

# FORMALIZING SHIM6

## AN IETF PROPOSED INTERNET STANDARD IN UPPAAL

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### Background

#### Multihoming

- A technique to increase the reliability of a network connection.
- Features redundancy, load sharing, performance and policy.
- Current multihoming practices (IPv4) impose a threat on address and routing scalability.
- SHIM6 is a proposal by the IETF to provide multihoming that solve these issues.
- No formal methods have been applied to the draft specification.

**Aim;** improve the quality of the specification by applying formal methods.

#### How SHIM6 works

**IP roles** SHIM6 splits the two semantics of an IP address (*end point identifier* and *locator role*).

**Initial contact** Normal data communication between end point identifiers, no SHIM6 needed.

**Context Establishment** Communication to exchange multihoming information. Data communication remains normal.

**Failure detection** Messages are transmitted to detect a link failure.

**Locator pair exploration** In case of a link failure, a new locator needs to be selected. Locators are mapped back at the host to the

end point identifier. Transport session remains stable. Communication resumes with SHIM6 data packets that provide mapping information.

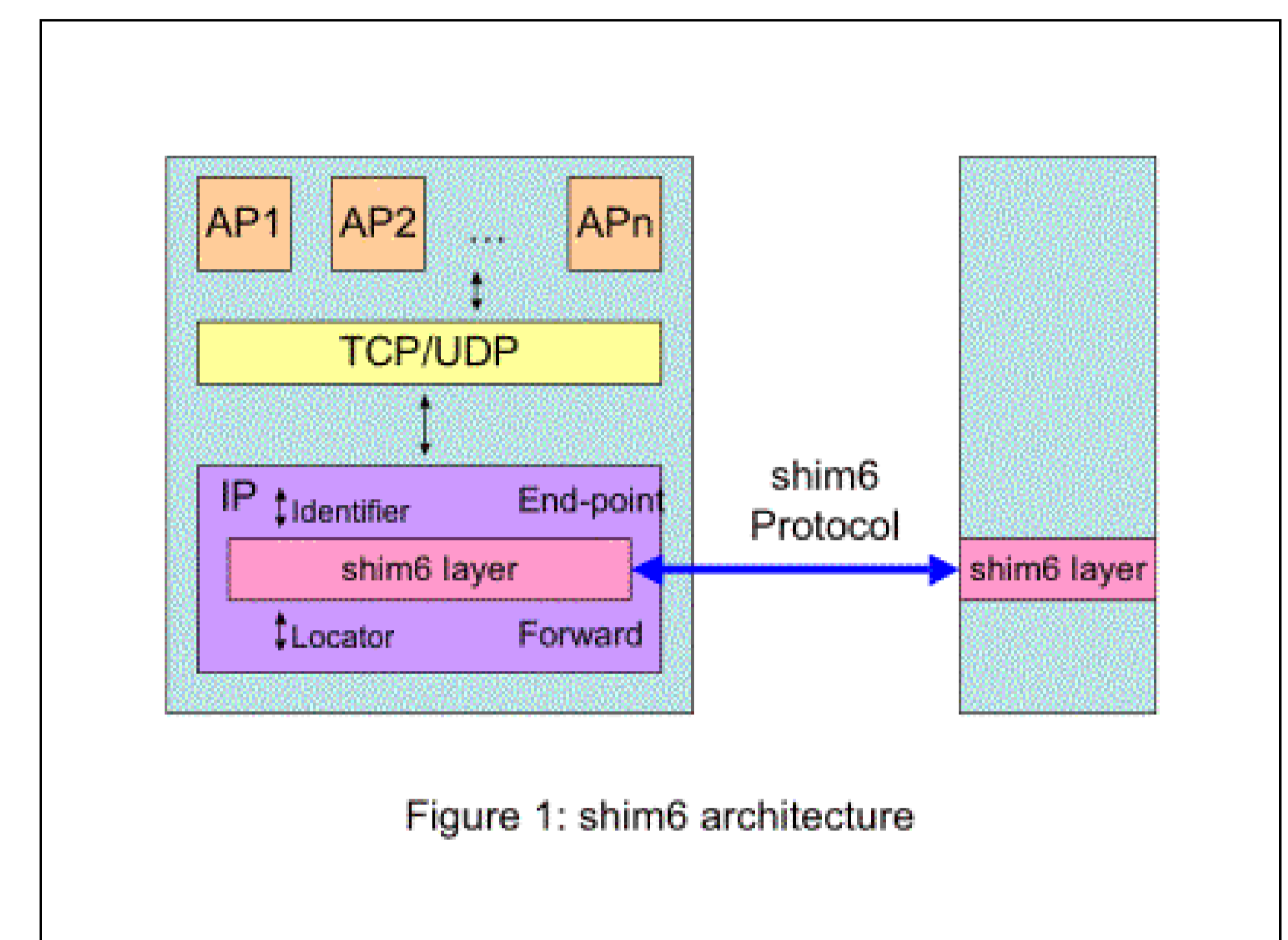
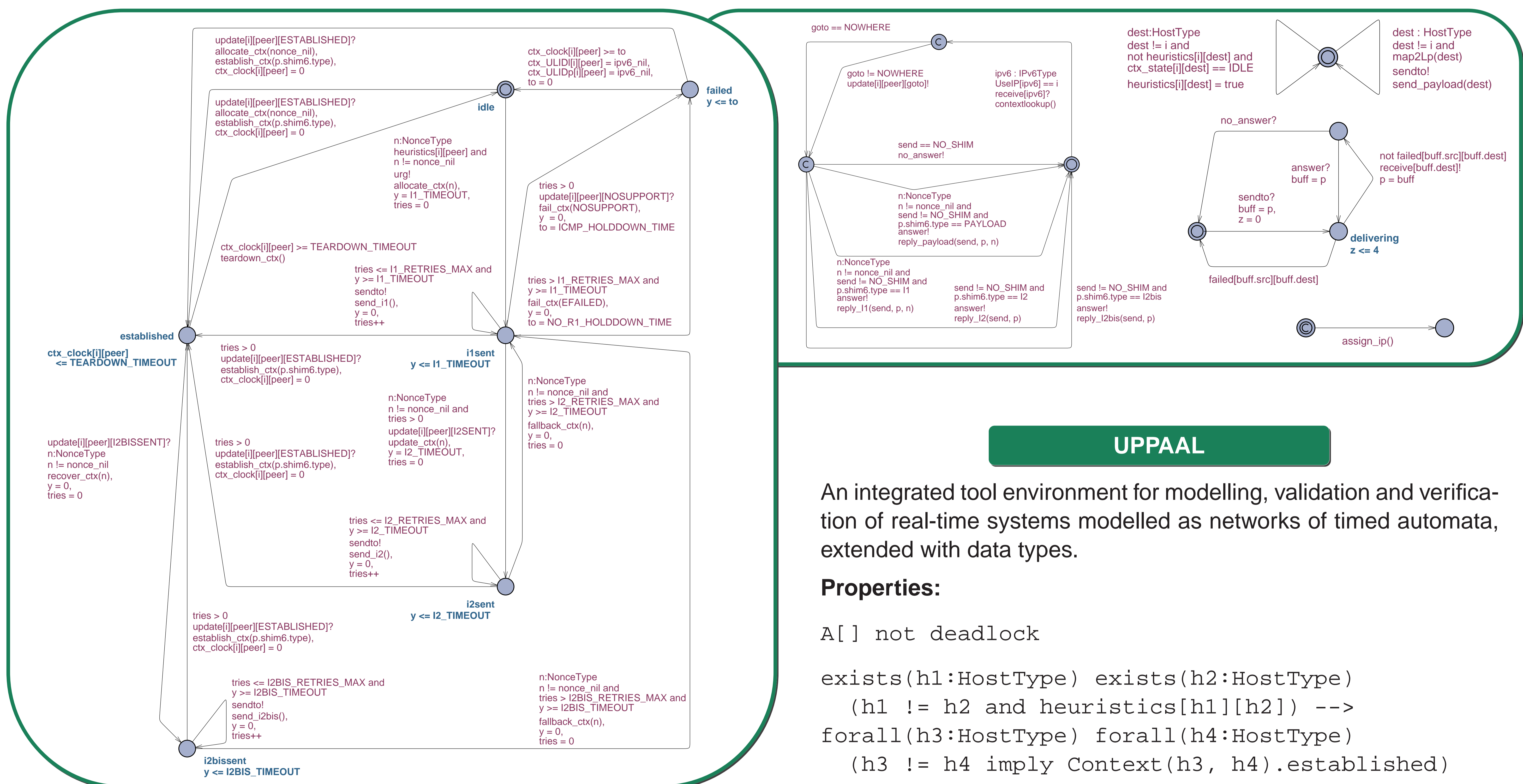


Figure 1: shim6 architecture

### Formalization and Verification



#### UPPAAL

An integrated tool environment for modelling, validation and verification of real-time systems modelled as networks of timed automata, extended with data types.

#### Properties:

A[] not deadlock

exists(h1:HostType) exists(h2:HostType)  
(h1 != h2 and heuristics[h1][h2]) -->  
forall(h3:HostType) forall(h4:HostType)  
(h3 != h4 imply Context(h3, h4).established)

#### Results

- Revealed incorrectness upon receiving payload in I2-SENT or I2BIS-SENT.
- Revealed possible deadlock with optional re-transmitting I2 / I2bis messages.
- Clarified confusion about responder nonce.

Revealed several other ambiguities, omissions and inconsistencies. Acknowledged by SHIM6 draft authors. Will be incorporated in new IETF proposal.

#### Future Work

**UPPAAL:**  
Improve model to verify on scale.  
Add failure detection and exploration.  
Extend UPPAAL verifier language.  
Indicate model state space.  
**SHIM6:**  
Implementations.  
Add HBA and CGA, Context Forking.  
INTEROP test.  
Traffic engineering issues.

#### Further Information

**SHIM6:**  
<http://www.shim6.org>  
<http://tools.ietf.org/wg/shim6/>  
<http://www.ietf.org/html.charters/shim6-charter.html>  
**UPPAAL:**  
<http://www.uppaal.com>  
**Master Thesis (Approx. May 2007):**  
<http://www.ita.cs.ru.nl/publications/papers/fvaan/SHIM6/>