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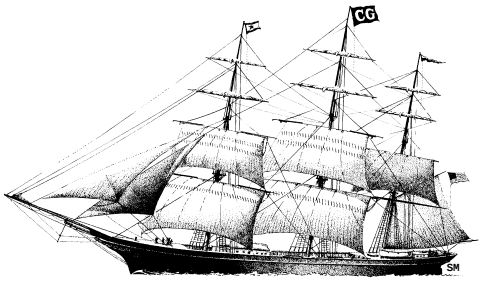

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Shining the Light on Utility Computing — A Business Perspective

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Management Summary

Utility computing is a hot topic in the IT community. The media covers it extensively; vendors promote it; and enterprises are beginning to implement it. However, it may not be clear to the average executive exactly what – or how useful – it is. New IT concepts like utility computing are prone to being misunderstood. Technologists often do not translate the meaning into business terms, which can leave non-technical persons in the dark. It is time to shine the light on utility computing from a business perspective.

To get into the utility mindset, consider how a cell phone plan affects your calling behavior. If your plan has virtually unlimited minutes and calling areas, you probably use the phone without thought or constraint. But if you have a more modest service plan with a certain calling area, specific minutes allowed during daytime and off hours, and expensive roaming charges, you are probably more careful about when, where, and how long you call. You probably favor calls during off hours, avoid making them outside your area, and generally optimize usage according to the benefits and costs of the plan. Service providers, for their part, design and offer plans to maximize revenue and usage of their wireless networks. All parties are optimizing a scarce resource to maximize their benefits and minimize costs.

Utility computing operates in a similar way. It raises IT to a new and higher optimization point of benefit, cost, and positive impact on business operations. At a time when IT has risen in importance and become critical to an enterprise's ability to adapt and succeed, utility computing offers a better and more refined approach. More specifically, it:

- Delivers IT as a service, not as a box or fixed asset,
- Provides the enterprise the right services in the right amounts at the right time,
- Optimizes the reliability, performance, and total cost of ownership of IT resources,
- Responds quickly to support changing business requirements, and
- Raises accountability for responsible consumption and reliable service delivery.

Properly understood, this broad concept encompasses both technical and business operations. Therefore, implementing utility computing involves clearing technical hurdles and changing business process and culture. Read on for details.

IN THIS ISSUE

The Rise of Information Technology

Utility computing has arisen in the context of our increasing reliance on electronic information. This is the Information Age, and people's daily lives are filled with all things digital – computers, mobile phones, games, video, music, the Internet. Businesses depend on IT to efficiently run their internal operations and to interface with the outside world. Software applications provide critical support for nearly all processes. Imagine a day without e-mail, word processing, spreadsheets, enterprise resource planning, or whatever applications you normally use. It would not be a productive day, to say the least. IT permeates modern commerce, and it has become a major enterprise activity and expense that deserves to be managed well.

Furthermore, the pace of commerce has quickened thanks to the light-speed flow of information around the world, open borders, and free markets. Competition has never been more intense. In any system undergoing fast change, the most important trait for long-term survival is adaptability. In the case of commerce, this means sensing a change in the market and quickly adjusting the enterprise's course of action to compensate for it. Enterprises live or die by this ability to continually change. The central role of IT puts it in a position to hinder or help an enterprise to be more responsive and adaptable.

The utility computing concept acknowledges the importance of IT in business operations and its pivotal role in enabling adaptability. Just as giant motorized tractors and harvesters are much more productive tools for agriculture than ox plows and hoes, utility computing represents a true advancement for IT.

	TRADITIONAL OPEN SYSTEMS	CONSOLIDATED OPEN SYSTEMS	UTILITY COMPUTING
Business/Cultural Attributes			
Accountability	Users demand the best service, provider supposed to deliver regardless of cost implications	Users demand the best service, provider accountable for cost-effective delivery	Users accountable for consumption, provider accountable for SLAs
IT function within organizational structure	Distributed or partially centralized	Mostly centralized	Centralized enterprise-wide
Cost efficiency	Low / medium	Medium	Highest
Technical Attributes			
Method of provisioning	Box-oriented	Service focus, but lacking metrics and granularity	Multiple, measured tiers of service
Consolidation	Proliferation of smaller units of hardware	Physical consolidation – larger, shareable units	Logical consolidation – single virtualized "pool"
Management centralization	Proliferation of point utilities	General management console + point utilities	Single management console for heterogeneous infrastructure
Automation	Manual administration (e.g., Excel spreadsheets)	Manual initiation and change via partly-automated tasks	Full policy-based automation, minimal human intervention
Adaptability	Labor-intensive change management – hardware and software resources dedicated to applications and departments	Less difficult to change, though resources still dedicated	Dynamic resource allocation among users and applications based on priority and need

Exhibit 1 - Phases of Computing: Present and Future

Phases of Computing

Utility computing is best understood in light of how it differs from previous forms of computing. *Exhibit 1* on the previous page describes IT evolution in three phases: traditional open systems, consolidated open systems, and utility computing.[1] The phases are like points along a continuum, and enterprises move from one to another as their systems improve and evolve. The descriptions include both technical and business/cultural attributes, because IT is not defined by technology alone, but also by how the rest of the business uses, manages, and interfaces with it. At the end of the day, it is a business productivity tool. The two sets of attributes form a holistic enterprise IT profile.

Business and Cultural Attributes

Accountability for consumption and delivery of resources is realized fully in the utility computing model. In earlier phases, accountability was limited to users[2] demanding top-notch service for everything – all the time – and expecting IT providers[3] to deliver. In contrast, utility computing makes users accountable for their consumption. They will have a hand in defining their needs, but they also must be aware of cost/performance trade-offs in specifying the service-level agreements (SLAs). It is no longer acceptable to assume these resources are limitless. IT providers, for their part, are accountable to meet the SLAs agreed upon. When equipped with the right enabling technology and tools, their jobs can actually be easier because goals are defined, measurable, and not subject to interpretation (e.g., *Why is the application down? Aren't you guys doing your job?*). Users are more likely to be satisfied because they know what to expect and their demands are more realistic. Moreover, executives will be pleased with finally having a good handle on IT costs and the impact of IT on the enterprise. Life is better all around.

Utility computing also involves a centralization of the IT function to maximize economies of scale across the organization. Rather than letting each department do its own thing, which costs more and is less robust, IT becomes a central function that delivers services to all users and departments. The technology assets themselves may still be distributed geographically, but the management of them is not. The infrastructure effectively becomes a single utility with one organization behind it. If a centralized IT department delivers the right services to the right users in a timely manner, there is no need for individual departments to deploy and manage assets locally.

Furthermore, the utility is the most cost-effective approach to computing, especially in terms of long-term total cost of ownership. Its business and technical attributes allow it to make the most of IT assets with the least effort to manage them.

Technical Attributes

Utility computing provisions resources in multiple, measured tiers of service, rather than as discrete boxes, systems, or solutions. This is a fundamental distinction, like the difference between a telecommunications network and a long-distance plan, or a power plant and a home electrical outlet. Users consume and experience computer processing, storage capacity, network bandwidth, and application software in terms of how response time, throughput and consistency (performance), the percentage of time it is online (availability, recoverability), the quantity they receive (e.g., storage capacity), and its cost. Service levels can be different for each application or user, depending on requirements. From the user's perspective, the boxes and systems that deliver services are behind the scenes and left for the IT providers to manage, just like it would be for the phone service or electricity delivered to one's home. In turn, the providers are responsible for delivering the services according to measured SLAs. (See the box on the next page for an example of a storage service level.) This requires the right technology to be in place, especially intelligent management software that can virtualize,

[1] Mainframe computing has and will continue to play an important role in enterprise computing, but it is not addressed in this discussion because it sees itself, largely, as a self-contained universe, especially with respect to disk storage.

[2] In the broad sense, "users" includes departments, workgroups, divisions, and individual users. If the provider is an outsourcer instead of in-house IT department, users can also include customers.

[3] A provider can be an in-house IT department or a third-party service provider.

Storage Service Level Defined

The description of a *service level* will vary by resource and degree of sophistication. A storage service level, for instance, might include the following characteristics:

- Amount of capacity in MBs,
- Performance in MBs or I/Os per second,
- Availability in percentage of uptime,
- Recoverability in time to restore, and
- Cost per unit of capacity.

A single application might also take advantage of multiple service levels or tiers of storage. Since not all data has the same value or service-level requirement, the data can be migrated to less-costly and less-capable storage systems as its value decreases, thereby saving on overall storage costs. This is also known as *data or information lifecycle management*.

provision, monitor, report, and automate computing resources as a service.

In a utility, the IT infrastructure is virtualized or consolidated into a logical *pool*. Whether the resource is storage, computing, or networking, virtualization masks the underlying physical complexities and allows it to be securely partitioned and allocated among the many applications and users. The infrastructure can operate as a unified entity, though it might consist of many components from multiple vendors. Administrators can manage it centrally with a single console rather than the usual bevy of device managers – one for each make and model of equipment and software. The result is a higher level of utilization and ease of use than in traditional environments, which consist of many, fragmented, hard-to-manage computing and storage *islands*.

Once virtualization and centralized management are in place, there is a foundation for full automation and adaptability. Automation is a capability that minimizes human intervention by allowing the infrastructure to essentially manage itself. It can respond to changes, alerts, and events based on predefined policies and priorities that administrators establish. It is like autopilot on an airplane. Automation allows an administrator to effectively handle a greater quantity of IT resources. There is also less susceptibility to operator error and misconfigurations than with earlier forms of computing.

Adaptability, then, is not so much a technical feature itself, but a culmination of the other feature/characteristics. It means that resources can be added or reallocated on the fly, according to new and changing needs. For instance:

- A new application is rolled out more quickly because the computing resources are readily provisioned,
- Web servers that are suddenly overwhelmed with traffic, and that have priority over other applications, automatically receive additional resources, while others make do with less for a while, or
- A mission-critical transaction-processing application that is about to run out of storage space dynamically receives more capacity at the appropriate quality of service.

With utility computing, resources are fluid and not necessarily fixed or dedicated to single applications or departments.

The Business Benefits

Enterprises can benefit from utility computing in four major ways:

- Lower TCO,
- Better alignment between IT and the broader enterprise,
- A more adaptable enterprise, and
- A greater likelihood of meeting enterprise objectives.

Lower TCO

In mathematical terms, total cost of ownership equals acquisition cost plus operating cost minus residual value:

$$TCO = AC + OC - RV$$

Utility computing acts to lower TCO by reducing the amount of hardware and software purchased (acquisition cost) and by reducing

the management and environmental expenses over the useful life of the equipment (operating cost).

First, it lowers acquisition costs by using assets more efficiently. For instance, enterprises typically utilize only 30 - 40% of their storage capacity, but there is no reason it could not be upwards of 80% if it were virtualized, networked, and smartly managed. Moving from 40% to 80% utilization would cut storage hardware and array-based software costs in half. Extrapolate this same dynamic over servers, software, and networking, and it becomes clear how utility computing can take a bite out of acquisition costs by improving utilization.

But the procurement savings do not stop there. Utility computing also delivers service levels to users and applications more precisely. The disciplines of accountability and establishing SLAs help define what the individual needs are. Giving everyone exactly what they require – no more and no less – avoids blanketing a group of users or applications with a higher service level than all of them need and overspending on IT. In short, precision cuts out wastefulness.

Secondly, utility computing lowers operating costs primarily by simplifying management. By far, the greatest cost of computing in the long run is management, especially skilled workers to operate the infrastructure. It adds up to many times the cost of acquisition over the useful life of an asset. Through centralized management, virtualization of heterogeneous resources, and automation, utility computing dramatically raises the productivity of each administrator. Therefore, management costs are lower. It also makes the job of an administrator more interesting by automating many of the repetitive, boring tasks, freeing them to work on more strategic and complex tasks.

Since utilization levels are higher, there is less equipment to manage – a sort of virtuous circle. There are also fewer environmental expenses like power, cooling, and floor space, which can add up over the lifetime of a hardware asset.

While utility computing does not change the residual value of an asset, it may allow it to be used for a longer duration, which extends the return on investment. With the power of virtualization and centralized management, there is little extra effort in continuing to operate and make available an older piece of equipment. Even if the asset does not have the power, capacity, or bandwidth of the latest equipment, why not keep using it if it still runs well and requires little incremental effort? As you can see, utility computing works every variable of the TCO equation – to squeeze out a tremendous amount of cost.

Better Alignment Between IT and the Broader Enterprise

The impact of IT on an enterprise is a function of the technology itself, how well it is managed, and its linkage with the business processes. Utility computing gets all the wood behind the arrow, so to speak, by delivering precisely the right services in the right amounts at the right time to each user. No more blanket, indiscriminate coverage or one-size-fits-all service. No more inadequate support of important applications, either, which negatively impacts the productivity of the associated business processes. Applying high performance and reliability in the right places raises the net effectiveness of the whole infrastructure. For instance, if a critical application requires the highest degree of protection and recoverability, such as remote mirroring with nearly instantaneous failover, it can receive this service while other applications get a less-sophisticated and more cost-effective alternative. Utility computing strikes the optimal balance between business demands and cost.

A More Adaptable Enterprise

If both front wheels on a vehicle turn in unison, it can effectively move around town by adapting to changing road and traffic situations. However, if only one wheel turns and the other remains fixed, that car would not get around well. Traditional IT is more like the fixed wheel because it is costly and time-consuming to change. Utility computing is just the opposite – flexible and fluid. This adaptability is found in the ability to virtualize, centrally manage, and dynamically provision and reallocate resources. Utility computing is a pivot point that, when liberated, allows the enterprise to respond more quickly to changing

market and competitive conditions.

A Greater Likelihood of Meeting Enterprise Objectives

Enterprise objectives are the highest-level objectives of an enterprise, such as to satisfy customers and deliver a return to shareholders. By more effectively supporting the business processes that achieve these objectives, utility computing does impact the bottom line. Part of the support comes from more precise application of service levels; part comes from shaving out costs; and part comes from better availability, recoverability, and performance of enterprise applications. The latter is a result of having a single utility and resource pool from which to draw, combined with dynamic resource allocation and self-correction, when problems arise. It is like the difference between a single-person rowboat and an eight-person boat with a coxswain to steer. If the single-man boat loses an oar, it is doomed to go in circles. But the eight-man boat can compensate for a missing oar and still move forward at a good pace. In this case, the finish line is the attainment of enterprise objectives.

At the same time, one must be careful not to overpromise here. IT is not a cure-all, and it should not be thoughtlessly thrown at business problems. While it is a major and growing piece of the commercial puzzle, it is still one of many that must fit together seamlessly to deliver on enterprise objectives. IT cannot compensate for a lack in vision, tactics, human talent, or financial resources, but it can accelerate and magnify the impact of all of them, if done properly. Utility computing is about making IT more effective so that the business can be more effective.

The Journey to Utility Computing

If you find the utility computing concept compelling and worthwhile, the next question is how to implement it. In a sense, utility computing is like the end of the line in the evolution of IT. Some passengers will go all the way, others may get off a few stops before, and some will miss the train altogether. But the economic and business benefits are real, and no one wants to be left behind. So, how can an enterprise get on the train and move toward this better place?

Rome was *not* built in a day, and neither is a utility. Utility computing represents a major renovation of both technology and business process. So, the best approach in most instances is to take one step at a time, demonstrate tangible progress through a series of successful projects, and keep moving forward as needs dictate and resources allow. Like Rome, a utility is also an ideal and a practical reality at the same time. It is a long-term journey with milestones along the way. The objective is not *arriving*, so much as it is making progress and steadily approaching the ideal.

Below are some salient steps to help your enterprise embark on the utility computing journey.

Embarking

- **Assess your enterprise IT profile.** *Where is your enterprise in the phases of computing described above?* You may have a highly distributed computing environment in which each department owns and manages its own set of equipment. Or you may have begun a process of physical consolidation by co-locating assets in a central data center and migrating to larger, shareable platforms. Consolidation has been an active trend for years, and many enterprises find themselves somewhere between traditional and consolidated open systems. A few leading enterprises have even begun to virtualize IT assets, and the journey is far from over.
- **Move down the continuum by making improvements on the technical infrastructure and business processes and culture.** The two work together synergistically, so it is best to push on both fronts at the same time. Equipped with a sense of your enterprise's current state of affairs, focus on areas of obvious need – the low-hanging fruit – and keep in mind the end goal.

Technical Infrastructure

- **On the technical side, you need to build utility characteristics into your IT infrastructure.** These include virtualization, central management, policy-based automation, flexibility, and the ability to provision resources as measured, tiered services. The scope of the renovation

includes all infrastructure components – networking, computer processing power, storage capacity, and software applications. This is a broad undertaking that will require various products and technologies, which are available in part today and soon will be more fully as the supporting technologies develop. Pragmatism suggests that it would be better to enjoy a partial benefit today than to wait indefinitely for perfection.

- **Pay the most attention to software selection, especially management software.** In fact, software is more important than hardware in the utility equation. Hardware is what you see on the data center floor – servers, storage arrays, switches, routers, etc. You paid good money for it, and you need it. If more is required, any of a number of vendors could deliver a competitive, relatively-equivalent product.[4] There are learning curve and interoperability issues as well as advantages associated with any product, but mostly, these components are interchangeable, although the architectural approaches will vary.

  Perhaps the most critical component is the software for centralized management, configuration, virtualization, SLA provisioning and monitoring, and automation. It ties together and coordinates all of the utility components into a cohesive whole – whether computing, networking, or storage. Its central role makes it an important piece to get right. The software should embrace heterogeneous systems and open standards, thereby maximizing its scope and avoiding vendor lock-in. It should also support what is on the floor of your data center, preferably including legacy equipment.

- **Pick the right vendor(s).** When creating a utility, this may be more important than individual product choices , because a technology purchase is not just an isolated event to satisfy an immediate need. It is a commitment, of sorts, that becomes part of the foundation on which you will build and evolve in the future. *Is the vendor/supplier committed to utility computing? Will it develop and enhance its products to help enable this vision over time? Will it partner with you in the journey?* These are important questions since your final destination is known only in general terms, and you must rely on these vendors to help take you there. Trust, credibility, a solid track record, good products and professional services, and a sensible, open vision are important considerations.

- **Favor projects that make your infrastructure *look and feel* more like a utility.** If a project will enable your infrastructure to demonstrate more utility characteristics, then it is probably a good one. If you are not sure or if the project seems like a diversion, proceed with caution or perhaps reconsider.

- **Make leapfrog technical advances, where sensible.** It may be possible to jump from traditional open systems to utility-like characteristics in an area. For instance, if your data center contains servers with direct-attached storage, you might be able to migrate the storage into a shared, logical pool using a virtualization platform. Then connect it to the servers over a storage area network (SAN), and you have taken a big step toward a storage utility. If this is not practical, you could take a more conservative step of upgrading to larger, consolidated storage platforms. A SAN may still be a wise investment, in that case.

- **Shift gradually to policy-based automation.** Administrators will need time to prove the dependability of automated systems and policies. When the autopilot feature in jetliners was first introduced, pilots certainly did not use it immediately for entire flights. There was simply too much at stake. They probably turned it on for a short while when the jet reached cruising altitude, giving them plenty of time to correct any possible error or malfunction. You can also bet they never relaxed or left the cockpit. As the feature proved itself over time, they increased its usage and relaxed more during the operation. This same dynamic applies to IT administrators. Trust in automation will come gradually with time.

- **Consider outsourcing as an option.** The question of outsourcing is part of the larger utility computing discussion because not all

[4] Yes, there are differences among hardware choices. With respect to the large set of changes in moving toward utility computing, these differences are small enough to ignore, for now.

enterprises have the expertise or need to do everything themselves. Depending on enterprise requirements, internal capabilities, and willingness to cede control, it might make sense to source some or all services from a third-party provider.

- **Skate fast over thin ice.** As you implement improvements, pay special attention to the transition between the old systems or processes and the new ones. Cover your bases well and take precautions to avoid downtime or data loss. When everything is in place, make a swift and smartly-executed transition. This will minimize the possibility of difficulties during the process.

Business Processes and Culture

- **Establish a centralized IT function.** It may take some time to do this if you are starting with distributed or decentralized computing, where each department or subgroup buys and manages its own equipment. People may be used to doing it this way, even though it results in poor economics and, possibly, inadequate service levels. The challenge is to encourage the departments to cede control and management to a central IT department, which is a political and cultural issue as much as anything.
- **Show the departments and users how they will benefit from a utility.** The transfer of control can happen by executive decree, but forcing the situation too quickly can have unintended negative consequences. A good approach is to demonstrate how it will provide them better service levels and lower costs. *Spend less, get more* is always attractive. As consolidation projects are rolled out, they offer opportunities to demonstrate the benefits in practice, and to gradually centralize control.
- **Make SLAs the basis of accountability for consumption and delivery of IT services.** The SLA is essentially a contract that ensures a meeting of the minds between IT providers and users. The first required step is to put in place the technology for defining, measuring, and provisioning SLAs. Then, the actual definition of SLAs will probably entail a cooperative process between users, providers, and executive management. Users have the best sense for what they need; providers know best what can be done; and executives must make the final decisions between performance requirements and cost.
- **Establish a mechanism to encourage responsible consumption of utility services.** Users have to understand the relationship between desires, needs, and costs. *Give me all that I might need, at the highest qualities of delivery at any expense,* should be replaced with a more rational, *Let's agree on a service level based on my needs and budget.* This can be simple awareness through periodic reporting or a more formal system like internal charge-back for services, which introduces a level of discipline that approaches that of monetary budgeting. At the end of the day, charge-back is the most effective method of ensuring responsible consumption. (Nothing hurts like a hit to the pocketbook.)[5]
- Hold IT providers accountable for delivering on the SLAs. While not simple, their task is to deliver the appropriate service levels to the enterprise. Continuous cost improvement should also be part of the charter. Historically, the market price of processing, storage, and networking per unit of capacity goes down over time, and software becomes more sophisticated. This is the miracle of technology, and enterprises should benefit from the continuous innovation.

Conclusion

The utility computing concept is big, compelling, and, by all appearances, inevitable. It is fundamentally about making the smartest possible use of IT by delivering the right service levels to the right constituents at an optimized cost. Its benefits will be felt across the enterprise – from the IT department to the business processes and functions to the bottom line. Utility computing is a journey worth taking, and now is the time to begin.

[5] See *The Accounting Pendulum Swings at Storage (or, Why The Taxman Cometh?)* in **The Clipper Group Explorer** dated October 31, 2002, at http://www.clipper.com/research/TCG2002043.pdf.

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