

# Reflections on Grid Middleware – Lessons from the History of Unix<sup>1</sup> and Linux<sup>2</sup>

(Notes from Presentation at a GCC 2003 Panel Discussion)

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It has recently been suggested that the Globus Toolkit<sup>3</sup> has or is likely to become the “Unix/Linux of the Grid”. What is usually meant by this is that Globus would become a nearly pervasive and open and interoperable technology standard. When the term Linux is used, the idea is taken further to mean an open implementation standard. I present some observations on the bumpy road which we have traveled to convergence for Unix, and conclude with a few observations on the challenges that Globus must surmount to become an open technology standard of similar scale and impact.

## Unix Fragmentation and Incompatibility (1980’s)

Unix began life as an operating system focused low-end systems (PDP-11) being used for research and particularly software development environments. It was designed to be portable, and run on nearly any hardware with a modest porting effort. It was also built as a small, minimal system, with much of the functionality provided in libraries which were not generally expected to be standard. Unix was made widely available in source form through ATT and later UCB, resulting in broad diffusion of knowledge and expertise, and a large, passionate set of supporters and users.

As Unix moved into the commercial world, it became popular in workstations sold by companies such as Sun, Hewlett-Packard, IBM, SGI, as well as several software vendors who sold x86-based versions. As use increased, so did pressure for investment in the technology to meet an increasing spectrum of needs. Companies competing directly with each other also engaged in “customization or improvement” of their version of Unix. Both of these trends led to fragmentation with major efforts behind a BSD thread and ATT’s SVR4 which later spawned efforts such as OSF which largely failed to converge commercial Unix systems. While Unix systems share many common features, the major commercial dialects that were created by this fragmentation are still distinct and incompatible.

## Enter Third Party Applications, Linux, and Microsoft (1990’s)

Three distinct forces have been pushing the Unix/Linux community to a new focus around shared interfaces, function, and implementations. First, in the 1990’s major third party software vendors emerged (e.g. Oracle, Peoplesoft, SAP, etc.), building multi-billion dollar businesses, and exerting increasing influence over providers of operating systems and hardware. For such companies, a large number of incompatible Unix systems was a a porting and support cost and an impediment to growth. Second, Microsoft began a very aggressive development of Windows NT, with the explicit public goal of supplanting the Unix dialects. By promising compatibility across

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<sup>2</sup> Linux is a registered trademark of LMI.

<sup>3</sup> Globus Toolkit is a registered trademark of the University of Chicago.

many of these platforms, Microsoft was able to gain porting commitments (and even priority) from these third party software companies over many of the Unix dialects. Third, Linux had begun to grow like wildfire based on tight control by a strong technical team, innovative licensing (the Gnu Public License) which prevented fragmentation, and a strong free software ideological culture. These changes established a strong positive cycles amongst application vendors, hardware vendors, and end users around Linux. Remarkably, these changes led to major commitments behind Linux by all of the major Unix system vendors (IBM, Hewlett-Packard, SGI, and Sun) by the beginning of the 2000's decade.

## **Challenges for Globus**

In drawing the parallels to Unix's development and adoption, I would encourage caution in drawing conclusions. Historical retrospectives often make the actual outcomes seem inevitable, and rarely capture the uncertainty which existed as events actually occurred. In rough terms, Unix/Linux passed through three major phases: Shared Technology, Vendor Differentiation, and then Convergence. Globus has been introduced as an open source, shared technology, already used by a large community of scientific grid applications developers and users. It has gained significant support from the research community, federal research programs, and endorsement by major computing vendors – IBM, Hewlett-Packard, Sun, SGI, and even early grid computing companies such as Platform. It would appear that all of these constituencies would like to jump ahead to Convergence.

Globus faces three major challenges to become a converged technology forming the foundation of the grid. First, Microsoft remains as a major holdout in the support and adoption of Globus. Second, web services represent another major thread of interoperation and federation technology which competes in role. While substantial efforts continue to knit these streams together, the possibility of “web service solutions” to grid problems already addressed by Globus remain a possibility. Third, commercial products based on Globus source and technologies are just becoming available. As such, the competitive pressures for differentiation and fracture are just coming into play. The use of BSD licensing means that the benefits of interoperability must win out over the marketplace pressures for differentiation – the licensing cannot force coherence. A hopeful note is that more than ever, computing vendors and their customers understand the value of robust interoperability. Perhaps this time the community can exploit its experience to jump ahead to Convergence.

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