

NUTHOS-6 2004

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# Direct Control Flow Testing on Function Block Diagrams (Direct Function Block Diagram based Programmable Logic Controller Testing)

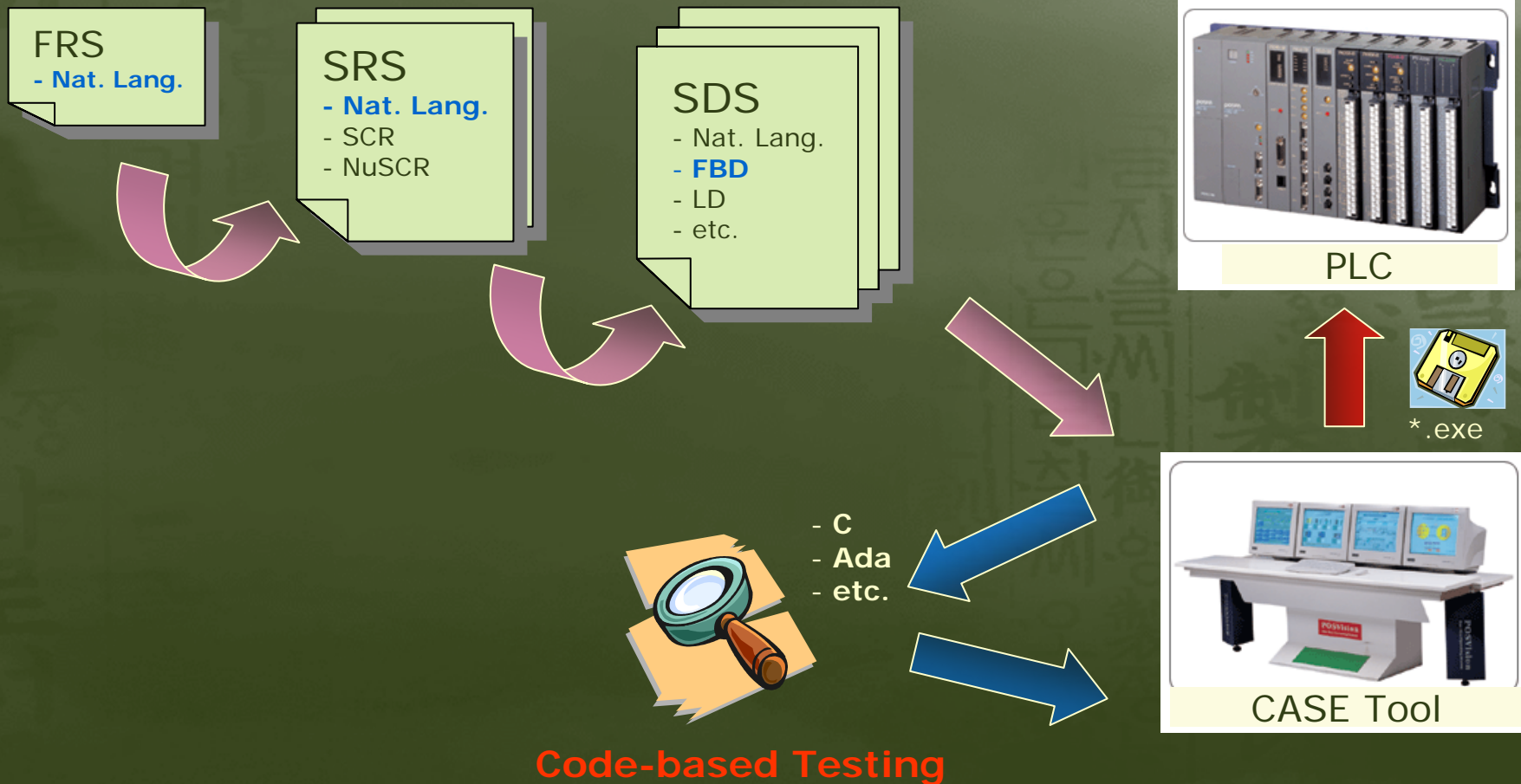
Junbeom Yoo

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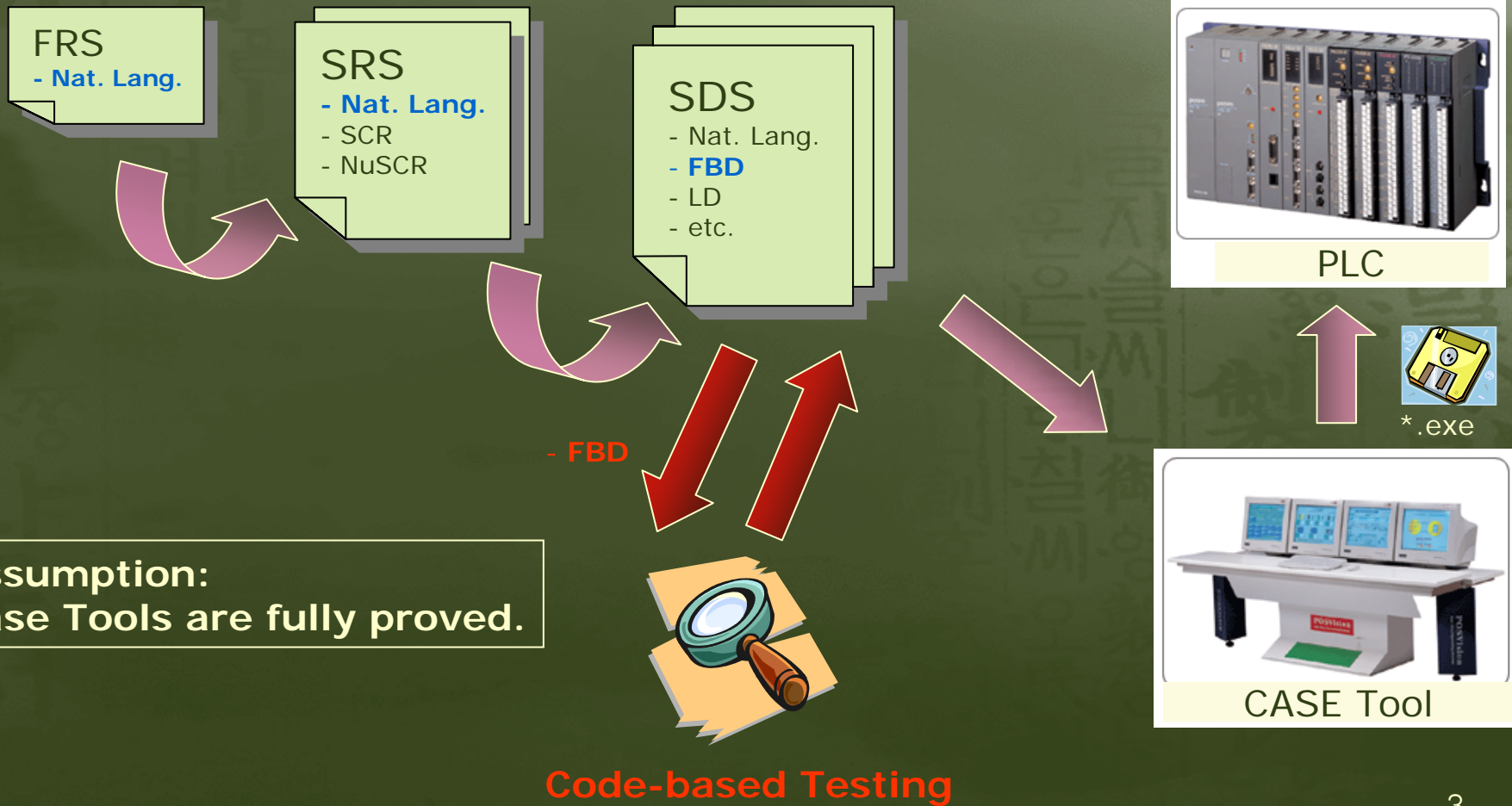
# PLC-based Software Development

## General I&C System (KINCS)



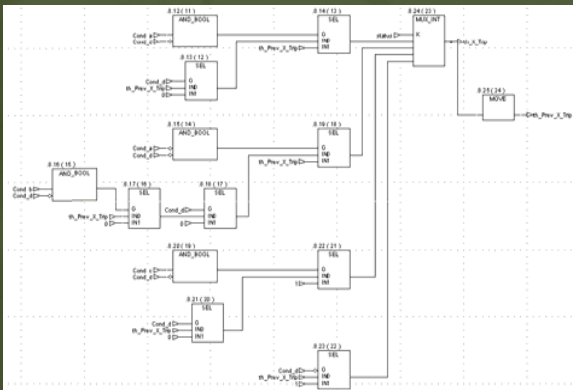
# Proposed Testing Approach

## Direct FBD Testing



# Direct Testing on FBD

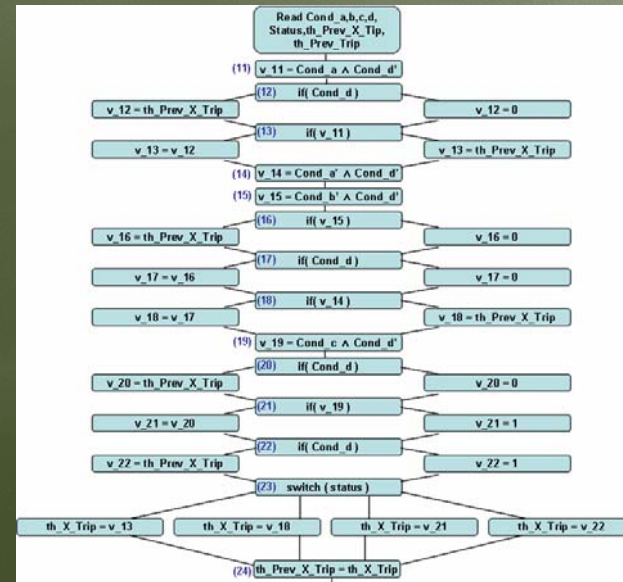
## Overview



FBD Unit

**FBD → CFG  
Transformation**

1



CFG (Control Flow Graph)

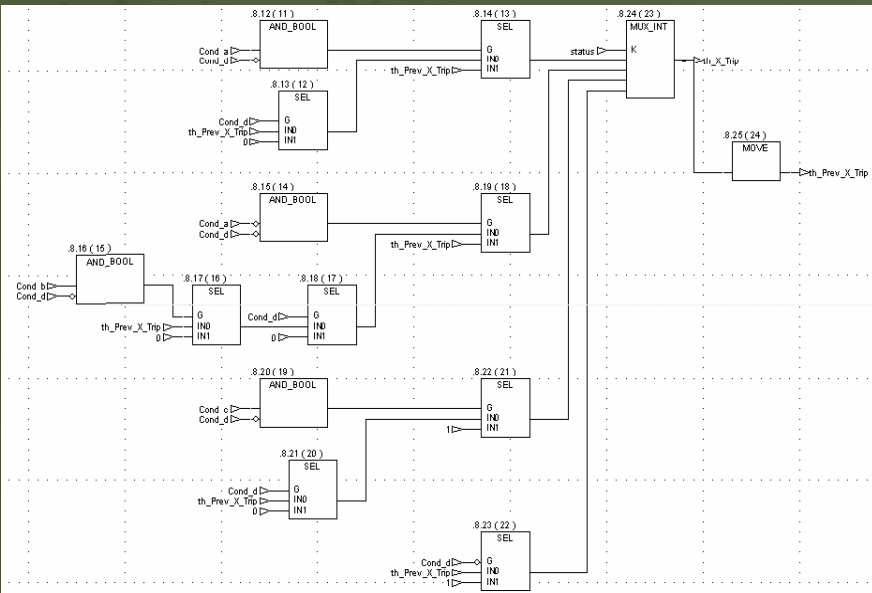
2

### CFG based Testing Coverage Criteria

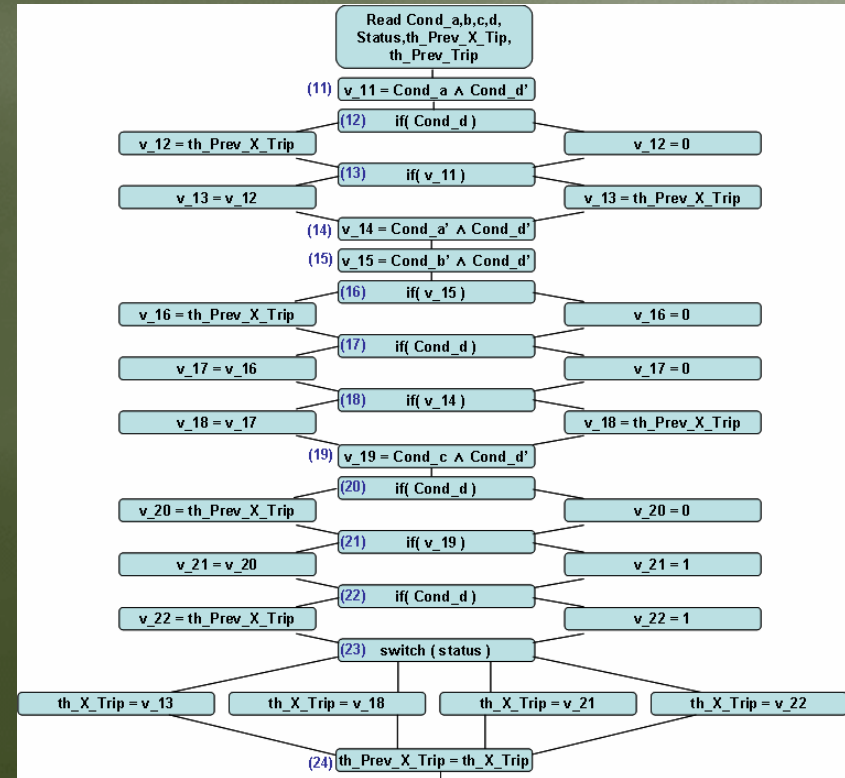
- All-Nodes, All-Edges, Paths
- Definition-Use
- FBD-unique ones
- Etc.

**Test Cases**

# 1. FBD → CFG Transformation

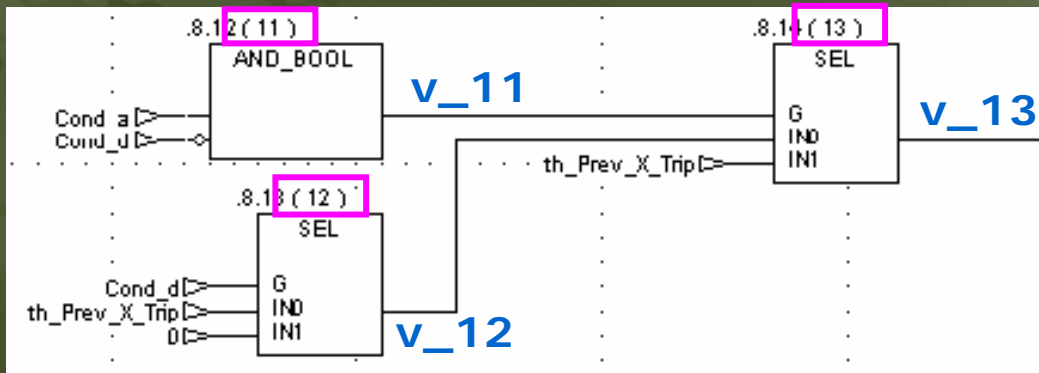


FBD Unit



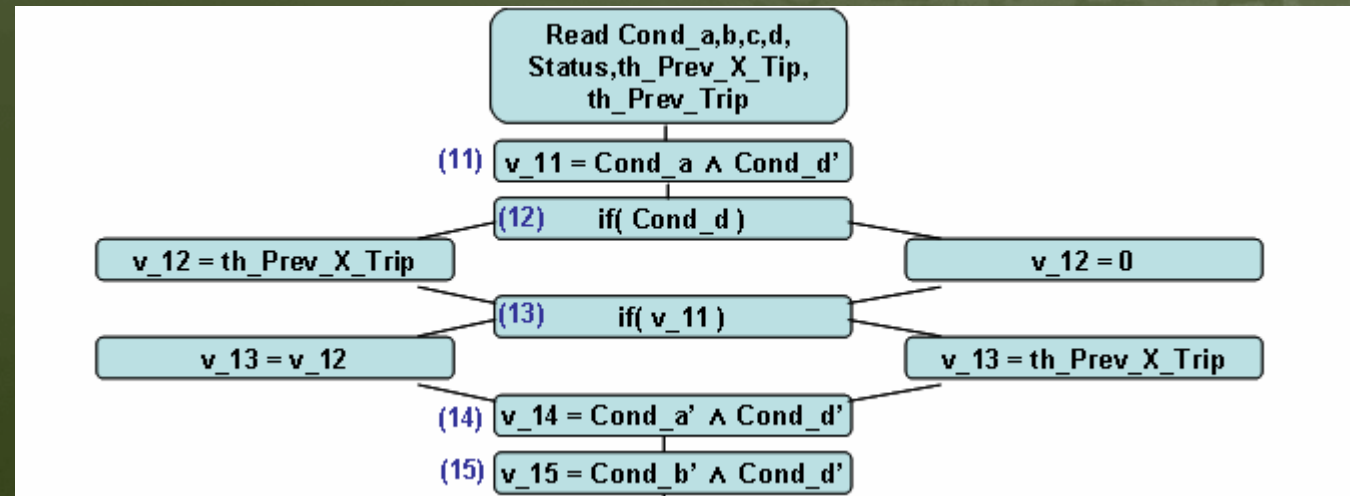
CFG (Control Flow Graph)

**Transformation**  
 - Procedure  
 - Formal Validation  
 (Proof of Soundness)



**Transformation Procedure**

- Use intermediate variables
- Preserve execution order of FBD
- Need proof of soundness



## 2. CFG based Testing Coverage Criteria

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Can Apply Existing Coverage Criteria for CFG

- Control Flow Testing Coverage
  - All-Nodes
  - All-Edges
  - Paths
- Data Flow Testing Coverage
  - Definition-Use
  - All-Definitions
  - All-Uses



Finished



On-Going

FBD-Unique Testing Coverage Criteria

- Something for Timer (TOF function block)
- Execution Order of FBD
- Etc.



On-Going

# Conclusions and Future Work

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## Direct FBD Testing without Intermediate Code Generation

- Assumption on CASE Tools
- Can Reduce PLC Software Testing Cost

## Further Work

- Formal Proof of Transformation Procedure
- Data Flow Testing Coverage Criteria
- FBD-Unique Coverage Criteria