

“SwitchCraft”

A Tool for Generation of Switch Networks for Digital Cells

¹Vinicius Callegaro, ²Leomar S. da Rosa Jr, ¹André I. Reis, ¹Renato P. Ribas

¹Instituto de Informática – Nangate/UFRGS Research Lab, Porto Alegre, Brazil.

²Departamento de Informática – IFM – UFPel, Pelotas, Brazil.

{vcallegaro, andreis, rpribas}@inf.ufrgs.br, leomarjr@ufpel.edu.br

Currently, VLSI design has established a dominant role in the electronics industry. CAD tools have enabled designers to manipulate a huge number of transistors on a single die and shorten time-to-market. In particular, logic synthesis tools have contributed significantly to reduce the design cycle time. In this sense, it becomes comfortable to have efficient algorithms to derive optimal transistor networks automatically. There are a large variety of transistor networks arrangements, presenting naturally different behaviors in terms of area, delay and power consumption. Thus, network functional verification, network profile extraction and performance estimators are also quite useful for those designers that aim to generate and to evaluate potential logic gate implementations to feed standard-cell flow designs (using cell libraries), and for those ones who target the use of library-free technology mapping concept (using automatic cells generators).

SwitchCraft environment provides a set of tools for switch network (and logic gate) generation. Transistor networks corresponding to target logic functions can be generated from Boolean equations and/or from BDD graphs. Logically and topologically complementary networks can be derived through dual-graphs. Different CMOS logic styles can be obtained, e.g. single- and dual-rail, static and dynamic topologies, with disjoint planes (pull-up PMOS / pull-down NMOS) and in a PTL-like structure (with a shared pull-up/pull-down structure). Estimators for delay propagation, layout area and power dissipation (dynamic and leakage) are available. The switch network profile can also be extracted, providing the logic function behavior, switch/transistor count, number of connections in internal nodes, the longest and shortest paths, and so on.

Reference

[1] Leomar S. da Rosa Jr., “Automatic Generation and Evaluation of Transistor Networks in Different Logic Styles.” PhD Thesis PGMicro/UFRGS, Porto Alegre, Brazil. 2008. 147 f. <http://www.inf.ufrgs.br/nangate/>.

The screenshot displays the SwitchCraft software interface with the following components:

- Expression container:** A table listing expressions and their corresponding formulas.
- Switch Network Container:** A list of generated switch networks.
- Command aliases:** A table defining shortcuts for various operations.
- Schematic Viewer:** A graphical representation of a switch network with nodes and connections.
- Visualization:** Three diagrams showing different network topologies for a function F10.
- Switch Network Factory:** A dialog box for configuring network generation parameters.
- Command Line:** A text area showing executed commands and their outputs.

Name	Expression
e3	(a + b)
e4	(a * (b + c))
e1	(a * b * (c + d))
e2	(a * b)
e7	((a * b) + (c * d) + (e * f))
e6	((a * b) + (c * d))
e_bdd	(a * b * (c + d))
e5	(a + (b * c))

Command	Alias
run_script	run
view_switch_network	vs
print_expression	pf
create_switch_network_from_d	cs
expression_to_expression	ee
create_logic_gate	clg
convert_switch_network_to_parallel	cn
create_switch_network_from_dual	csd
view_logic_gate_network	vlgn

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create_switch_network_from_dual_rail e_bdd sw_bdd
view_switch_network sw_bdd
expression_to_expression e2 a*b
```