



XPress XRN for Registry Services

... the net-worked database

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1 Introduction

Licensing costs for conventional databases when applied to registry services represent a sizeable and direct bite into profits. Wide distribution and high availability required to provide low latency services across the network are not service foci for traditional database systems. Accessibility of millions or even billions of connected objects across the network is becoming real, and the need to span multiple services already includes DNS (ENUM, URL forwarding), VoIP, and telecommunication number translation services, among others. Backend database needs are crucial to provisioning these services, but conventional technologies create unfavorable performance-cost ratios, and *real-time updates regardless of scale are not possible* with conventional solutions. Relational databases provide generality but are expensive to scale and do not distribute easily and cost-efficiently. Directory services provide distribution but not efficient update or replication. While bind has demonstrated global service distribution and robustness, it was never designed to manage mobile objects, or multiple services concurrently. Yet a universe of proliferating objects and services continues to expand, and needs for object mobility approach ever more rapidly and specifically for registry service providers.

Registry service providers do not merely need more performance at refined price-points, but convenient and modular scalability for transaction growth, in a replicated high-availability environment, with an altogether different computational-cost basis. These needs can be all reduced to an infrastructure's ability to locate network-wide objects with performance, transparency, scalability, and resiliency. XPress XRN is designed to provide the generic key-value management that registry services require: DNS (traditional IP-hostname mapping, ENUM, URL forwarding, etc.), VoIP, number translation services, and so on. XPress XRN provides high performance, convenient scalability, resilient distribution, and a new computational and financial cost-structure unavailable with other technologies for generic background database needs.

2 Service Domains

Helping to lower costs and provide a generic backend database solution optimized for the network, XPress XRN head-on addresses the needs of current and arriving registry services.

On the one hand, service providers are increasing types of services provided. Providers are supporting services ranging from guaranteed update times for private network DNS, to dynamic number translation services for telecommunications carriers that draw on registry expertise. Types of services, and the volume of those, will continue to proliferate. *On the other hand*, service providers are forced to exploit available technologies to address current needs with technologies designed for different application purposes, such as relational databases, directory services, and retasked DNS (for example, with Content Delivery Networks) for common back-end service delivery. Yet today's data management solutions cannot account for the diverse ways that tomorrow's applications will manage the underlying key-value associations that facilitate number indexing, metadata indexing, and messaging needs that the high volume transaction applications will need in the machine room or across the network.

A new kind of database is needed to *generically* support these new applications. It must go above and beyond the relational database model, directory service, and retasked DNS. It must, in real time, manage information describing distribution, data availability, and delivery. Arriving applications will require information tracking and management characterized by:

- **Identity** - how objects are determined to be unique
- **Mobility** - that data will commonly move
- **Locality** - that diverse applications will need to connect to mobile data
- **Presence** - that dynamic service discovery and data availability must be characterized.

To support identity, mobility, locality, and presence, converged registry services must minimally provide:

- **Performance** networking to describe static *and* mobile data
- **Scalability** without performance depreciation, in computationally and financially appropriate form-factor
- **Network-Memory-Disk** synchronization across sites for data and redundancy at the atomic level.

Current database technology can be deployed to address such needs, but pushes much low-level functionality to the developer, such as replication and distribution provisioning. Current database technology is known not to scale arbitrarily and was not designed to provide equivalent computational and financial economies when forced to scale, as XPress XRN delivers.

XPress XRN addresses exactly this gap between conventional technologies stretching their design purposes, and the database needs required to support small messaging manipulation across the network wire – as a generic service for diverse applications.

XPress XRN design does not address the generality of the relational database model, does not use the replica distribution model of directory services for performance, or the DNS hierarchy for distribution, although it can do some, parts, or support components of all of these.

Alternatively, XPress XRN provides networked performance unimaginable to relational design, global distribution not suited for directory services, and real-time update capacity unavailable to DNS hierarchy.

XPress XRN isolates a specific function: mapping and unmapping relationships that go on and off the network wire, at new levels of **performance**, **scalability**, and **availability**. For registry applications wanting to manage high performance needs efficiently in the machine room or in distribution across the wire, XPress XRN has no peer competitor.

3 Service Goals

Registry service providers are not the only benefactor, but will be one of the early benefactors of this new database technology. As registry services expand in scale, complexity, distribution, and diversity, they require the performance, scalability, and networking efficiency of a database designed to manage object indexing; metadata describing the objects stored within, outside, and among provider installations; and message delivery for diverse application needs. XPress XRN can create arbitrarily large single- or multi-site object stores that can resolve every item's key-value relationship on a network in near-real-time.

As a network optimized database for registry services, XPress XRN offers specific technical design advantages:

- Up 100x to 1000x greater performance than relational databases
- Linear scalability to support any capacity need (compute, storage, distribution)
- Atomic data consistency between memory and disk without compromising performance advantage, even when distributed across the network
- Faster *replicated* service than non-replicated service in other technologies
- Fast recoverability
- Real-time record synchronization on the network
- Real-time network-wide data consistency
- Geographic distribution limited by network latency.

Providing such functionality lets registry service providers construct flexible, dynamic, distributed policy management heretofore unavailable. XPress XRN provides a common backend that can concurrently support multiple registry services.

4 Service Needs

Out of this growth scenario, specific needs become increasingly critical to the adoption, proliferation, and growth of new services on communications networks. What needs does XPress XRN address for registry service infrastructure?

1. **Performance.** The need to locate, manage, and retrieve data objects quickly and transparently among devices across a network, at tunable performance levels.
2. **Scalability.** The need to smoothly and modularly scale according to growth, to any conceivable degree, as the number of objects and devices increase.
3. **Availability.** The need reliably to handle multi-site data distribution.

Traditional databases for communications networks do not scale to meet these needs, and their price-performance does not meaningfully address OEM market needs. Finally, other solutions do not provide efficient, integrated networking embedded into the core of the database services like XPress XRN. XPress XRN not only meets these needs, but exceeds them in a cost-effective form-factor. We briefly evaluate these needs.

4.1 Performance

Today global itemization can occur through services and embedded technologies tasked for specific purpose: but database back-ends are not fast enough to support dynamic data mobility in near-real-time at high volumes of randomized data exchange, such as appropriate for number portability. Worse – traditional databases are not designed to support the *networking* required to provide such service in an appropriately efficient form-factor. XPress XRN can provide generic per-item tracking in real-time. It is designed and written to manipulate small messaging on networks, such as IP addresses, hostnames, URL management, GPS location, ESN mappings, Instant Messages, etc. XPress XRN permits tracking individuated networked objects in real-time.

Protocols and implementations exist for transport, but increased distribution will require a new logical and functional service to manage the volume of objects and potential for randomized mobility across the networks in which the objects exist and move. Supporting such service requires not only efficient transport mechanisms, but similarly efficient indexing

technology that smoothly handles the volume and dynamism of objects that move through registry service infrastructures as the infrastructures are deployed, grow, change, and evolve. Providing such service will require finding, adding, deleting, or updating registry objects quickly, scalably, and with replication for availability. A network-designed association database is an appropriate logical unit to this solution.

XPress XRN was designed to address these messaging needs head-on, like no other available database technology, and operates at speeds up to orders of magnitude faster than other database technologies. **Figure 1: XPress XRN Relative Performance** shows the relative performance differentiation between XPress XRN and other database technologies.

Figure 1: XPress XRN Relative Performance



4.2 Scalability

With the proliferation and introduction of new services, smoothly and modularly scaling according to growth already is a common design concern, and this will increase as the number of data objects increases exponentially. Registry providers should be able to make cost-effective hardware selections, and then modularly expand that hardware choice according to growth, rather than according to preselected chassis size. High performance

in-memory relational databases trade disk reliability against speed, and contain processing overhead and generality that is wrongly tasked and poorly designed to address distributed processing across the network. Contrary to “in-memory” speed without persistent storage, XPress XRN provides up to orders of magnitude superior performance than the fastest in-memory relational databases, by removing unneeded design for unneeded function. XPress XRN includes *guaranteed network-memory-disk synchronization* at the sustainable performance levels previously indicated in **Figure 1: XPress XRN Relative Performance**.

Alternative to relational databases, **directory services** such as LDAP, achieve low latency and high distribution by increasing the number of replicas – but at the cost of update speed. More replicas increases lookup performance, which also proportionately decreases update performance. Such design is also not tasked for the exploding proliferation and mobility of objects on networks. In contrast, XPress XRN achieves increased performance through clustering which improves both lookup and update performance uniformly – rather than replica distribution. In addition, XPress XRN achieves distribution through efficient networking, and per-record replication provides high availability at orders of magnitude performance improvement compared against not only directory services, but against all other alternatives.

With the XPress patent-pending clustering technology, XPress XRN applications have no upper bound performance restrictions except network capacity. Unparalleled performance levels are showcased in the ability to process over 20 billion transactions per day on simple, Pentium-based hardware, or 200,000+ peak performance transactions per second, on a single processor. As illustrated in **Figure 2: XPress XRN Scalability**, XPress XRN exhibits linear scalability between the number of transactions per second and the number of servers in a cluster. This linear behavior allows XPress XRN to support systems needing multi-millions of objects and their associated values – *appropriate for managing DNS, distributed service management, number translation services, in a cost-efficient, high-availability platform that registry services require*. XPress XRN does this without the overkill of relational databases pushed to their limits, directory services wrongly tasked for managing updates, or the legacy concerns of retasking DNS hierarchy for alternative functionality than it was designed for.

Figure 2: XPress XRN Scalability

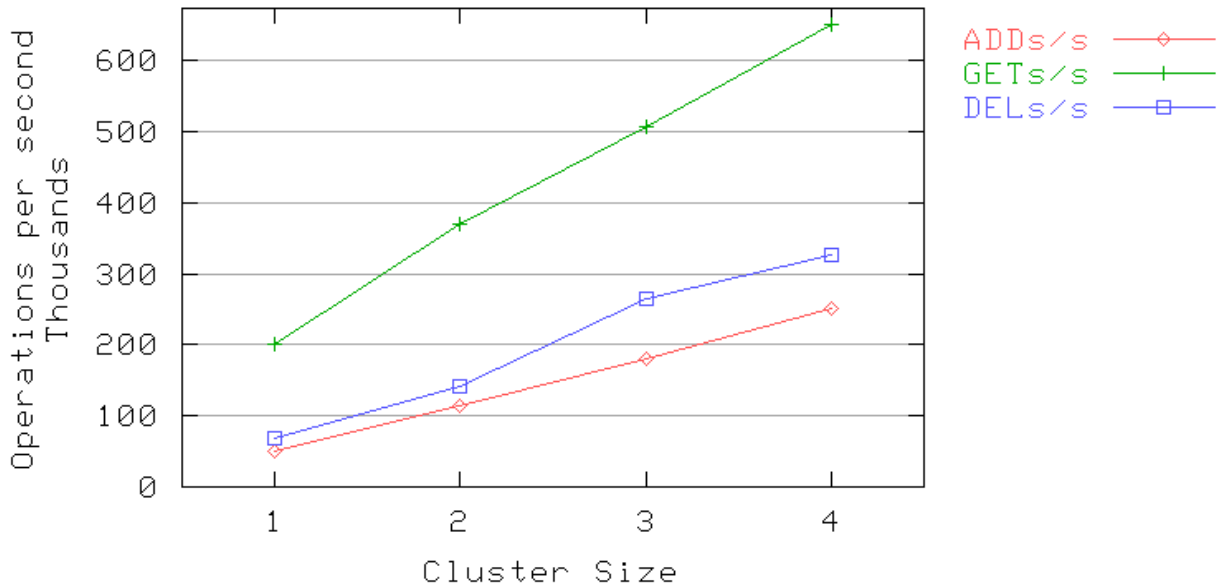


Figure 2: XPress XRN Scalability shows a cluster of 4 Pentium III servers performing 650,000 lookups/second, or 39 million lookups/minute. These tests include round-trip TCP/IP times, running on standard 100mbps Ethernet.

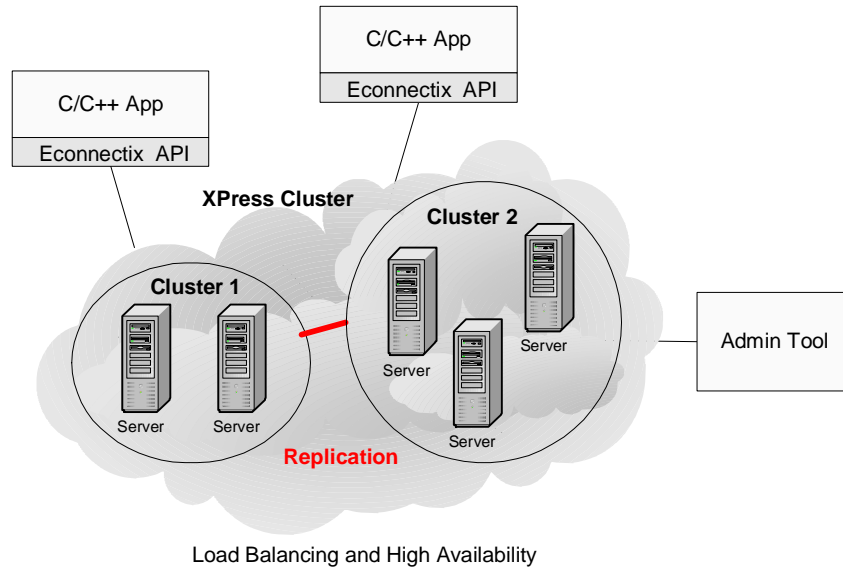
4.3 Availability

Registry services will need increasing availability of critical object information as it becomes distributed. If the object data is not multiply-located, and queries are distributed, aggregate system performance can degrade. Conventional solutions typically include either:

1. Moving registry objects closer to clients for low latency. But distributing data increases update time costs. This design often characterizes the directory solution.
2. Centralizing registry objects to increase performance through hardware and middleware. But centralization increases network latency costs, which can be unsatisfactory. This design often characterizes relational database solutions.

A properly implemented solution would (a) minimize computational and networking overhead to provide efficient distributed or centralized management, (b) provide superior computational efficiencies to drive costs down and performance up, and (c) provide strict modularity to support linear scalability. With the economies provided by XPress XRN, applications may push object tracking to the edge or the center, or combinations of both, while still providing reliable, predictable, and scalable performance.

Figure 3 : XPress XRN High Availability



When files are accessed frequently, they can be moved to closer network caches to reduce latency both for awareness of the networked objects, and for optimal data transfer time.

5 Conclusion

Registry services will continue to require increasing levels of performance, scalability, and availability. Providing these will require database services *designed* for object management in networked environments. Econnectix XPress XRN provides such services using a patent-pending disk-memory-network synchronization architecture that provides breakthrough performance, scalability, and availability for managing small data elements in networked contexts.