

## Application Brief

### Dynamic Resource Allocation Controller (DRAC)

#### Introduction

Advanced research in fields as diverse as economics and the sciences continue their insatiable demand for computing resources, particularly processing and storage. Historically, these demands were addressed through supercomputer technologies that were expensive to scale and limited to those institutions and researchers that could afford them. While many postulated that a computing grid shared by multiple users would provide the necessary processing power, this concept was difficult to achieve in the real world due to the cost of interconnecting processors with low latency and high bandwidth.

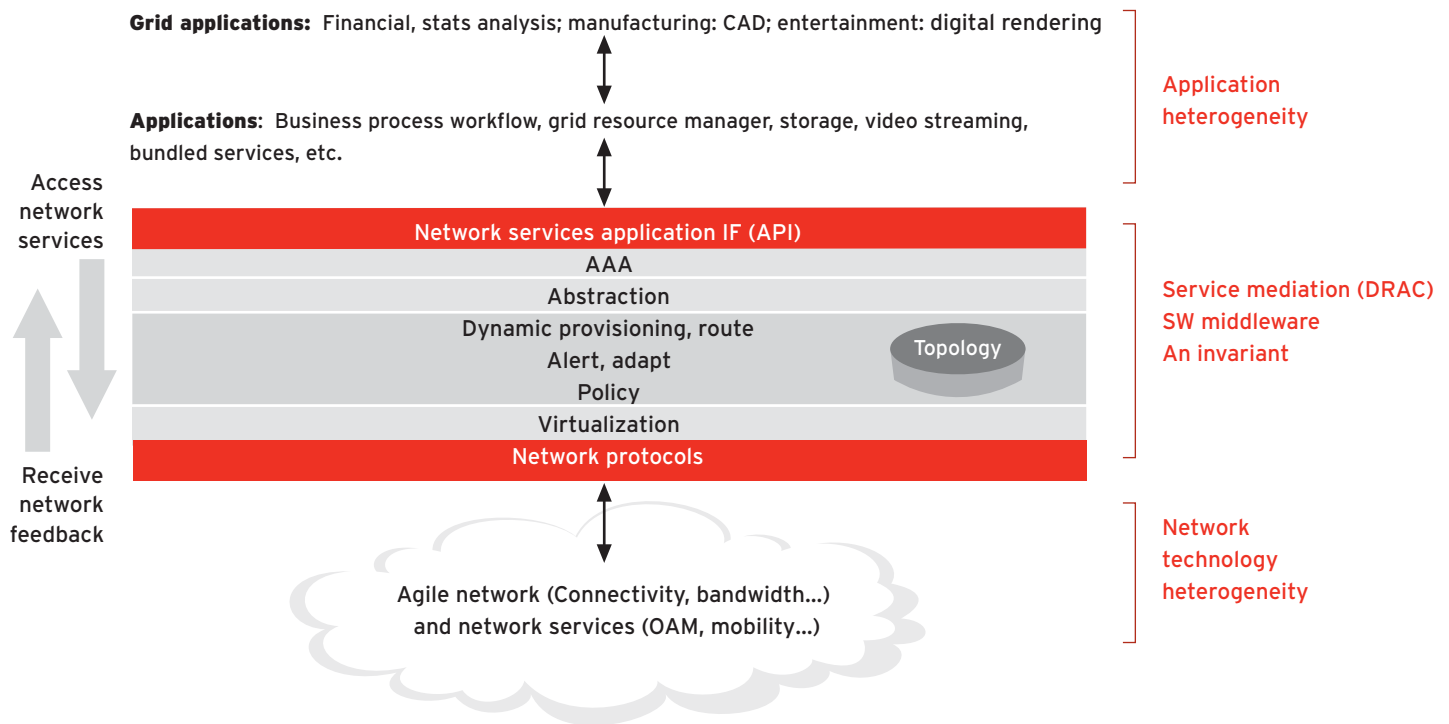
Recently, however, the steep decline in bandwidth pricing resulting from the industry adoption of Wavelength Division Multiplexing (WDM) has made the concept of high performance grid computing possible over MAN/WAN distances. In this topology, connectivity becomes a fundamental

resource that can be exploited to address processing and storage requirements. Architectural challenges remain for the research and experimental network owners, however. Fundamentally, these challenges stem from the diverse user requirements being placed on these networks, creating data transfer requirements that range from single-user to single-user multi-gigabit/s (e.g., grid applications) to best effort

many-to-many kilobytes (e.g., e-mail). How can you possibly optimize your network for its myriad and diverse users? Can the network provide the cost/performance profile of lower layer (e.g., optical) technologies and the dynamic capabilities of higher layers? Assuming an optimal static network topology is deployed, how can it be evolved as applications evolve?



**Figure 1. DRAC conceptually**



**SURFnet operates and innovates the national research network, to which over 150 institutions in higher education and research in the Netherlands are connected. The organization is among the leading research network operators in the world. SURFnet is responsible for the realization of GigaPort Next Generation Network, a project of the Dutch government, trade and industry, educational institutions, and research institutes to strengthen the national knowledge infrastructure. Research on optical and IP networking and grids is a prominent part of the project. For more information, visit: <http://www.surfnet.nl/>**



### **Introducing Dynamic Resource Allocation Controller**

Nortel has embarked on a proof-of-concept program named Dynamic Resource Allocation Controller (DRAC) that is meant to provide the necessary steering mechanism to address these pragmatic next-generation networking concerns. The primary goal of the DRAC (pronounced d-rac) project is to enable a high degree of coupling between applications and networks, resulting in an improved application-network experience, while optimizing equipment investments and operational expenses. These new capabilities provide applications the means to directly drive their share of network resources within a policy defined envelope of flexibility. Network resources include bandwidth, quality of service (QoS), security, acceleration appliances, sensors, and more.

In the first public demonstration of DRAC capabilities, SURFnet is deploying DRAC at the heart of a hybrid optical and packet switching network architecture—SURFnet6, which is being realized in the context of the GigaPort Next Generation Network project—that optimizes Layer 1 network resource utilization based upon the end-user requirement. In this implementation, applications driving multi-gigabit/s transfers bypass the packet layer and are steered directly onto wavelengths between end points across temporarily assigned optical links. Traditional many-to-many low-capacity applications are steered to the packet layer and routed appropriately. This hybrid architecture approach leverages the low-latency, high-capacity optical network for point-to-point, massive data transfers at the best price/performance ratio with a model that can scale to any conceivable capacity requirement.

## The DRAC model defined

DRAC makes a strong departure from point-and-click human-driven interfaces and network operators. Likewise, DRAC moves beyond the capex and opex inefficiencies seen in statically- and peak-provisioned network setups. DRAC provides a service interface with an abstracted view of the network. It enables applications to control the network, yet without requiring applications to interface directly with a wide range of diverse and constantly evolving network protocols, features, and devices. The interface to applications is bi-directional, enabling network performance and availability information to be abstracted upwards towards the application. DRAC's strategy is to use existing standards and toolsets for these interfaces to greatly simplify deployment in multi-vendor, multi-technology environments. This concept is shown pictorially in Figure 2.

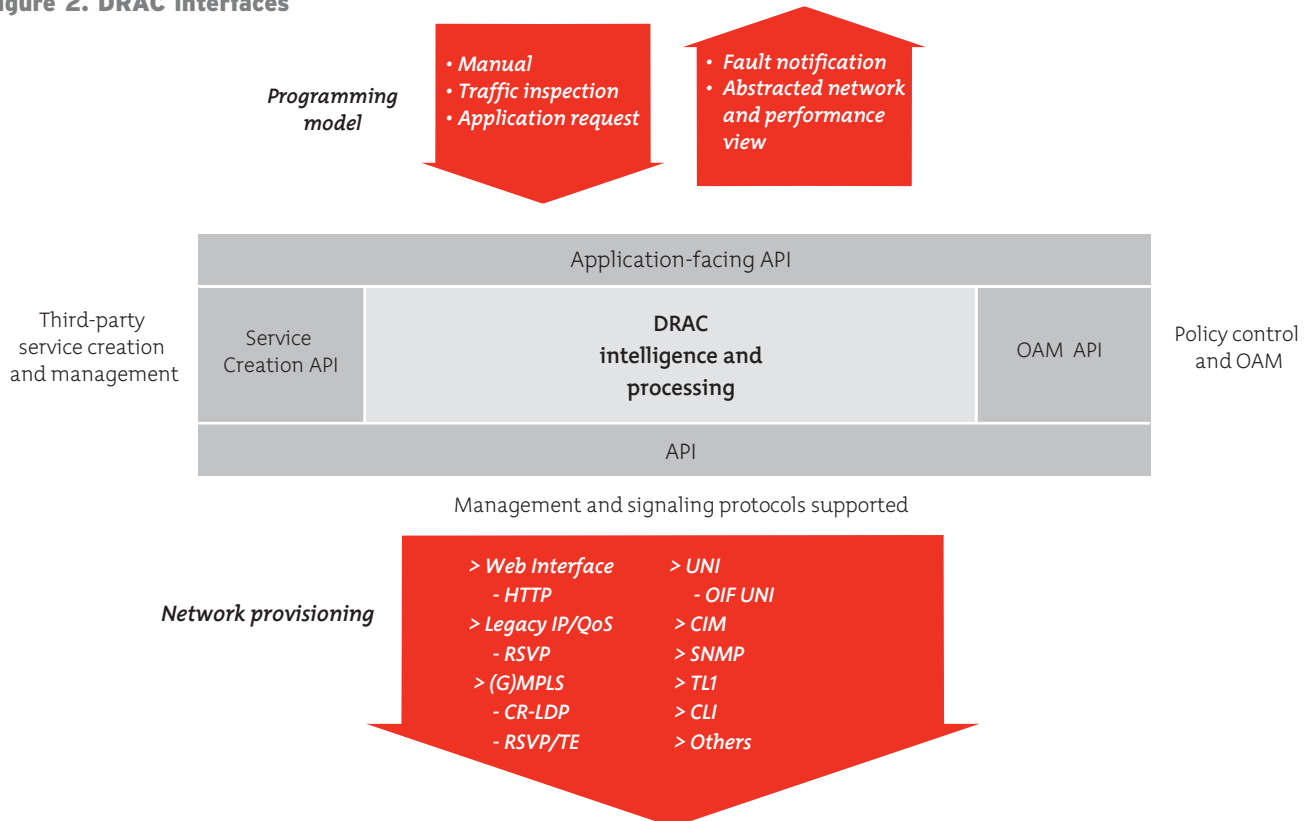
**"Next-generation hybrid optical and packet switching networks harbor a lot of new possibilities and will create a paradigm shift in networking. DRAC will bring these new opportunities alive and within reach of the users. SURFnet is proud to be among the first to allow its users to benefit from this potential."**

—Kees Neggers, managing director of SURFnet

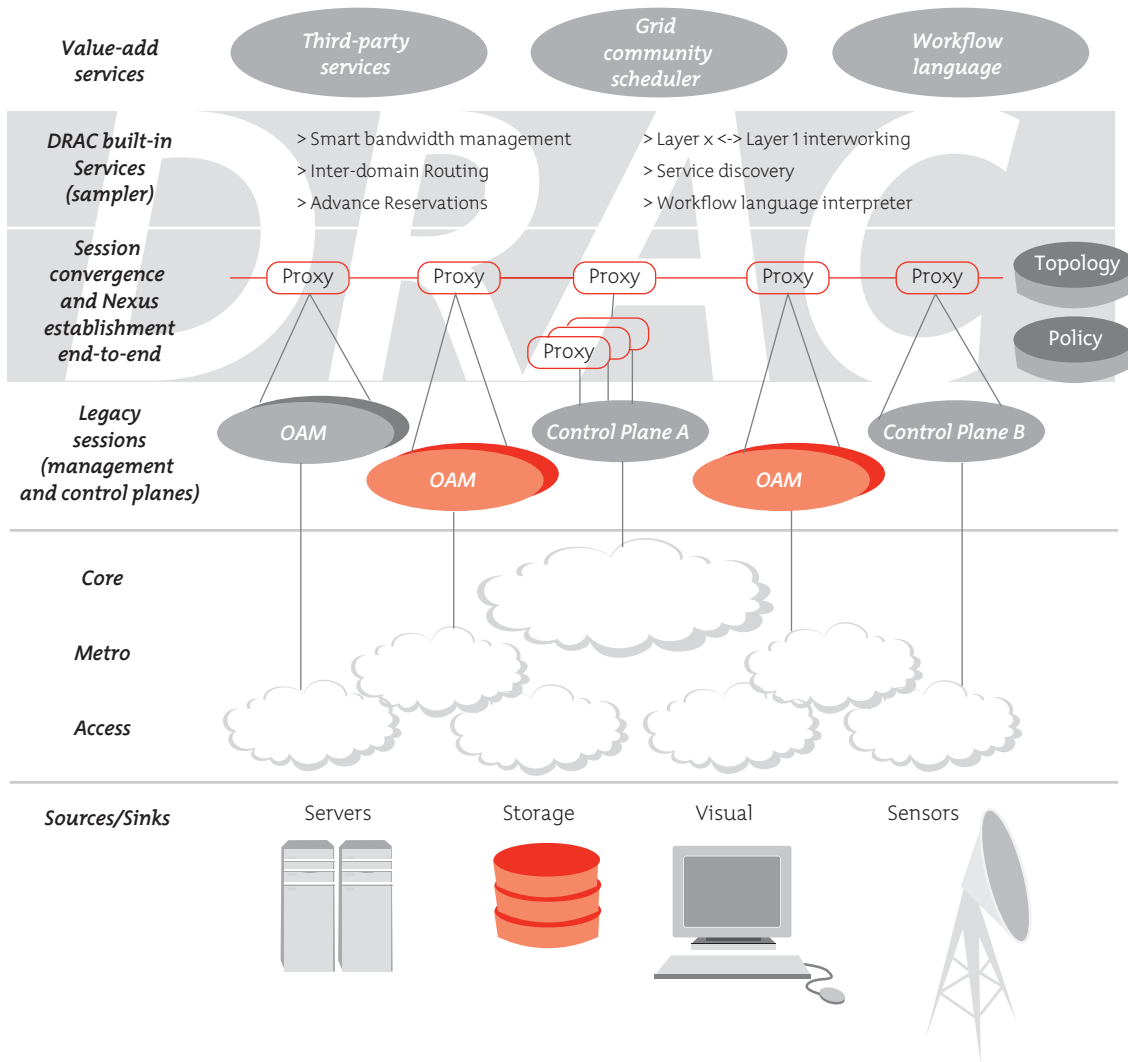
Up until now the separation of concerns between networking and applications has enabled each respective area to scale and evolve. To satisfy complex application demands such as the ones shown by grid applications and virtual organizations, it is necessary to move to far more symbiotic relationships between applications and networks—and their constituent layers. It is necessary to abstract and encapsulate the network resources into a set of services that can provide scheduling, monitoring, and usage—all within an extensible service platform, end-to-end. By abstracting these concepts, each domain preserves sufficient separation to scale and evolve.

With DRAC, Nortel envisions a three-degree of coupling between applications and networks. The first degree of coupling is the one seen in hybrid optical and packet switching networks such as SURFnet6, where DRAC provides *cut-through* capabilities, across network layers, by steering very large flows of packets or low-latency applications dynamically over Layer 1 instead of Layer 3. This type of engagement is ideal in any situation where there are marked impedance mismatches, as seen between packet-routed and circuit-switched clouds, or between wireline and wireless.

Figure 2. DRAC interfaces



**Figure 3. DRAC application and network coupling**



The next degree of coupling is the one where DRAC is capable of recognizing the “network footprints” of a given application (e.g., through deep packet inspection or direct signaling from the application). As such, it makes sure that the network reacts appropriately to an application’s behavior. For example, when a critical storage restore operation is initiated due to a disaster recovery, DRAC ensures that the network dedicates a large fraction of its resources to expedite that operation.

Finally, the highest degree of coupling is the one where DRAC becomes privy to the overall “flight-plan” of an application. For instance, DRAC learns how a particular workflow unfolds among peering instances of a distributed application. This way, DRAC can anticipate their network requirements, evaluate what-if scenarios, and enact failure-recovery strategies that are cognizant of the workflow. These are the defining properties of what we refer to as “Workflow-Engaged Networks” (WENs).

DRAC is implemented as middleware layered between the application and the network elements. It is designed to be portable to any Java platform. The DRAC platform is highly extensible, both in its northbound services rendered to applications, and in its southbound interfaces to network elements be it Optical, Wireline, Wireless, etc. The DRAC core framework includes a policy engine, AAA services, a QoS manager, a resource monitor, and a topology discovery engine.



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### **The application value of DRAC**

Currently, DRAC's value propositions have been validated within four verticals—hybrid optical and packet switching networks, data centers, healthcare, and grids.

Hybrid optical and packet switching networks validate DRAC's cut-through capabilities by steering very large data flows across an ephemeral optical circuit, and allowing smaller flows, more tolerant to latency and/or congestion loss, to communicate via Layer 3.

Within the data center vertical, DRAC will help storage partners realize large bandwidth savings across the MAN when operating their Replication, Business Continuity, and Disaster Recovery applications. During trials completed with some of Nortel's

storage partners, storage and network management were merged into a single interface, with DRAC discovering the topology and composing a complete system view inclusive of the storage topology.

Healthcare's workflows (e.g., in radiology practices) are a natural fit for DRAC's ambitions in WENs. Beyond the bandwidth savings seen in data center scenarios, the WEN can improve on dependability, while optimizing the expenses in network and storage setups.

Within grid computing communities, we are working towards elevating the network to a primary, grid-managed resource, akin to CPU and storage resources. DRAC can tame the complexity and diversity of network elements to open the way for eUtilities.

### **The next step**

DRAC has demonstrated compelling values in a wide range of applications requiring high-touch and highly adaptive user/network experiences. Detailed studies have shown large cost savings in MAN/WAN networks, thus providing an appealing alternative to the old approach of static, over-provisioned networks. DRAC is a development program undergoing validation in real-world network deployments with high-performance computing networks. If you are interested in exploring the role that DRAC could play in your network, contact Franco Travostino at [travos@nortelnetworks.com](mailto:travos@nortelnetworks.com).

Starting at Supercomputing 2004, Nortel will demonstrate DRAC features in cooperation with recognized R&E leaders including SURFnet, Netherlight, University of Amsterdam, Internet2, Canarie, iCAIR, and Starlight.

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