User's guide

The history of supercomputing in Stuttgart is fascinating. It is also complex. Relating it necessarily entails finding one's own way and deciding meaningful turning points. Many accounts thus begin with an origin story whose impact is said to persist to the present day. Origin stories satisfy the desire for maximum simplification. The history of supercomputing in Stuttgart is so complex that it has given rise to two different origin stories.

One of these stories involves the appointment of aerospace engineer John Argyris to the University of Stuttgart in 1959.[1] Beginning with Argyris means tracing contemporary simulation culture as far back as it will go. Argyris wished to apply numerical methods to problems of elasticity theory. For this purpose, he used a mainframe Ferranti computer evocatively named Pegasus to test different solutions. This origin story gives rise almost effortlessly to a narrative that portrays state-of-the-art computing in Stuttgart as an interplay of local advances in methods and deployment of the fastest, most powerful machines.

The other, no less mythical origin story of Stuttgart supercomputing is the "pivot to the future," which Lothar Späth – ministerpresident of Baden-Württemberg from 1978 to 1991 – hoped to usher in by purchasing a Cray-2.[2] Installed in Stuttgart in 1986, this machine was the fastest computer in the world and the first of its kind in Europe. But the Stuttgart Cray-2 was also the product of an unprecedented procurement process that sidestepped the complex negotiations characteristic of funding agencies and relegated the state and federal governments' coordinating bodies to idle spectators. Späth is the referent for narra-

tives in which a strong minister-president and a bold university rector are vested with decision-making power in supercomputing matters.

Our study takes a history of technology approach to the story of supercomputing in "Stuttgart", i.e. the university, its computing center, the academic and industrial region or the government of Baden-Württemberg. We focus on the problems to be solved and the solutions that have enabled Stuttgart to perform at the limit of computability for half a century. We take the position that origin stories are ill suited to recounting this history. Its course of development was too complex and punctuated by too many interruptions, crises, "reboots," and surprises. We believe that supercomputing in Stuttgart was reinvented at frequent intervals to maintain its appeal as a service to science and industry. The fundamental building blocks of this service included operations, user policy, financing, and science policy. These building blocks were continually shuffled and reshuffled at the computing center. A computing center itself is the product of the interplay of machines, networks, buildings, personnel, and users; of competition and cooperation with other computing centers; of the interests of the sciences; and of the shaping power of funding agencies, university administrations, and industry.

How did the vicissitudes of science policy influence supercomputing in Stuttgart? How did the switch from vector to multiprocessor systems change Stuttgart's simulation culture? Which sciences influenced the development of supercomputing? What role did industry play in Stuttgart? How were users introduced to supercomputers, made familiar with them, and simultaneously tutored in their use? These are the questions we wish to address. In so doing, we want to highlight problems occasioned by conflicts between local operations and trends in science policy that

Fig. 1: The work of reconfiguration: rarely seen, but essential.

affected supercomputing in Germany and elsewhere in Europe, and to show how those problems were solved.

We have divided our history of supercomputing in Stuttgart since the 1970s into four sections. In each section, we have identified specific organizational, scientific, and technological strategies that brought computers, personnel and programs,

buildings, networks, and users, as well as the institutional and political framework, into a new relationship. As elsewhere, the history of supercomputing in Stuttgart constitutes a series of configurations.[3]

In the first configuration, much of the discussion centered on the highly controversial centrality of the service. In 1972, the University of Stuttgart Computing Center became the Regional Computing Center of the University of Stuttgart (RUS). The fastest machine on-site was a CD 6600 made by Control Data. The mission of RUS was to supply the regional universities with computing capacity. To this end, RUS lobbied the Deutsche Forschungsgemeinschaft (DFG), Germany's national research foundation, to extend its building and computing capacity. Nevertheless, in 1983, more by accident than by design, a Cray-1 – an aging supercomputer from the 1970s – was installed at the computing center.

The second configuration emphasized local supercomputing performance. In 1986, the first Cray-2 on the European continent landed in Stuttgart, with great fanfare and through political force of will. It was a spectacular acquisition. Yet the computer was difficult to operate, and procuring a replacement turned into a project lasting several years. Supercomputing was increasingly about performance, testifying to West Germany's global competitiveness. Stuttgart's procurement problems remained unsolved until 1996, when the High Performance Computing Center of the University of Stuttgart (HLRS) was founded and commissioned to provide peak computing capacity for the entire federal republic. The HLRS was financed by a public-private partnership that also involved the regional energy and automotive industries. The HLRS was organized as a service center responsible for distributing computing capacity.

The third configuration depended very strongly on the combination of heterogeneous computer architectures. By the end of

the 1990s, the HLRS was not only coupling vector computers to massively parallel computers: it was even planning to offer metacomputing to the entire world. At any rate, establishing connections between institutions and local operations opened the way to the integration of German supercomputing into a national research network (D-GRID), though it would take a considerable amount of cooperation, conceptualizing, and committee work.

Much of the work in the fourth configuration focused on supercomputing users. Training programs were attracting more users than ever to the center, and service-level agreements defined a new relationship between users and the center. In 2006, the HLRS moved to a permanent address in the new building at Nobelstrasse 19 on the Vaihingen campus. Owing to its expertise in virtual reality simulation, the HLRS became a cornerstone of the University of Stuttgart's structural realignment. At the same time, the university was striving to shift the spiral of innovation and investment in high-performance computing to the European level.