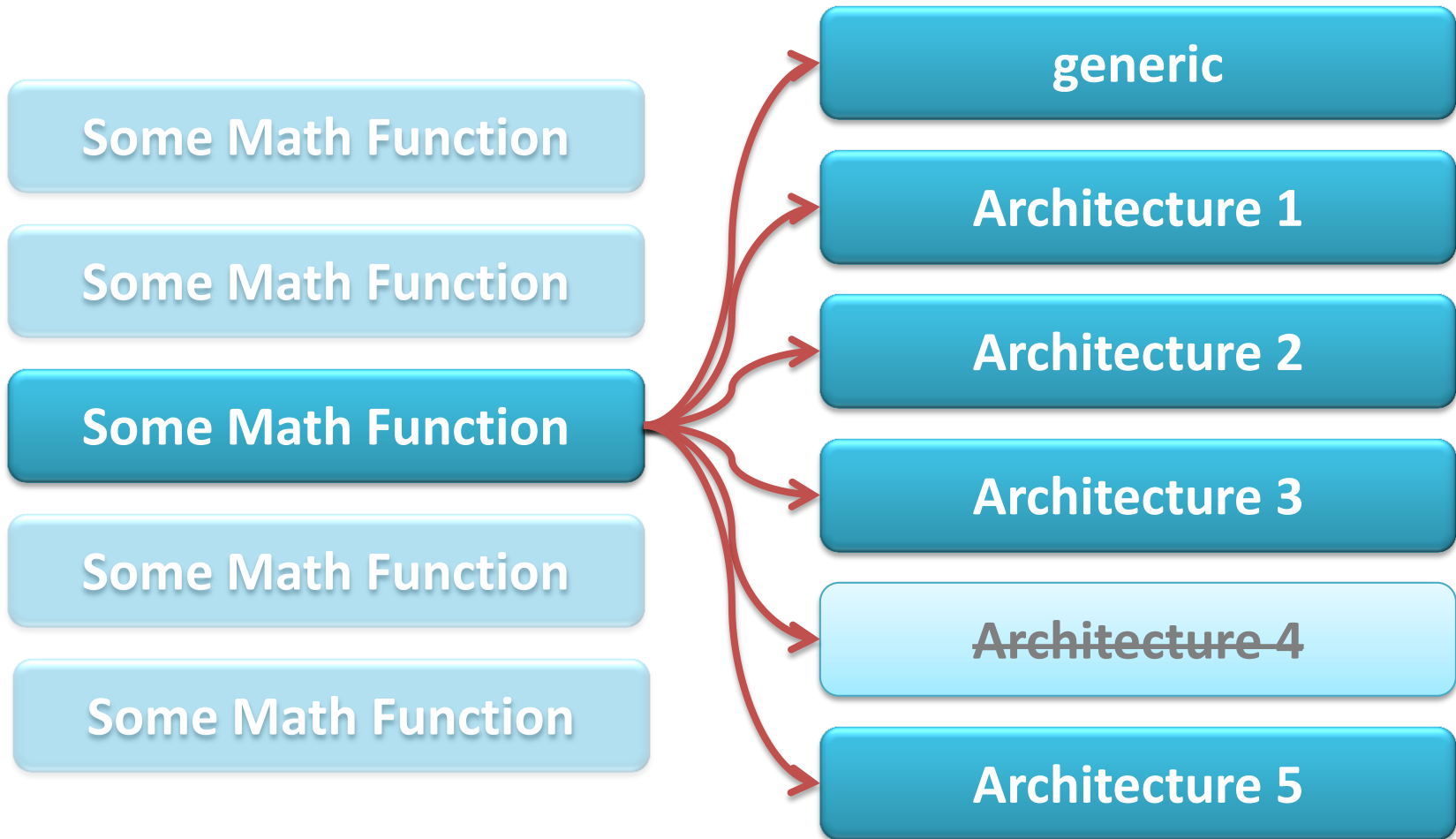
Holds doubles, floats, ints, shorts, and chars



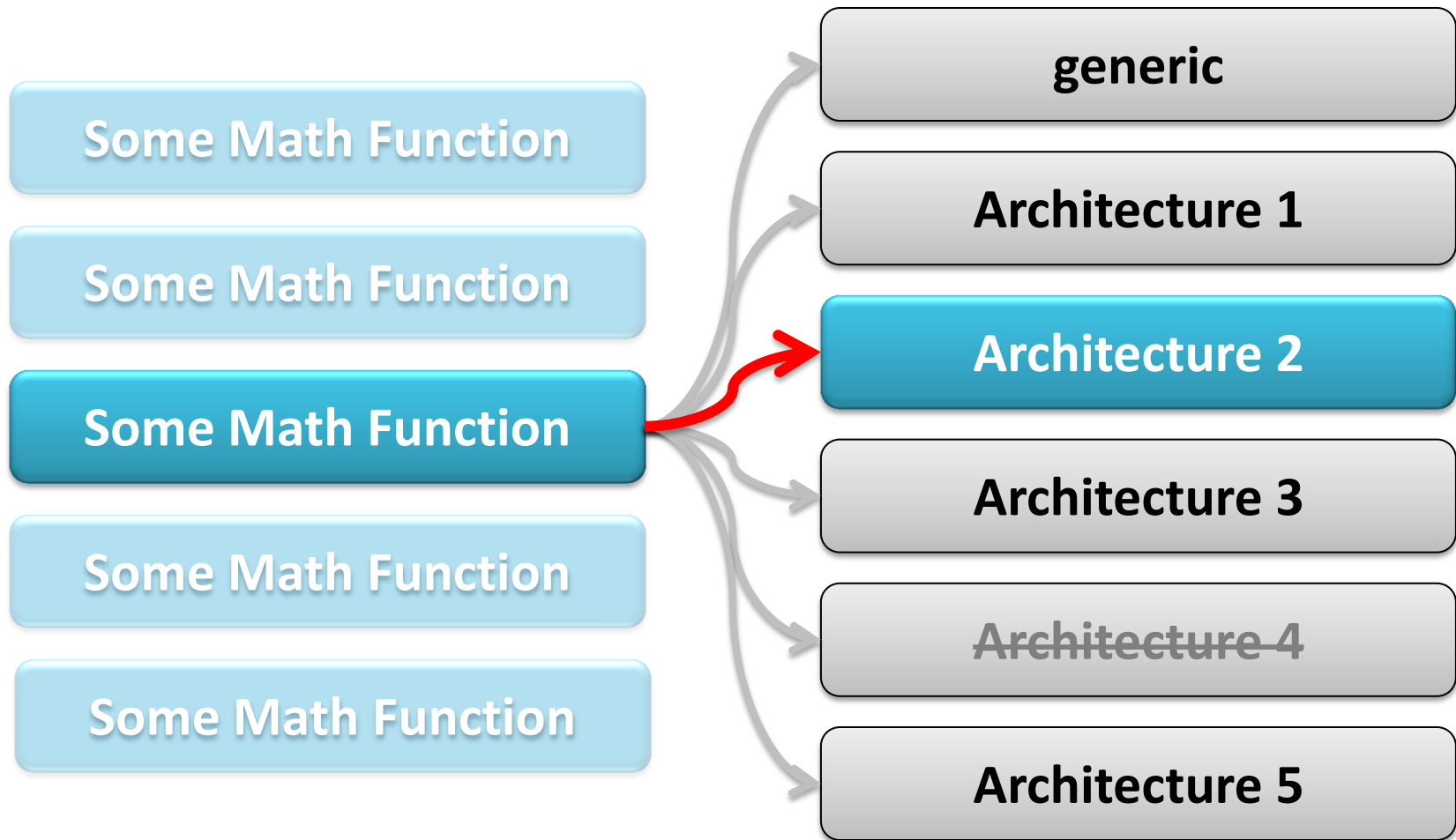
Other SIMD architectures

- Intel: SIMD (SSE, AVX)
 - AVX extends to 256-bit registers
- PowerPC: AltiVec
- AMD: 3DNow!
- ARM: NEON
- Others, but mostly on dead architectures

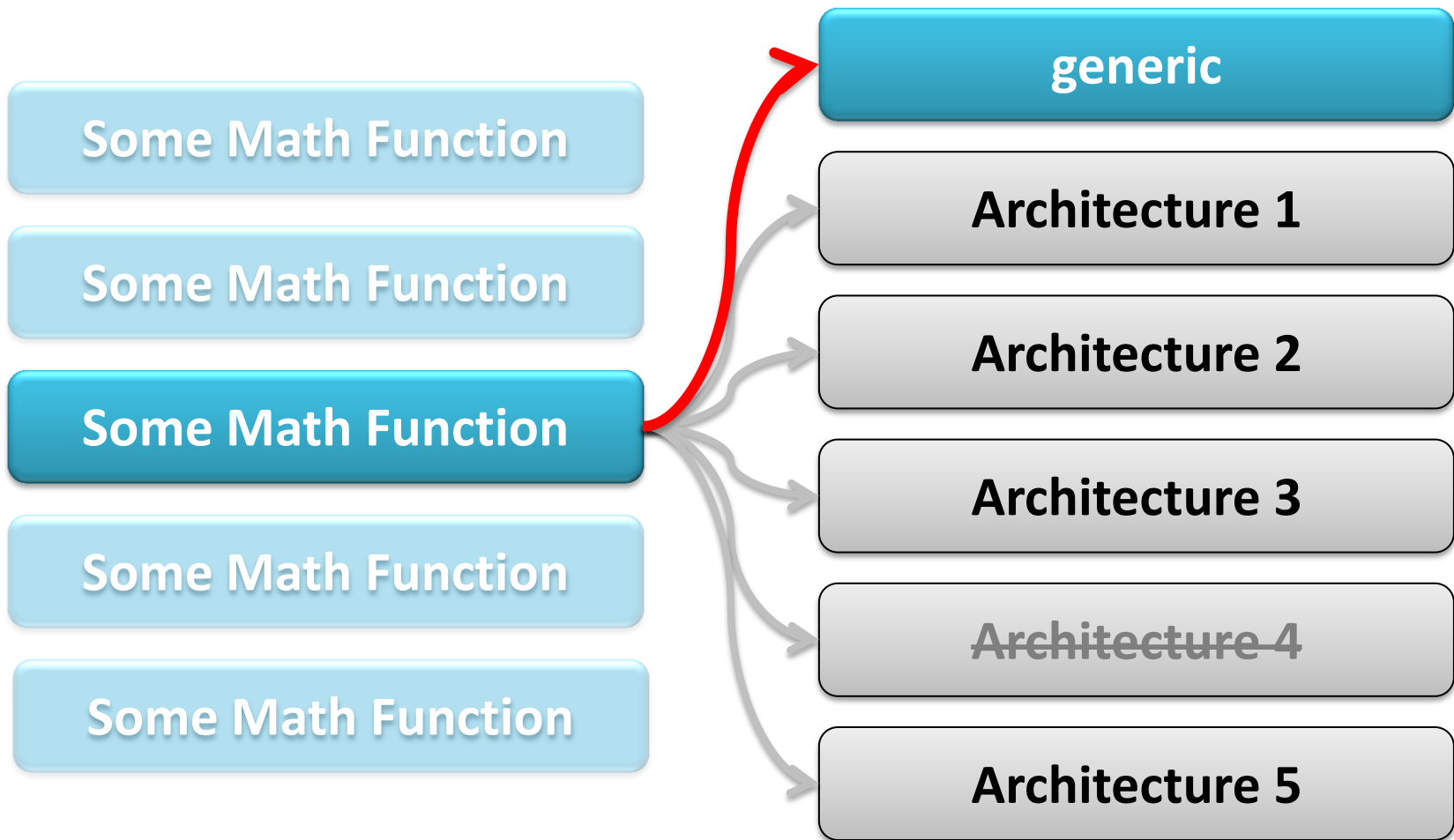
VOLK: Set of architecture-specific kernels



Runtime engine finds best architecture for the processor and selects it.

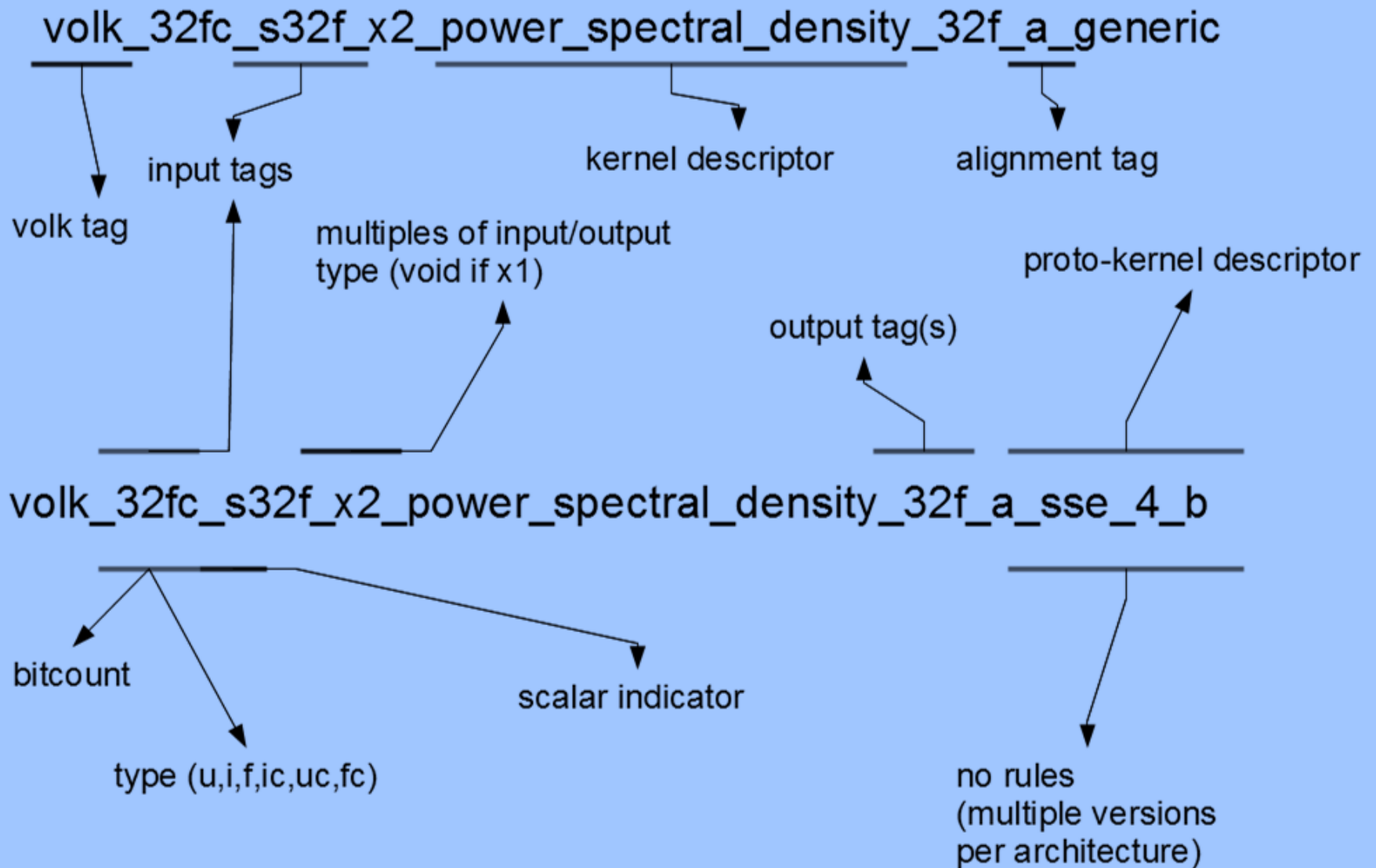


If no suitable architecture kernel has been written, fall back on the generic kernel.



Naming Convention:

<http://gnuradio.org/redmine/projects/gnuradio/wiki/Volk>



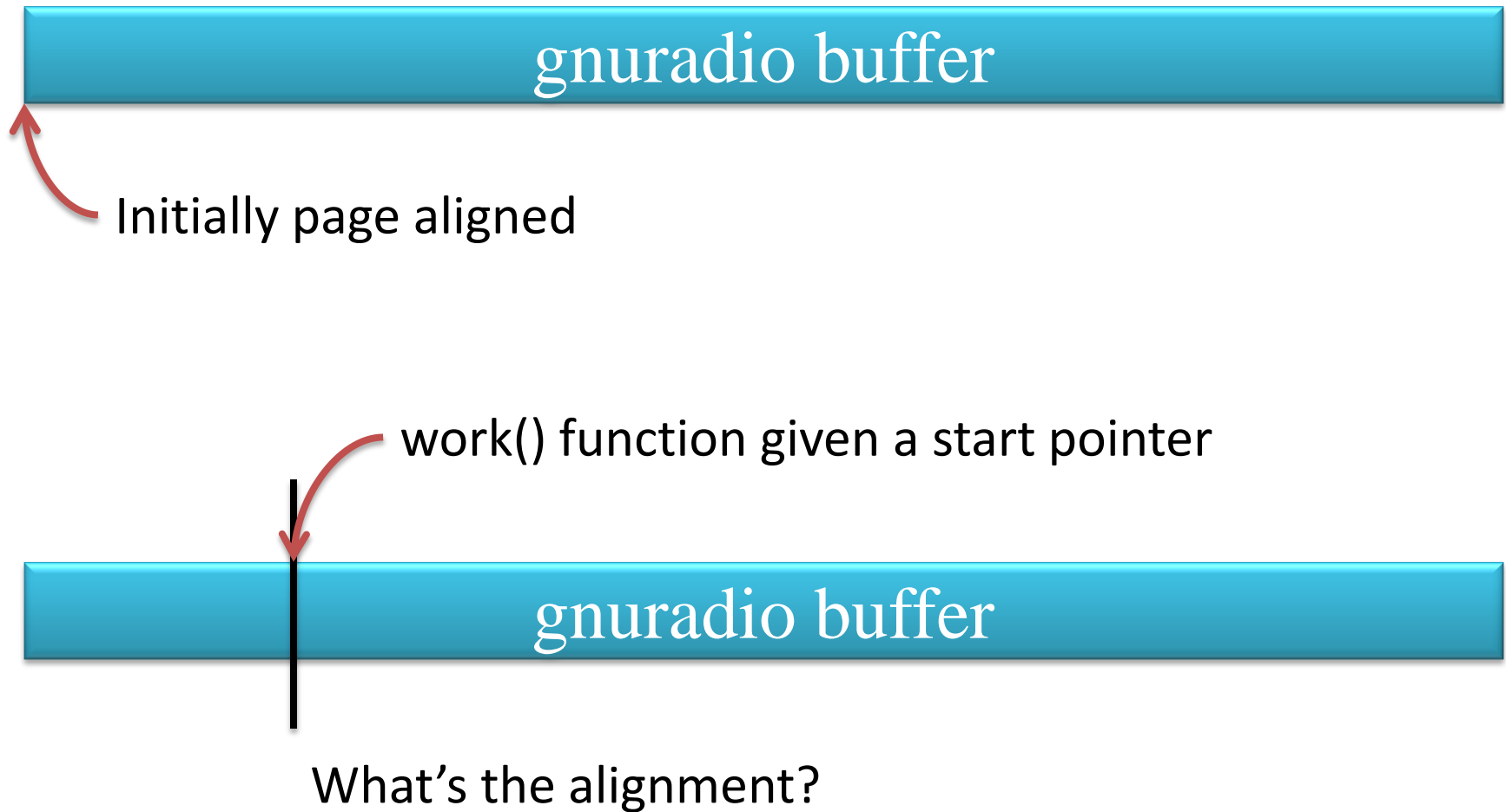
GNU Radio Implementation Issues

Memory Alignment

- SIMD instructions (generally) want to have some byte alignment
 - SSE: 16-byte aligned loads
 - AVX: 32-byte aligned loads
- Loading unaligned data can cause a seg fault.
- Using special unaligned load instructions is very time consuming
 - Aligned memory in an unaligned load is not guaranteed to be promoted

GNU Radio Implementation Issues

Memory Alignment



GNU Radio Implementation Issues

Memory Alignment



Use `set_output_multiple(x)` to ensure alignment



Given an output multiple commensurate with the alignment and data type, we can keep alignment.

fin