SystemC – Data Types (06A)

SystemC

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Please send corrections (or suggestions) to youngwlim@hotmail.com.

This document was produced by using OpenOffice and Octave.

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Based on the following original work

[1] Aleksandar Milenkovic, 2002
CPE 626 The SystemC Language – VHDL, Verilog Designer's Guide
http://www.ece.uah.edu/~milenka/ce626-02S/lectures/cpe626-SystemC-L2.ppt

[2] Alexander de Graaf, EEMCS/ME/CAS, 2010
SystemC: an overview ET 4351
ens.ewi.tudelft.nl/Education/courses/et4351/SystemC-2010v1.pdf

[3] Joachim Gerlach, 2001
System-on-Chip Design with Systent of Computer Engineering
http://www2.cs.uni-paderborn.de/cs/ag-hardt/Forschung/Data/SystemC-Tutorial.pdf

[4] Martino Ruggiero, 2008
SystemC
polimage.polito.it/~lavagno/codes/SystemC_Lezione.pdf

[5] Deepak Kumar Tal, 1998-2012
SystemC Tutorial
http://www.asic-world.com/systemc/index.html

SystemC Data Types

Type	Description
sc_logic	Simple bit with 4 values(0/1/X/Z)
sc_int	Signed Integer from 1-64 bits
sc_uint	Unsigned Integer from 1-64 bits
sc_bigint	Arbitrary size signed integer
sc_biguint	Arbitrary size unsigned integer
sc_bv	Arbitrary size 2-values vector
sc_lv	Arbitrary size 4-values vector
sc_fixed	templated signed fixed point
sc_ufixed	templated unsigned fixed point
sc_fix	untemplated signed fixed point
sc_ufix	untemplated unsigned fixed point

Examples

- **bool** *2 value single bit type [0 or 1]*

```
bool A, B;
sc_in<bool > input
```

;

- **sc_logic** *4 value single bit type [0, 1, X or Z]*

```
sc_logic C, D;
sc_out<sc_logic > E;
```

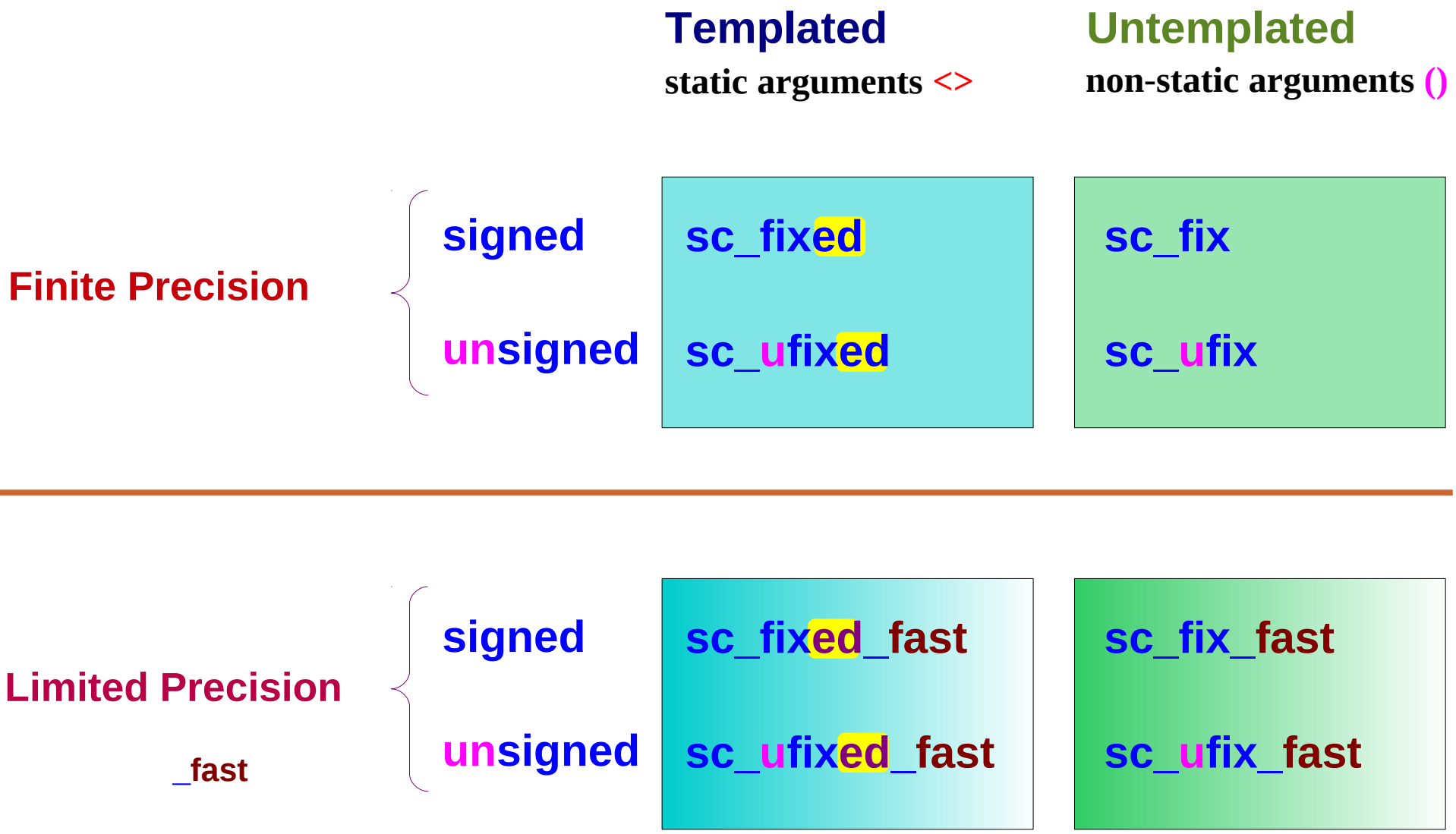
- **sc_int** *[1 to 64]-bit signed integer type*

```
sc_int<16> x, y;
sc_out<sc_int<16> > z;
```

- **sc_time** *time (units: SC_PS, SC_NS, SC_MS etc.)*

```
sc_time t1(10, SC_NS)
```

Fixed Point Types (1)



Fixed Point Types (2)

Templated **static arguments -** can be know in compile time

```
sc_fixed < wl, iwl, q_mode, o_mode, n_bits > var_name (init_val);
sc_fixed_fast < wl, iwl, q_mode, o_mode, n_bits > var_name (init_val);
```

Untemplated **non-static arguments -** can be configured during run time

```
sc_fix      var_name ( wl, iwl, q_mode, o_mode, n_bits ) ;
sc_fix_fast var_name ( wl, iwl, q_mode, o_mode, n_bits ) ;
```

set_fxtype_context useful for an array of the _fix types
can set default parameters

Fixed Point Parameters

```
sc_fixed < wl, iwl, q_mode, o_mode, n_bits > var_name (init_val);
sc_fix   var_name ( wl, iwl, q_mode, o_mode, n_bits ) ;
```

wl	- total number of bits
iwl	- number of integer bits
q_mode	- quantization mode
o_mode	- overflow_mode
n_bits	- number of bits for overflow mode

optional for _fixed

optional for _fix

q_mode - quantization mode

SC_RND	Round
SC_RND_ZERO	Round towards zero
SC_RND_MIN_INF	Round towards minus infinity
SC_RND_INF	Round towards infinity
SC_RND_CONV	Convergent rounding
SC_TRN	Truncate
SC_TRN_ZERO	Truncate towards zero

o_mode - overflow_mode

SC_SAT	Saturate
SC_SAT_ZERO	Saturate to zero
SC_SAT_SYM	Saturate symmetrically
SC_WRAP	Wraparound
SC_WRAP_SYM	Wraparound symmetrically

Fast Fixed-point Data Types

Arbitrary Precision vs. Simulation Speed

Achieving Faster Speed

- Use double as underlying data type
- Mantissa limited to 53 bits
- Range limited to that of double

Fast Fixed-Point Types

- **sc_fixed_fast**, **sc_ufixed_fast**
- **sc_fix_fast**, **sc_ufix_fast**

Exactly the same declaration format and usage as before

All fixed-point data types, can be mixed freely

SC_FIXED Example (1)

sc_fixed< wl, iwl, q_mode, o_mode, n_bits > var_name (init_val);

sc_fixed< 8, 4 > my_var (-1.75);

(1.75)$_{10}$ = (0001.1100)$_2$

8

4

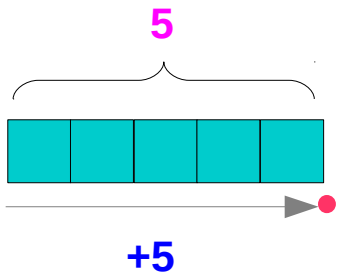
wl = 8 - total number of bits
Iwl = 4 - number of integer bits

1's complement of (0001.1100)2 = (1110.0011)2
2's complement of (0001.1100)2 = (1110.0100)2

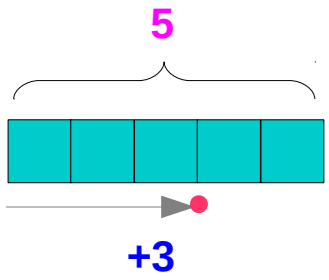
SC_FIXED Example (2)

sc_fixed< wl, iwl, q_mode, o_mode, n_bits > var_name (init_val);

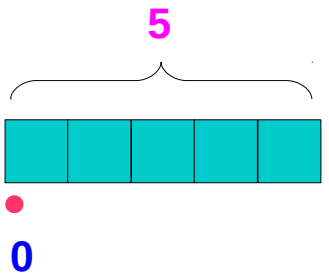
sc_fixed< 5, 5 > A1;



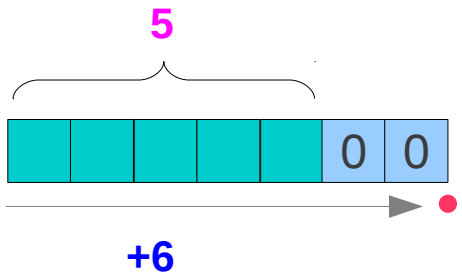
sc_fixed< 5, 3 > A2;



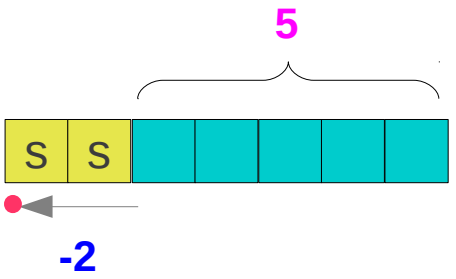
sc_fixed< 5, 0 > A3;



sc_fixed< 5, 7 > A4;



sc_fixed< 5, -2 > A5;



References

[1] Aleksandar Milenkovic, 2002
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