Web Server Performance Simulation

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18th July 2002

Aims / Parts

1. Creation of WS^3 (Web Server Simulation System) — simulates generic systems.
2. Web Serving Guidelines using WS^3 — by evaluating hypothetical models.

Background and Motivation

- Increasing use of web: performance issues.
- Notorious failures (e.g. UK 1901 Census).
- Capacity planning tools tend to be:
  - Flooding tools.
  - General simulation tools/toolkits.
  - GUI tools.
  - Non-web-specific.

Simulation

Simulation uses virtual time-stream; queueing network; statistical distributions to create inter-event times.

- Good at answering specific questions.
- Quick and easy — unlike queueing theory.
- Requires attention to accuracy and general pattern discovery may be difficult.

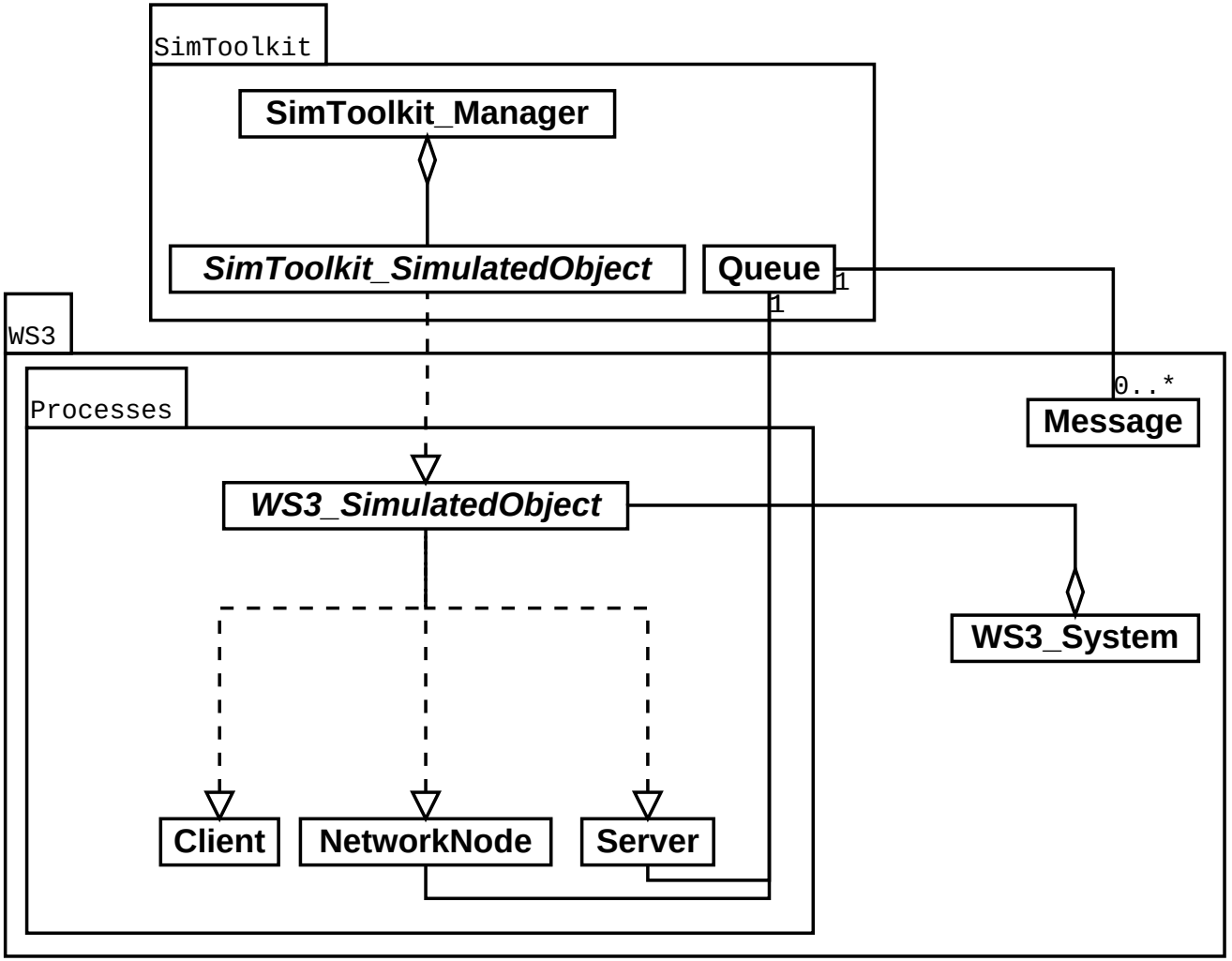
Design of WS^3

Objectives:

- Easy-to-use.
- Unlikely to cover everything so designed for future extension.

Decisions:

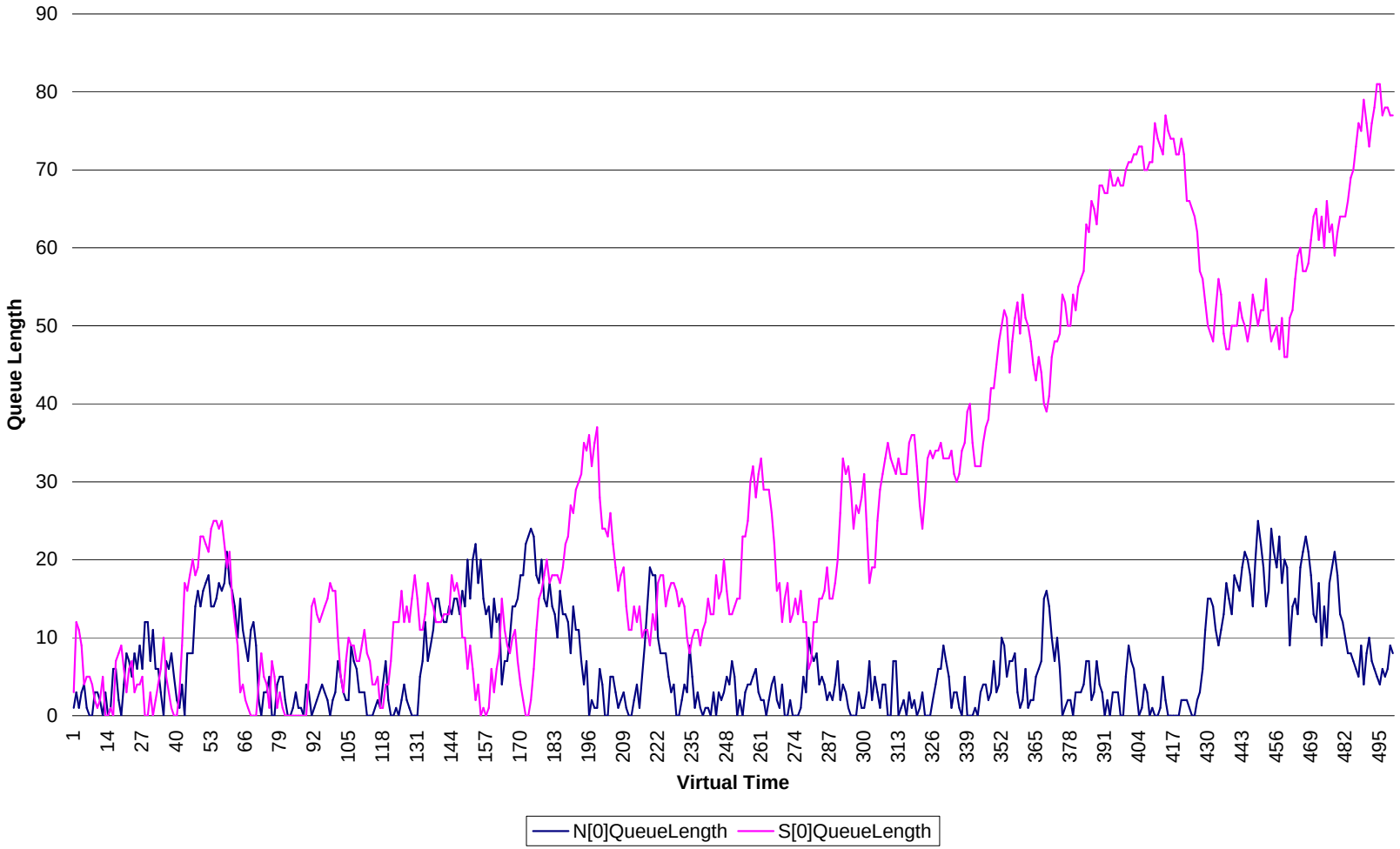
- Java (programming language).
- XML (input file format — for system specification), XML Schema, Apache Xerces Parser.
- Simulation Toolkit (Tony Field) — process based.


SimToolkit
SimToolkit_Manager
SimToolkit_SimulatedObject
Queue
1
1
WS3
Processes
0..*
Message
WS3_SimulatedObject
WS3_System
Client
NetworkNode
Server

Implementation Issues

Implementation mostly straightforward. However:

- Randomness — $x_n = f(x_{n-1})$.
- Equilibrium.
- Added features:
  - Routing System Changed.
  - Server Multithreading and Multiprocessors.
  - Tracing / Data Dumping.
  - Queue Length Capping.
  - Others (see report).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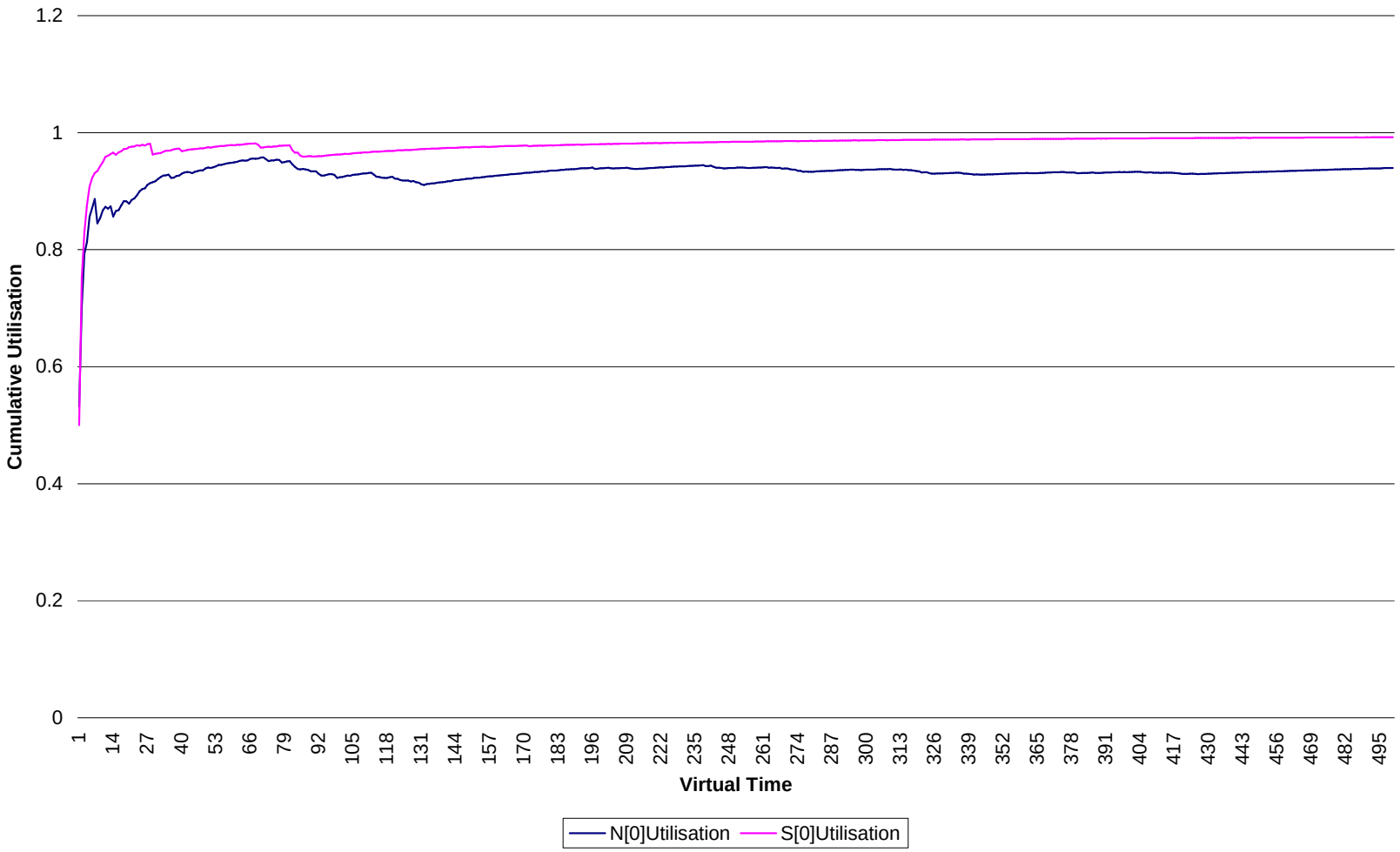
Virtual Time
N[0]QueueLength
S[0]QueueLength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Virtual Time
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S[0]Utilisation

Testing / Evaluation Distinction

- Testing — TST — Validity test cases: part of software creation.
- Evaluation — CNC — Hypothetical queueing systems: used to discover guidelines: second part of project.

  Also discussed accuracy, speed of simulation, etc. (in report)

Testing

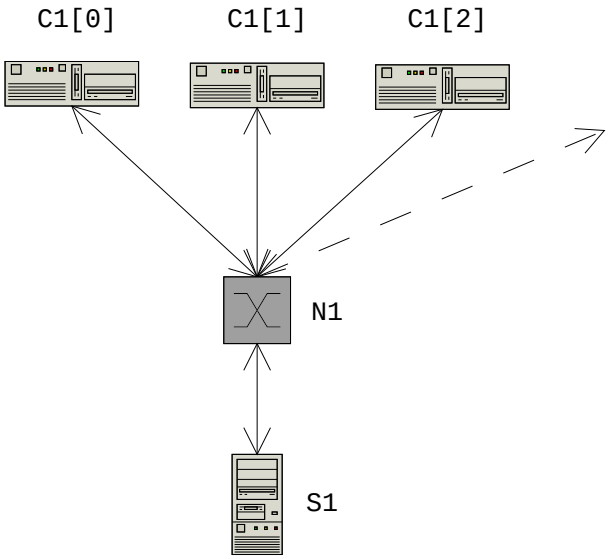
Test cases for:

- Invalid XML / Invalid XML for WS^3.
- Simple test cases — checked with queueing theory
- Boundary condition cases (large names, unusual parameters etc.)
- Others (see report)

Evaluation

Second (and smaller) part of project.

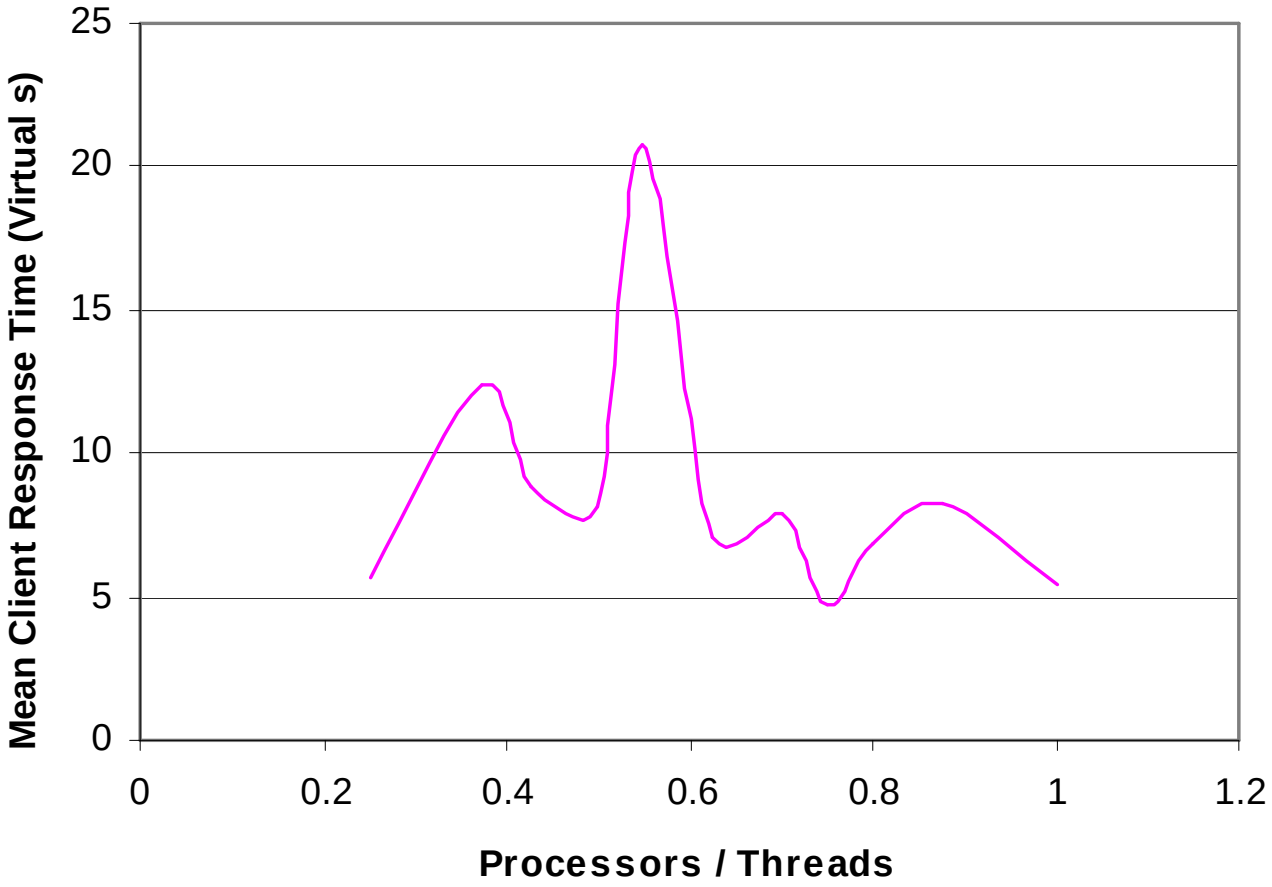
One unusual and interesting example from report. Purpose was to examine ratio: $\frac{Processors}{Threads}$ on a single server.



Evaluation Procedure

- 50 clients. Varied $\frac{Processors}{Threads}$ ratio. Ran simulations (equilibrium-adjusted).
- Plotted server utilisation, client response time, other parameters.

Most interesting pattern discovered was...


Mean Client Response Time (Virtual s)
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20
15
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1.2
Processors / Threads

Conclusion

1. Created WS^3 — many features: clients, network nodes, multi-processor and multi-threaded servers, 8 different statistical distributions, different queue lengths, network node message dropping etc. . .
2. Evaluated WS^3 — hypothetical system evaluation, discussed speed, accuracy etc.

Future Extensions

- Features for WS^3: an empirical distribution, time-based demand variation, different types of requests, etc. . .
- Graphical interface for industrial use.
- More analysis of: different hypothetical models, accuracy.

Any Questions?

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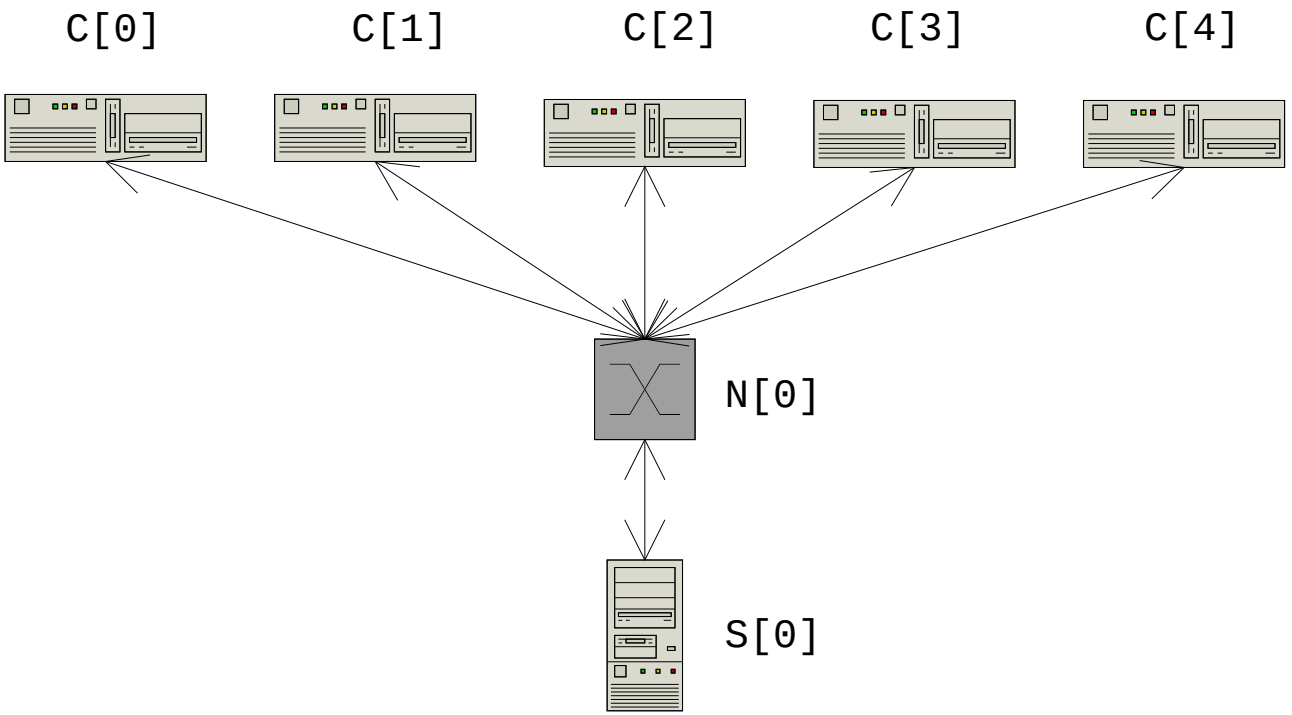
Thanks to: Peter Harrison, Uli Harder, and Tony Field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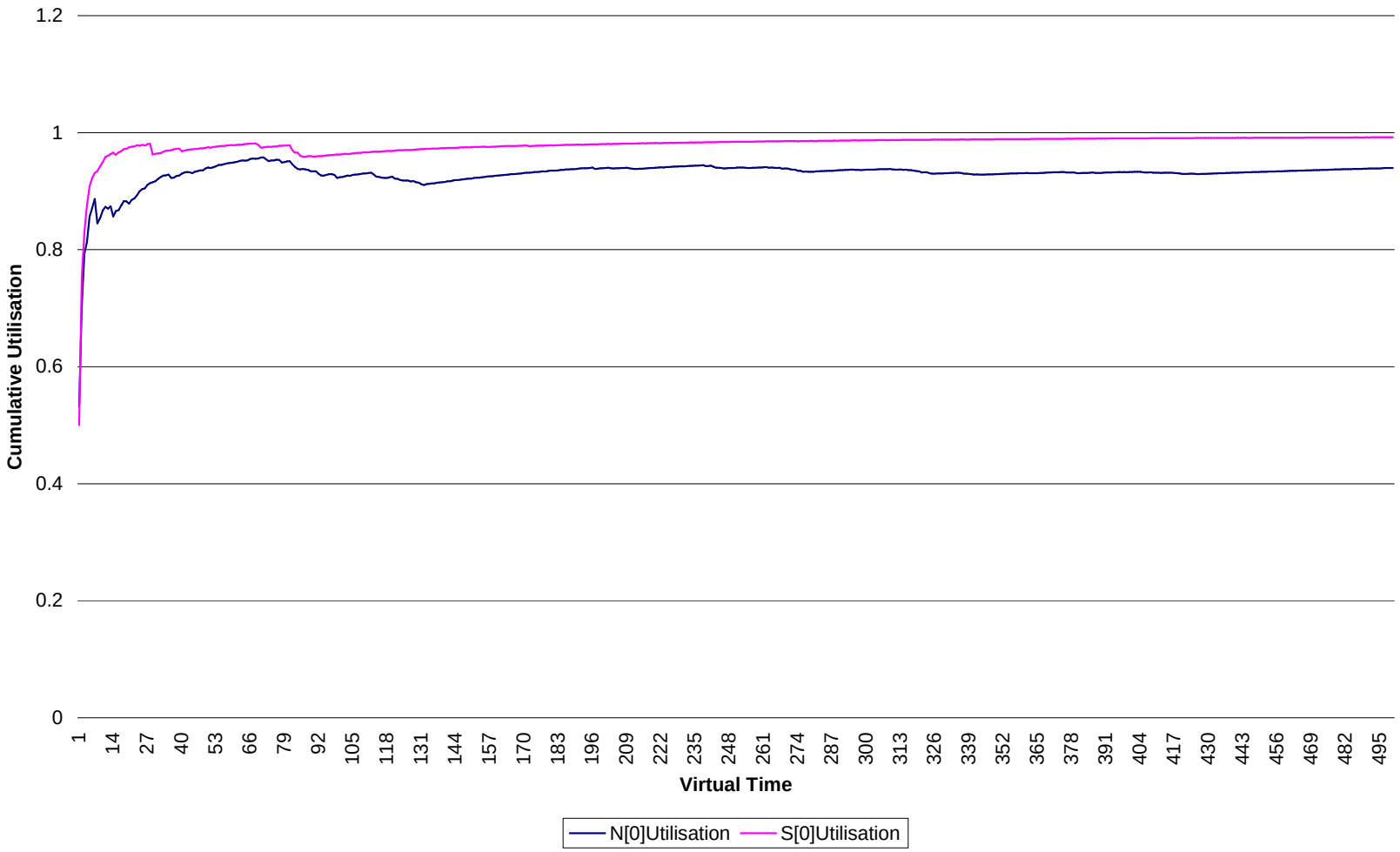
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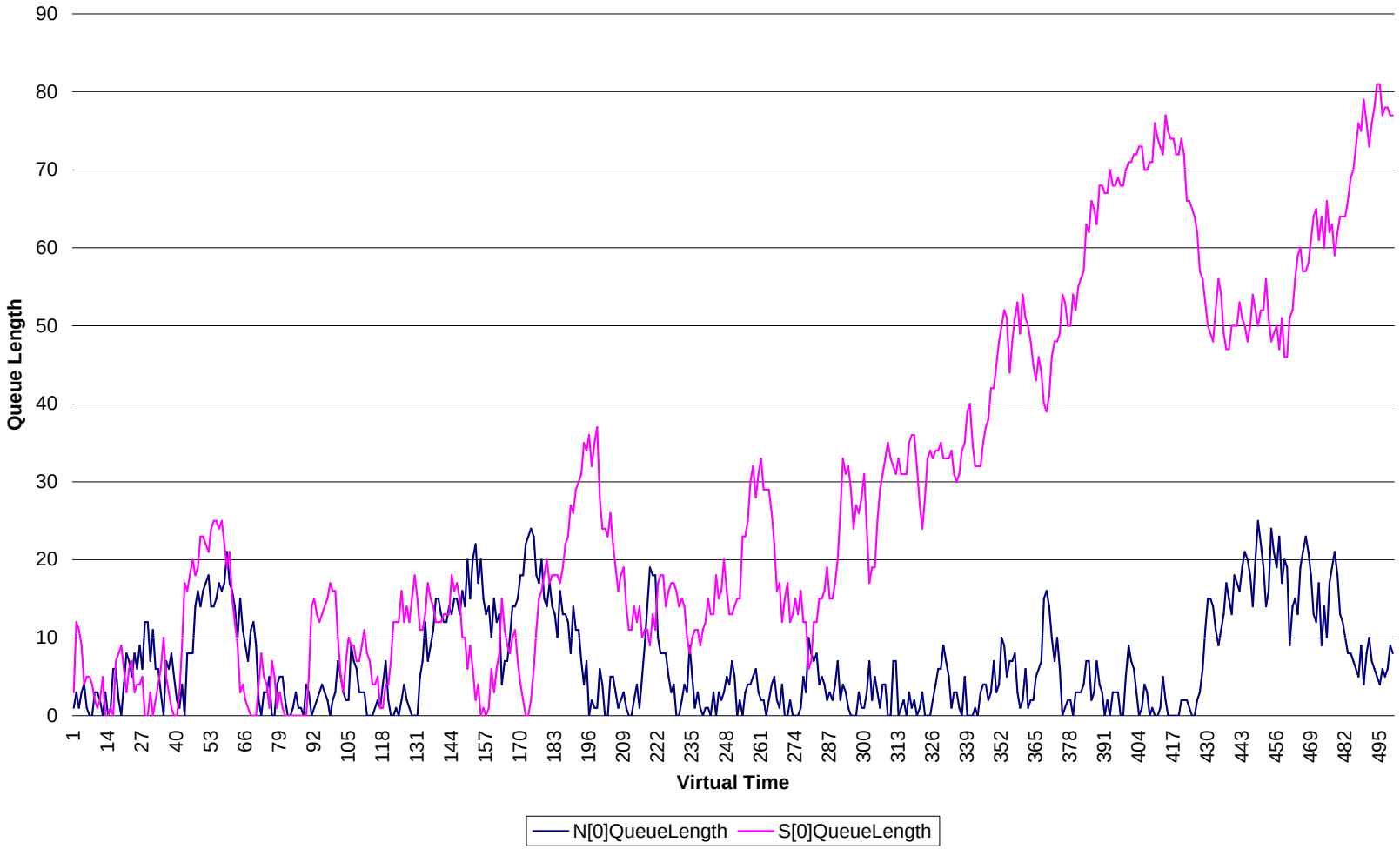
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