

Abstract

This is the abstract for my master's thesis.

Copyright

Disclaimer

Acknowledgements

Table Of Contents

Abstract	4
List of Figures	5
List of Tables	5
List of Acronyms	5
1 Introduction	7
2 Background	8
3 Systems Security Engineering	9
3.1 NIST Special Publication 800-160	9
3.2 Verification & Documentation	9
3.3 Principle of Complete Mediation	9
3.3.1 Formal Verification Using Computer-Aided Reasoning .	9
4 Certified Security by Design (CSBD) & Access-Control Logic (ACL)	10
4.1 Certified Security by Design (CSBD)	11
4.2 Access-Control Logic (ACL)	11
4.2.1 Principals	11
4.2.2 Well-formed Formulas Formulas	11
4.2.3 Kripke Structure	11
4.2.3.1 satisfies	11
4.2.3.2 soundness	11
4.2.4 Well formed statements	11
4.2.5 Inference Rules	11
4.2.6 Complete mediation	11
4.3 ACL in HOL	11
4.3.1 satList	11
4.3.2 Complete Mediation	11

5	Patrol Base Operations	12
5.1	Motivation	13
5.2	Ranger Handbook Description	13
5.3	Describing The Patrol Base Operations	13
5.4	Hierarchy of Secure State Machines	13
5.4.1	OMNI-Level	13
5.4.2	Escape	13
5.4.3	Top Level	13
5.4.4	Horizontal Slice	13
5.4.4.1	ssmPlanPB	13
5.4.4.2	ssmMoveToORP	13
5.4.4.3	ssmConductORP	13
5.4.4.4	ssmMoveToPB	13
5.4.4.5	ssmConductPB	13
5.4.5	Vertical Slice	13
5.4.5.1	ssmSecureHalt	13
5.4.5.2	ssmORPRecon	13
5.4.5.3	ssmMoveToORP4L	13
5.4.5.4	ssmFormRT	13
6	Secure State Machine Model	14
6.1	State Machines	15
6.1.1	Next-state Function	15
6.1.2	Next-output Function	15
6.1.3	Transition Commands	15
6.2	Secure State Machines	15
6.2.1	State Machine Versus Secure State Machine	15
6.2.2	Transition Types	15
6.2.3	Authentication	15
6.2.4	Authorization	15
6.3	Secure State Machines in HOL	15
6.3.1	Parameterizable Secure State Machine	15
6.3.2	Parameterization	15
6.3.3	Configurations: five parts	15
6.3.3.1	State Interpretation	15
6.3.3.2	Security context	15
6.3.3.3	Input stream	15
6.3.3.4	State	15
6.3.3.5	Output stream	15
6.3.4	Authentication	15
6.3.5	Configuration Interpretation	15

6.3.6	Transition Definitions	15
7	Patrol Base Operations as Secure State Machines	16
7.1	ssmPB: An Example from the Hierarchy	16
7.1.1	Principals	16
7.1.2	States	16
7.1.3	Commands	16
7.1.4	Next-State Function	16
7.1.5	Next-Output Function	16
7.1.6	Authentication	16
7.1.7	Authorization	16
7.1.8	Proved Theorems	16
7.1.8.1	Platoon Leader Is Trusted on plCommands .	16
7.2	Other Variations	16
7.2.1	ssmPlanPB: Non-sequential Transitions	16
7.2.2	ssmConductORP: Principals Authorized for Subsets of Commands	16
8	Discussion	17
8.1	Recap	17
8.2	Mission Accomplished	17
8.3	Stop-Gaps, Lessons Learned, & Advice	17
8.4	Other Verifiable Theories	17
8.4.1	Platoon Theory, Soldier Theory, Squad Theory, etc. . .	17
8.4.2	Soldiers in Roles	17
9	Future Work & Implications	18
9.1	The Devil Is in The Details	18
9.2	Accountability Systems	18
9.3	Applicability	18
10	Appendices	19
.1	Access Control Logic Theories in HOL	19
.2	Secure State Machine Theories Applied to Patrol Base Oper- ations	19
.3	Pretty-Printed Theories	19
.4	Map of The File Folder Structure	19

List of Figures

List of Tables

List of Acronyms

Chapter 1

Introduction

Chapter 2

Background

Formal Methods

Functional Programming

Higher Order Logic (HOL) Interactive Theorem Prover

Other Interactive Theorem Provers

Chapter 3

Systems Security Engineering

3.1 NIST Special Publication 800-160

3.2 Verification & Documentation

3.3 Principle of Complete Mediation

3.3.1 Formal Verification Using Computer-Aided Reasoning

Chapter 4

Certified Security by Design (CSBD) &

Access-Control Logic (ACL)

4.1 Certified Security by Design (CSBD)

4.2 Access-Control Logic (ACL)

4.2.1 Principals

4.2.2 Well-formed Formulas Formulas

4.2.3 Kripke Structure

4.2.3.1 satisfies

4.2.3.2 soundness

4.2.4 Well formed statements

4.2.5 Inference Rules

4.2.6 Complete mediation

4.3 ACL in HOL

4.3.1 satList

4.3.2 Complete Mediation

Chapter 5

Patrol Base Operations

5.1 Motivation

5.2 Ranger Handbook Description

5.3 Describing The Patrol Base Operations

5.4 Hierarchy of Secure State Machines

5.4.1 OMNI-Level

5.4.2 Escape

5.4.3 Top Level

5.4.4 Horizontal Slice

5.4.4.1 ssmPlanPB

5.4.4.2 ssmMoveToORP

5.4.4.3 ssmConductORP

5.4.4.4 ssmMoveToPB

5.4.4.5 ssmConductPB

5.4.5 Vertical Slice

5.4.5.1 ssmSecureHalt

5.4.5.2 ssmORPRecon

5.4.5.3 ssmMoveToORP4L

5.4.5.4 ssmFormRT

Chapter 6

Secure State Machine Model

6.1 State Machines

6.1.1 Next-state Function

6.1.2 Next-output Function

6.1.3 Transition Commands

6.2 Secure State Machines

6.2.1 State Machine Versus Secure State Machine

6.2.2 Transition Types

6.2.3 Authentication

6.2.4 Authorization

6.3 Secure State Machines in HOL

6.3.1 Parameterizable Secure State Machine

6.3.2 Parameterization

6.3.3 Configurations: five parts

6.3.3.1 State Interpretation

6.3.3.2 Security context

6.3.3.3 Input stream

6.3.3.4 State 15

6.3.3.5 Output stream

6.3.4 Authentication

6.3.5 Configuration Interpretation

6.3.6 Transition Definitions

Chapter 7

Patrol Base Operations as Secure State Machines

7.1 ssmPB: An Example from the Hierarchy

7.1.1 Principals

7.1.2 States

7.1.3 Commands

7.1.4 Next-State Function

7.1.5 Next-Output Function

7.1.6 Authentication

7.1.7 Authorization

7.1.8 Proved Theorems

7.1.8.1 Platoon Leader Is Trusted on plCommands

7.2 Other Variations

7.2.1 ssmPlanPB: Non-sequential Transitions

7.2.2 ssmConductORP: Principals Authorized for Subsets of Commands

Chapter 8

Discussion

8.1 Recap

8.2 Mission Accomplished

8.3 Stop-Gaps, Lessons Learned, & Advice

8.4 Other Verifiable Theories

8.4.1 Platoon Theory, Soldier Theory, Squad Theory, etc.

8.4.2 Soldiers in Roles

Chapter 9

Future Work & Implications

9.1 The Devil Is in The Details

9.2 Accountability Systems

9.3 Applicability

Chapter 10

Appendices

- .1 Access Control Logic Theories in HOL
- .2 Secure State Machine Theories Applied to Patrol Base Operations
- .3 Pretty-Printed Theories
- .4 Map of The File Folder Structure

Bibliography