**Performance Modelling:**
**Modelling Web Services with PEPA**

Stephen Gilmore

November 10, 2009

---

### Security and use of encryption

- Second party clients need to use encryption to ensure authenticity and confidentiality. First party clients do not.
- Brokers add decryption and encryption steps to build end-to-end security from point-to-point security.
  - When processing a request from a second party client brokers decrypt the request before re-encrypting it for the Web service.
  - When the response to a request is returned to the broker it decrypts the response before re-encrypting it for the client.

---

### PEPA model

#### Second party clients

- A second party client composes service requests, encrypts these and sends them to its broker.
- It then waits for a response from the broker.
- The rate at which the first three activities happen is under the control of the client.
- The rate at which responses are produced is determined by the interaction of the broker and the service endpoint.

---

#### Brokers

- The broker is inactive until it receives a request.
- It then decrypts the request before re-encrypting it for the Web service to ensure end-to-end security.
- It forwards the request to the Web service and then waits for a response.
- The corresponding decryption and re-encryption are performed before returning the response to the client.
In the initial state of the system model we represent each of the four component types being initially in their idle state.

\[
\text{System} = \text{SPC}_{idle} \parallel \text{Broker}_{idle} \parallel (\text{WS}_{idle} \parallel \text{FPC}_{idle})
\]

where

\[ \mathcal{K} = \{\text{request}_b, \text{response}_b\} \]
\[ \mathcal{L} = \{\text{request}_ws, \text{response}_ws\} \]
\[ \mathcal{M} = \{\text{invoke}_ws, \text{result}_ws\} \]

- The lifetime of a first party client mirrors that of a second party client except that encryption need not be used when all of the communication is conducted across a secure intranet.
- Also the service may be invoked by a remote method invocation to the host machine instead of via HTTP.
- Thus the first party client experiences the Web service as a blocking remote method invocation.

- There are two ways in which the service is executed, leading to a choice in the process algebra model taking the service process into one or other of its two modes of execution.
- In either case, the duration of the execution of the service itself is unchanged.
- The difference is only in whether encryption is needed and whether the result is delivered via HTTP or not.