Performance comparison between a 2 phases and a 3 phases Negotiation protocol

Antoine Pichot, Alejandro Gaspar
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Agenda

1. Problem
2. Model
3. Results
The Problem
The context: Co-allocation

Multiple Computing farms

A (G)MPLS network

How to reserve two (or more) resources at the same time?
I.e.: A network connexion & a CPU
Solutions

- VIOLA like (2Phases commit protocol)

- WS-Agreement based Negotiation (3Phases Commit Protocol)
  - Cf O. Waeldrich & W. Ziegler draft @OGF18
3 Phases Commit Protocol vs 2 Phases

- Capability and availability check

- Pre-reservation
  - Resource are reserved with short reservation lifetime
    - (No penalties if reservation is cancelled at this stage)

- Commitment
  - Resource are reserved whenever needed
    - (penalties if cancelled)
VIOLA reservation process

Figure 1: The negotiation process
VIOLA’s Meta-Scheduler reservation
The Model Explained
Model origin

Gurbani V.K., Jagadeesan L., Mendiratta V.B.,

“Characterizing session initiation protocol (SIP) network performance and reliability”,

*International service availability symposium*, April 2005
Model explained (1)

Job requests $\Rightarrow$ Clients of the queuing network

Time spent in a waiting queue $\Rightarrow$ Time spent in a state inside the MS

A queue $\Rightarrow$ A state inside the MS
Model Explained (2), Notation convention

\[ \mu_1 \]

1/\( \mu_1 \) is the average time taken by the Meta-Scheduler to
- receive the CreateAgreement message,
- process it, and
- take action

\[ \mu_2 \]

\[ \mu_1 \] is the average time taken by the Meta-Scheduler to
Model Explained (3), Example

Example synchronous
2 Phases Negotiation protocol Model

Asynchronous

Synchronous
3 Phases Negotiation protocol Model

Asynchronous

Synchronous
Service Time & Error Probability example

After a few measures on a P4@2.8GHz

- Receive an XML message .................................................. 1 ms
- Check message validity ..................................................... 0.002 ms
- Parse the message ......................................................... 0.715 ms
  +1.717ms

Probability to cancel a reservation : 10%
Probability to need to look after scheduling horizon : 10%

Those values can be modified to take more realistic values.
Limiting Queue

For example (3 Phases Asynchronous):

Arrival rate

\[ \rho_2 = \frac{\lambda / \mu_2}{1 - (Q + (M(A + CB)))} \]

Service rate

Probability to loop or to get an error

\[ N = \sum_{k=1}^{NbQueues} \frac{\rho_k}{1 - \rho_k} \]
Results
Maximum Job request Arrival Rate in the Meta-Scheduler

Almost NO IMPACT on Arrival Rate

NEED for ASYNCHRONOUS Implementation
Mean number of Jobs in the Meta-Scheduler

Performance loss of 3PNP over 2PNP
Less than 50%

Arrival Rate = 63 job/s
Delay ~ 240ms

xPNP : x Phases Negotiation Protocol
Conclusions

Need for an Asynchronous implementation (obvious)
Performance loss of a 3 Phases over a 2 Phases Negotiation protocol is

- less than 10% on the maximum job request arrival rate
- less than 50% on the total job request processing delay and memory requirement
References

Article to be published soon...
by the end of the year

For a similar model used in a different context: