

# Sample Beamer Theme

With KU Colors and ITTC

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Formatted with the Beamer Class for  $\text{\LaTeX} 2_{\epsilon}$

- ▶ Review access control modeling objectives
  - ▶ modeling platform MAC
  - ▶ modeling local access control
- ▶ Overview access control policy definition
  - ▶ design and modeling assumptions
  - ▶ platform boot policy definition
  - ▶ local policy definitions
- ▶ Overview models
  - ▶ domain and system models
  - ▶ communication model
  - ▶ theorems and status
- ▶ Identify next steps
  - ▶ runtime and moving beyond the SVP line
  - ▶ adding M&A detail

# Access Control Modeling Objectives

What we're about here

Reporting joint work with Geoffrey Brown, Indiana University (submitted) in which we verify two physical layer protocols.

- ▶ Biphase Mark Protocol (BMP)
- ▶ 8N1 Protocol

These protocols are used in data transmission for CDs, Ethernet, and Tokenring, etc. as well as UARTs.

- ▶ Correctness is reasonably difficult to prove due to many real-time constraints.
- ▶ Many previous formal modeling/verification efforts for these protocols.

# Columns and Blocks

Trying figures next to lists

Some normal text goes here  
just for introduction

- ▶ Appraisal
- ▶ Measurement
- ▶ Attestation
- ▶ vTPM

Why is this column getting  
higher?

Maybe it's not  
Center alignment seems best.

I like this for two column test  
and graphics

Getting higher???

# Big Picture

Armor Architecture

## Introduction to $\text{\LaTeX}$

Beamer is a  $\text{\LaTeX}$ class for creating presentations that are held using a projector...”

This is a definition

Not really a proof.

1. This is a step



## Not really a proof.

1. This is a step
2. This is another step





## Not really a proof.

1. This is a step
2. This is another step
3. This is a third step
4. This is a third step
5. This is a third step
6. This is a third step



- ▶ Item 1 followed by a pause

- ▶ Item 1 followed by a pause
- ▶ Item 3 followed by a pause

- ▶ Item 1 followed by a pause
- ▶ Item 2 followed by a pause
- ▶ Item 3 followed by a pause

- ▶ BMP has been verified in PVS twice and required
  - ▶ 37 invariants and 4000 individual proof directives (initially) in the one effort
  - ▶ 5 hours just to *check* the proofs in the other effort
  - ▶ A formal specification and verification of an independent real-time model in both efforts
- ▶ BMP has been verified in (the precursor to) ACL2 by J. Moore and required
  - ▶ A significant conceptual effort to fit the problem in the logic, arguably omitting some salient features of the model
  - ▶ The statement and proof of many antecedent results
  - ▶ J. Moore reports this as one of his “best ideas” in his career

## Not Your Father's Theorem-Prover

The verifications are carried out in the SAL infinite-state bounded model-checker that combines SAT-solving and SMT decision procedures to *prove* safety properties about infinite-state models.

- ▶ Theorem-proving efforts took multiple engineer-months if not years to complete.
- ▶ Our initial effort in SAL consumed about *two engineer-days*.  
...and we found a significant bug in a UART application note.

# Parameterized Timing Constraints

SMT allows for *parameterized* proofs of correctness. The following are example constraints from the BMP verification:

TIME: TYPE = REAL;

TPERIOD: TIME = 16;

TSAMPLE: INTEGER = 23;

TSETTLE: {x: TIME |  
          0 <= x  
          AND (x + TPERIOD < TSAMPLE)  
          AND (x + TSAMPLE + 1 < 2 \* TPERIOD)};

TSTABLE: TIME = TPERIOD - TSETTLE;

ERROR: {x: TIME |  
          (0 <= x)  
          AND (TPERIOD + TSETTLE < TSAMPLE\*(1-x))  
          AND (TSAMPLE\*(1+x) + (1+x) + TSETTLE < 2 \* TPERIOD)};

RSAMPMAX: TIME = TSAMPLE \* (1 + ERROR);

RSAMPMIN: TIME = TSAMPLE \* (1 - ERROR);

RSCANMAX: TIME = 1 + ERROR;

RSCANMIN: TIME = 1 - ERROR;

- ▶ Parser
- ▶ Simulator
- ▶ Symbolic model-checker (BDDs)
- ▶ Witness symbolic model-checker
- ▶ Bounded model-checker
- ▶ Infinite-state bounded model-checker
- ▶ Future releases include:
  - ▶ Explicit-state model-checker
  - ▶ MDD-based symbolic model-checking

All of which are “state-of-the-art”



Please direct your attention to the whiteboard.

# Timeout Automata<sup>1</sup> (Semantics)

An *explicit* real-time model.

- ▶ Vocabulary:
  - ▶ A set of state variables.
  - ▶ A *global clock*,  $c \in \mathbb{R}^{0\leq}$ .
  - ▶ A set of *timeout* variables  $T$  such that for  $t \in T$ ,  $t \in \mathbb{R}^{0\leq}$ .
- ▶ Construct a transition system  $\langle S, S^0, \rightarrow \rangle$ :
  - ▶ States are mappings of all variables to values.
  - ▶ Transitions are either *time transitions* or *discrete transitions*.
    - ▶ Time transitions are enabled if the clock is less than all timeouts. Updates clock to least timeout.
    - ▶ Discrete transitions are enabled if the clock equals some timeout. Updates state variables and timeouts.

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<sup>1</sup>B. Dutertre and M. Sorea. Timed systems in SAL. *SRI TR*, 2004.

# Disjunctive Invariants

Even with  $k$ -induction, getting a sufficiently strong invariant is still hard! *Disjunctive invariants* help. A disjunctive invariant can be built iteratively from the counterexamples returned for the hypothesized invariant being verified.

```
t0: THEOREM system |-  
    G(    (    (phase = Settle)  
            AND (rstate = tstate + 1)  
            AND (rclk - tclk - TPERIOD > 0)  
            AND (tclk + TPERIOD + TSTABLE - rclk > 0))  
    OR  
    (    (phase = Stable)  
        AND (rstate = tstate + 1)  
        AND (rclk - tclk - TSETTLE > 0)  
        AND (tclk + TPERIOD - rclk > 0)  
        AND (rdata = tdata))  
    .  
    .  
    .
```