CYBER SECURITY DIVISION

2013 PRINCIPAL INVESTIGATORS'

AVAP: Automated Verification of Acquirer Properties

Practical Information Flow Verification in a Software Supply Chain

HRL Laboratories LLC
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Homeland Security

Science and Technology

Team Profile

HRL Laboratories, LLC

George Kuan (PI) Aleksey Nogin

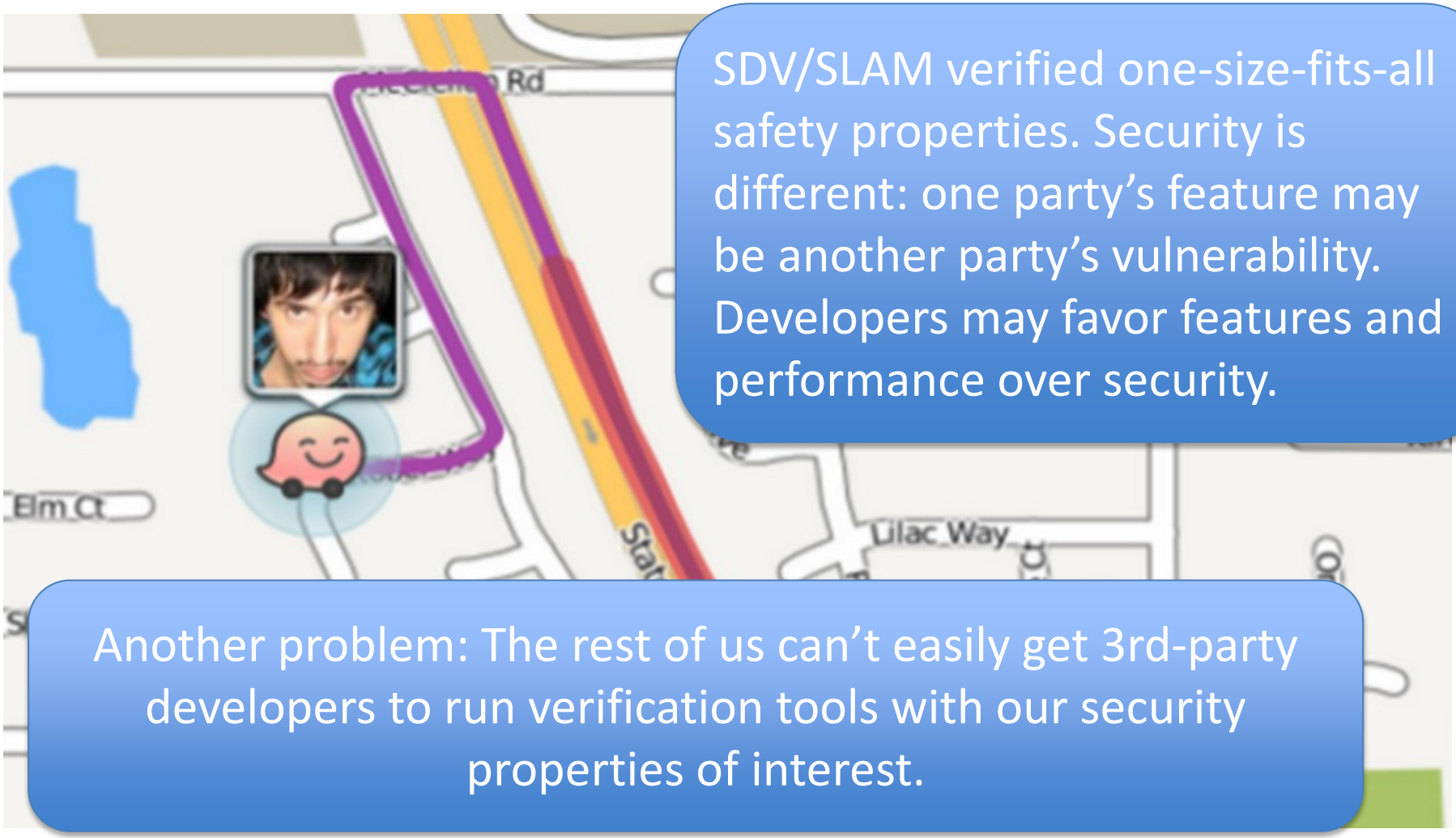
- Formerly Hughes Research Laboratories (est. 1948)
- Formed as a Limited Liability Company (LLC) , 1997
- R&D for The Boeing Company and General Motors
- Government and commercial contracts
- AS9100 accredited / DoD Trusted Foundry
- 250,000 square feet of lab space
- 10,000-square-foot Class 10 clean room
- Located on 72 acres in Malibu, CA

Stevens Institute of Technology

Dave Naumann (PI)
Andrey Chudnov

- Established 1870
- Located in Hoboken, NJ
- Also online and in DC
- Schools of: Engineering and Science; Technology Management; Systems and Enterprises
- Designated a National Center of Academic Excellence in Information Assurance Education (CAE) and Research (CAE-R)
- DoD National Center of Excellence in Systems Engineering Research
- DHS National Center of Excellence in Port Security
- Ranked #3 among US research universities for high ROI on research investment (Forbes.com)

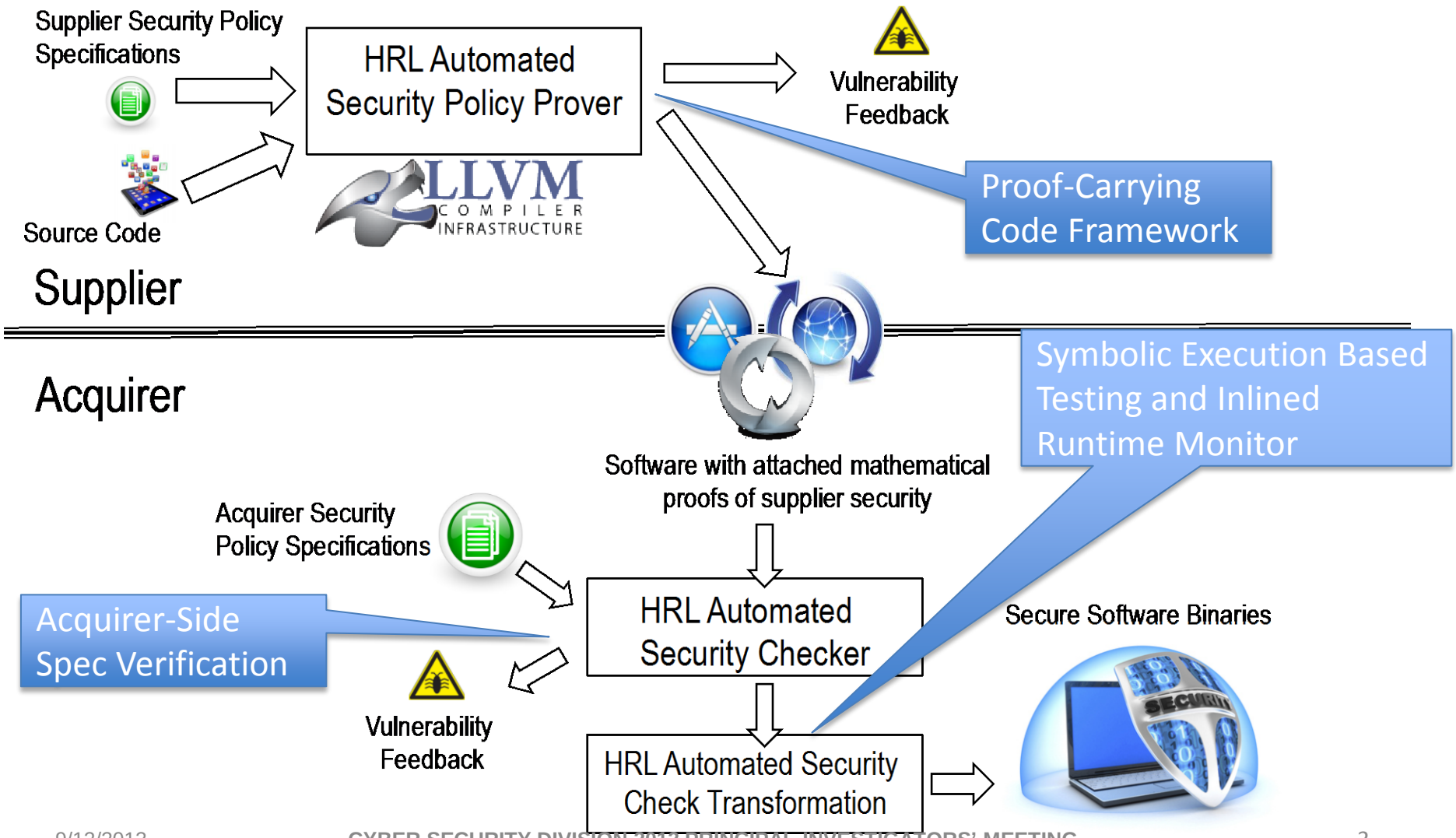
Customer Need



SDV/SLAM verified one-size-fits-all safety properties. Security is different: one party's feature may be another party's vulnerability. Developers may favor features and performance over security.

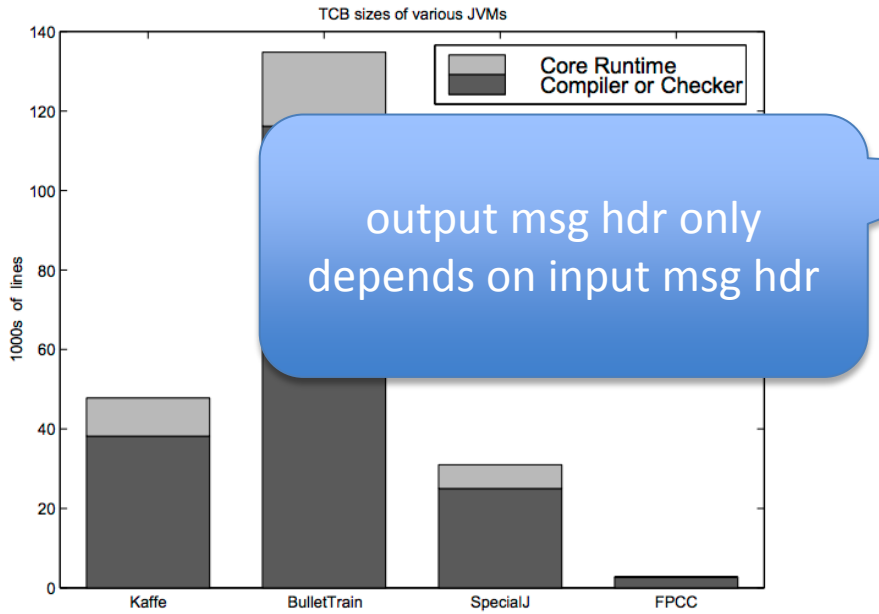
Another problem: The rest of us can't easily get 3rd-party developers to run verification tools with our security properties of interest.

Approach (1) - AVAP



Approach (2)

Proof-Carrying Code (Necula and Lee ’97) takes advantage of the observation that verifying a proof is easier and faster than generating one.

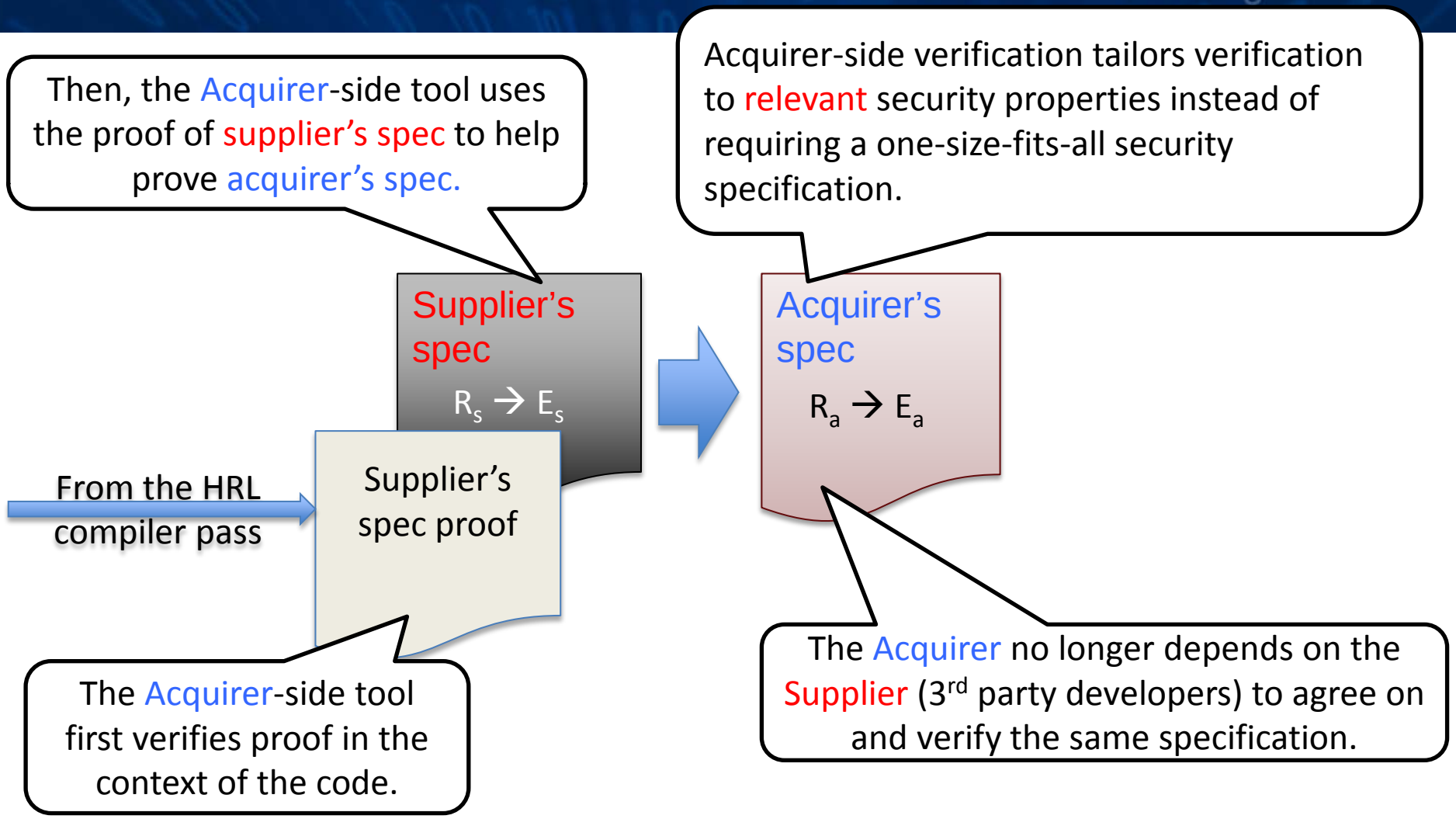


output msg hdr only depends on input msg hdr

- Security Properties
- Machine Semantics
- Proof Rules
- Proof Checker Core

Source: Appel et al ‘03

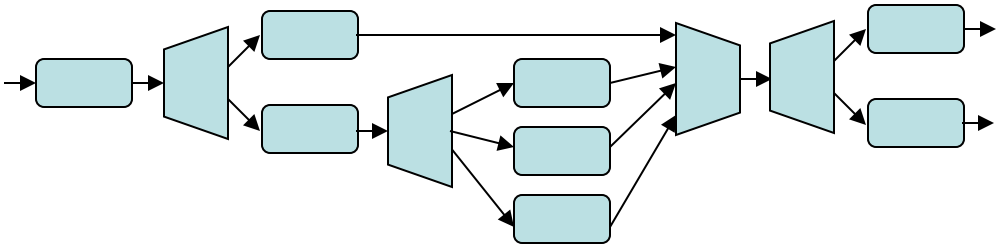
Approach (3)



Approach (4)

Control Flow Analysis

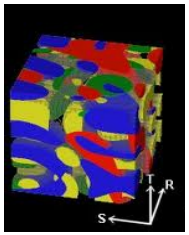
Representation

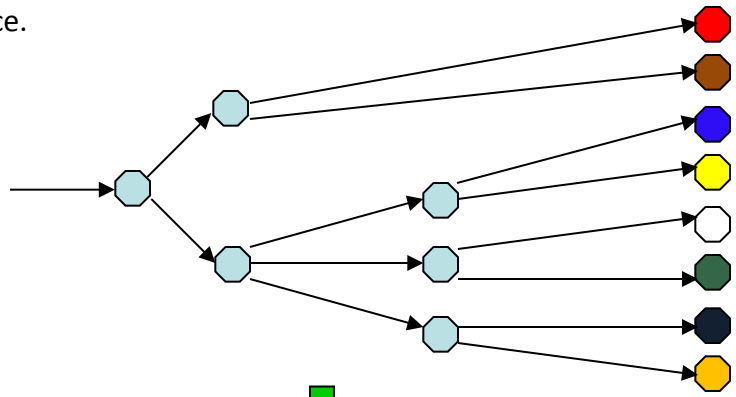


Static Semantic Representation
Control Flow Graph

(X,Y,Z)
Input space is divided into a set of equivalence classes, each defined by the region of input space that travels the same path through execution state space.

Symbolic Execution



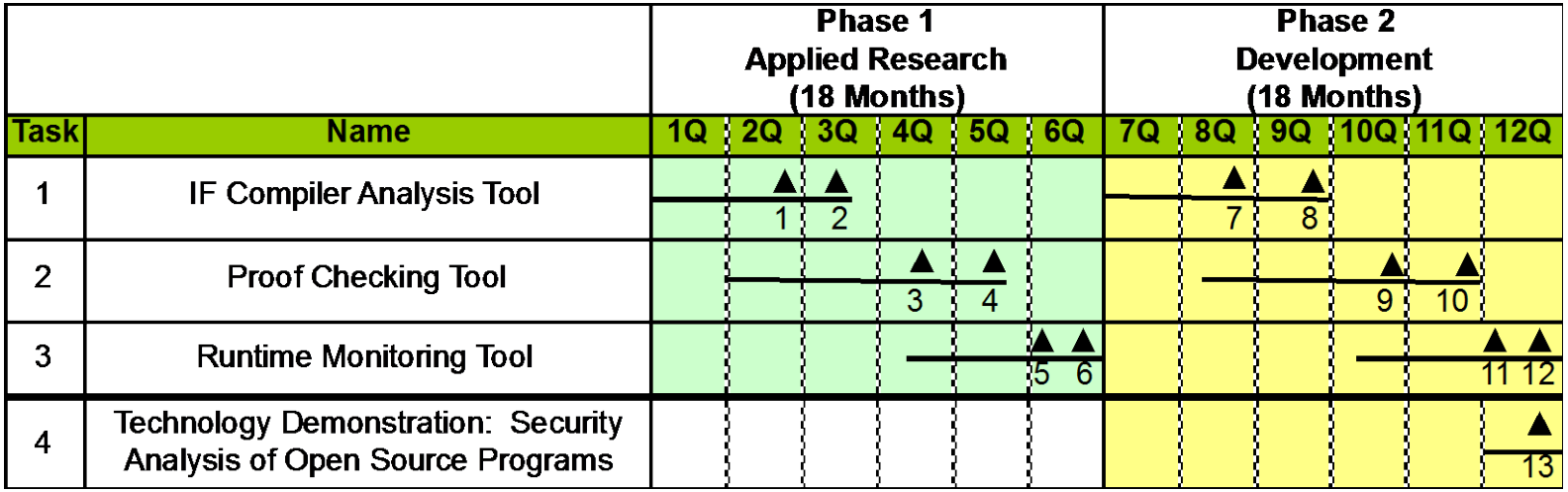


Dynamic Semantic Representation
Execution State Tree

Benefits

- For the Software Assurance community, Tunable Info Flow enables verification of Acquirer specs by the Acquirer without having to divulge the specs to the Supplier or a 3rd-party
- It empowers the Acquirer to check the most relevant information flow security spec and simultaneously simplify verification by taking into account the Acquirer's implicit assumptions
- Highly expressive framework for encoding properties
- Can help enable information flow-preserving compilation
- Portable across virtual machines and just-in-time compilers
- Takes advantage of existing compiler optimizations

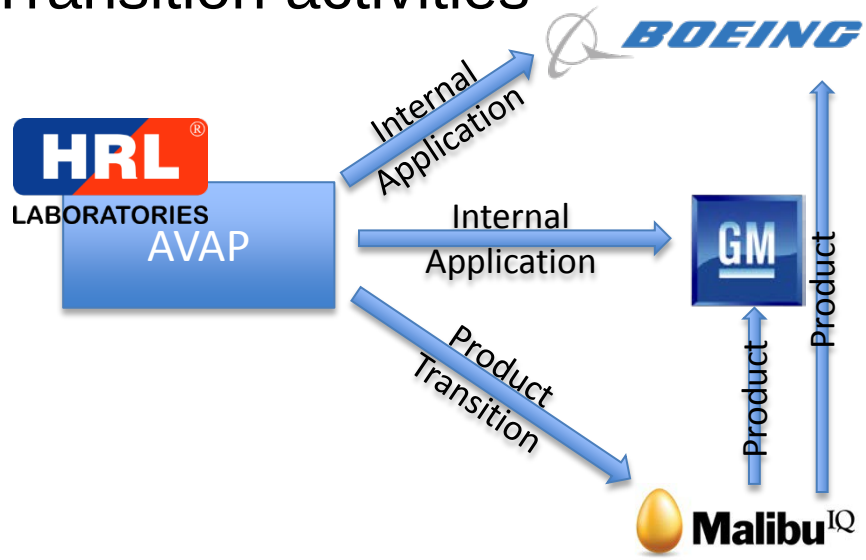
Current Status



- We have designed and implemented prototypes for the Compiler Pass and Proof Checking Tools.
- We have also designed the Runtime Monitoring Tool and adapted a symbolic executor to propagate information flow security tags.
- Designed an information flow specification contract language with novel features motivated by our analysis of vulnerabilities
- Theory and implementation technique for checking specification contract refinement

Next Steps

- Runtime Monitoring for Information Flow
- Larger-scale performance analysis
- Automated feedback mechanisms
- Transition activities



Contact Information

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