

Service Ecosystems will substantially increase the efficiency and economy of future applications and substantially reduce risks from contemporary threats. FineGrain Networks' **Regenerative Service Grid (RSG™)**, the first commercial service ecosystem, permits groundbreaking resource utilization and system security.

Making Grids More Productive to Businesses

Most grids in service today can only be used for a narrow range of problems dealing with compute intensive tasks. This limits grid applicability as many business problems do not fit this category. Architecturally, current grid product offerings are designed to connect servers and distribute parallel parts of work over high speed local area networks (LANs) - substituting cheaper servers for supercomputers. Current solutions typically allow one problem or application to use the grid at any time; significantly reducing business applicability and value for the whole organization.

Businesses require unified, automated, and systematic management of services, with coordination of deployment so the correct service is available at the right time, and with an even distribution of work loads among servers. Current Semantic Grids offer only loose service coordination over wide area networks (WANs), and do not provide coordinated service planning and management. Existing Semantic Grids are resource-inefficient management nightmares.

Service Ecosystems are *Network Resident Software™*

Neither server nor client software, network resident RSG™:

- is a general-purpose, network-aware, application-layer software grid;
- is policy-driven, secure, and self-regenerating;
- understands that server networks are always failing somewhere, and consequently plans for and accommodates for these failures so that delivery of application processing is continuous;
- reduces management/administrative overhead by more than a magnitude.

By providing the groundwork for service ecosystems, RSG™ enables a flexible IT support environment that specifically addresses major issues in building and deploying services today:

1. Many kinds of services concurrently share the grid
2. Services intelligently coordinate utilization of LANS and WANS
3. New services are created rapidly and efficiently
4. Policy and processes are deployed where business activity occurs
5. Every service accounts for, and pays for, the resources it uses
6. Secure data is globally available to any service, anywhere, anytime

1. A Business Services Grid That Supports A Wide Variety Of Services

RSG™ supports loosely-coupled web services, mobile agents, and closely-coupled, co-operative services. RSG™ supports both resident and transient services. Resident services remain in the grid – self managing & regenerating as needed. Transient services deploy only when requested (as for instance, when an event triggers them). When a job is complete, RSG™ removes the transient services freeing resources for additional tasks.

2. An Application Layer Grid That Distributes Services Over A Network

RSG™ leverages network architecture to efficiently distribute work everywhere a firm has compute resources – even to linking every dedicated server in your company within a shared grid. Using properties of Java and C# that allow these modern programming languages to send code “over the wire,” Finegrain Networks’ RSG™ is an application layer grid that proactively deploys services over a global network. RSG™ federates domains of business and IT activity, allowing RSG™ services efficient interaction in Local Area Networks (LANs) while utilizing information, finding resources, and providing services wherever the Wide Area Network (WAN) reaches.

RSG™ applications are designed as sharable sub-parts (Microservices) that run in different servers and intercommunicate over the grid. These Microservices automatically deploy, seek and discover their siblings, the resources they need, and then link-up into an interconnected, distributed application community. A blueprint of the physical & logical network is combined with event driven policy statements to determine what services run where at any given time. Then life-cycle management agents insure that, once deployed, the service is always resident and active on some server in the business domain; if a fault knocks out a server, the service is regenerated on a different server.

3. Rapid Service Development

RSG™ shelters developers from the complex concerns of distributed computing by providing a large number of utility services which together provide the “grid plumbing” for customer developed services. All customer developed services transparently inherit enforced utilization of these common services. This ecosystem of pre-developed, run-time “plumbing services” manages and controls the grid.

In addition, numerous business components are incorporated that provide modern distributed computing templates for meeting business problems. Examples of “business-oriented” components include: Distributed Data, Cooperative Work, Sense and Respond, Device Management, Security, and Accounting. RSG™ supports a wide variety of interaction patterns among services including: nested service transactions, adaptive state machines, and behaviorist (event or message driven) programming. Users can leverage “state-of-the art” biological system analogs (such as an ecosystem of competing

agents, cooperative social insects, or the central nervous system), to generate extraordinarily stable systems that exhibit desired “emergent” behavior.

Developers work with language standards (Java and C#) in familiar desktop development environments. FineGrain Networks provides a library from which customer developed services inherit the characteristics that enable and enforce interaction with the grid plumbing. Component organization trims the number of new interfaces developers must learn. New service development consists of simply inheriting a service type, selecting the interaction pattern template, adding data interfaces, selecting resource service interfaces, and encoding business policy in Event/Condition/Action (ECA) statements. New applications can be designed, developed, and deployed in days to weeks.

4. Coordinating Business Processes

With RSG™, virtually any business application can be re-engineered to run over the grid. For example, RSG™ is especially effective at coordinating business processes over global reaches. Instead of backhauling messages to a centralized rule server containing thousands of conflicting policy statements, with RSG™ many single-process, policy agents are deployed to where their domain of business activity physically occurs; these agents interact to establish decentralized, coordinated behavior. RSG™ will collect information from local sensors and from users and immediately apply local policy to invoke local actions; while concurrently coordinating group actions with distant business domains.

5. Accounting for Use and Needs

RSG™ incorporates a comprehensive “utility accounting” infrastructure into its architecture. Every service provides periodic resource utilization data to the accounting component. An embedded Micropayment protocol allows multi-party transactions to account for resource usage; for instance, the provider of a service, the providers of resource services used by that service, the container/server hosting the service, and the network utilization can separately “charge” the user for their part in delivery of the service. Accumulating over time, this provides accurate ROI information for every part of the grid and every application built with RSG™. This allows management “to push a button” to mine usage/value information, and apply this to more effectively target internal users needs.

6. Presenting Data as a Service to Other Services

One of many FineGrain Networks components, the Dispersed Data Grid represents data as a service to other services. The policy and processes involved in securing data, finding data, changing data, and the authorizations for data access and change are indelibly incorporated in the data service. The data grid allows hundreds/thousands of databases to be interconnected, sharing load and providing scalability. The data grid also supports data stores other than data bases, such as directories, file systems and tuple spaces.

Improving Reliability and Security

The full environment in which business live and work today is fraught with risk elements; many are not controllable by the corporate entity. Facing hard reality, both our public and private enterprises cannot ignore the threat of unexpected intrusions that result in both isolated & large-scale destruction of infrastructure services. Sometimes disruptions are direct, internal and localized; yet also today, disruptions occur because of large-scale slowdowns or failure of critical public infrastructure (provider networks, power grids, transportation systems). With RSG™ you can build systems that instantaneously recover from all kinds of failure situations: from a simple server fault to a natural disaster. RSG™ applications systems are secure and self-healing, recovering from partial or system-wide failures in software modules, server platforms and network connections. The service grid is self-managing and self-healing – yet, when problems occur that require human input or are beyond policy parameters of automatic response systems, RSG™ components automatically assemble the correct system management team in a shared group workspace with full data and tools to respond.

A comprehensive security model (comprising the systematic application of structural security and adaptive encryption) ensures that RSG™ service grids remain private and secure. Via inheritance, all services maintain an active connection to security watchdogs – utility security services that enforce security policies. These security methods supersede common “band-aid like” methods such as firewalls. Various services also watch for and trap unauthorized intrusion - invoking automatic defense services when intrusion is discovered. For example, RSG™ agent technology allows event-initiated swarming of counter-intrusion agents throughout the network grid.

Yet our security never locks system managers and developers out of necessary changes that otherwise might hinder application evolution. Precisely because critical applications must adapt quickly to changing needs, RSG™ architecture supports linear scalability, business flexibility, and on-the-fly problem-solving capabilities.

Example services

- **Re-locatable services:** RSG™ can deploy web service and agent applications as needed anywhere on a server network. Deployment can be based on event triggers or schedules. Deployment can be demand driven or based on user requests. With this technology, corporations can deliver service functionality with extremely low latency anywhere in the world.

- **Mission critical services:** using our agent management system we provide survivability of services (both web and closely-coupled) – on fault they are regenerated on different servers. This provides service applications with extraordinary reliability, providing survivability of business service applications during blackouts, isolations, and other disruptions. For example: if a data center loses power, remote areas sense this and RSG™ applications are automatically relocated elsewhere in the grid network and continue processing. This happens in a few seconds.
- **Dispersed Data Grid:** With the RSG™ Dispersed Data Grid, a firm can turn its existing network into one gigantic, secure data repository. Further, each node optionally could participate in controlling parallel distributed transactions, making the data throughput truly remarkable. Users can access any data to which they are authorized, anywhere in the world – without knowledge of its storage location or its organization. This considerably expands upon more primitive information services such as search engines limited to HTML content. It releases database programmers from tight coupling to existing data organization and data location.

Examples of telecom uses

- **Integration services:** The principle systems problem facing telecommunication providers is integrating a vast collection of isolated (silo) applications that have arisen through product purchases from different vendors, integration of different network/product technologies, and mergers. RSG™ leverages the industry acknowledged, leading integration approach, the TeleManagement Forum's NGOSS standard, as a starting point for integration. Using techniques pioneered in the ground-breaking Finegrain NGOSS Catalyst, networks, services, and customers can be interlinked and coordinated via distributed processes and policy.
- **Forward deployed device management:** With its understanding of LAN and WAN architectures, RSG™ supports the forward deployment of servers into POPs. Acting much like Internet middleware services (DNS, Directories, Mail, etc), these servers host re-locatable management services. As a device is added to the POP, the correct device management service and proper processes and policy are remote-loaded into servers adjacent to the device. These form a local, first approach automation to clear many problems on site, without operator intervention, and without network lags. Only events complex enough to require human or system-wide response are forwarded to the collaborative work system.
- **Collaborative Work:** RSG™ replaces the outmoded trouble ticket system (with its single individual action, hand-off, workflow methodology) with a collaborative, team approach to problem resolution and restoration. RSG™ supports event analysis and responding automatic deployment of policy based procedures and real-time selection of a team (from those who are

available, nearby, have the correct experience & skill, and proper job roles). This team is provided with all the information, tools and the established process for responding to this event in a collaborative group workspace which coordinates a team's communication. This was designed from actually observing how NOCs respond to alarms and realizing trouble-tickets systems get in the way of natural team responses. When coordinating with other networks and providers, teams are interlinked to form larger control teams.

- Everyone intercommunicates via a group workspace, accessing current and accumulated data. Actions are invoked automatically by events as they occur and processes adapt as circumstances change.
- QoS thresholds and procedures are automatically linked into process controls and relevant management and customer contacts are appraised of the event and progress toward restoration.
- **Gateway Services:** RSG™ incorporates the ability to support and interlink many different logical and physical domains. It understands that networks interconnect with specific protocols and process that require data transference with translation and security modifications. RSG™ deploys gateways that adjust to a wide variety of interaction patterns and provide a security membrane against unwanted intrusion.
- **Distributed SIP/Integrated NGN (triple play plus):** FineGrain Networks understands the importance of SIP signaling and architecture as well as 3GPP IMS, MS CFS, and NGOSS & OSS/J for delivering Convergent technology Next Generation Networks (C-NGN); so we build native services which support these. RSG™ provides reliability, security, interoperability, scalability, performance, and significant reductions in network back hall to SIP and IMS services. RSG™ is the optimal environment for delivering, not just the management of C-NGNs, but the implementation of the new products and services that utilize C-NGNs.
- **Hosting New Services:** RSG™ provides a natural, multi-party service design and delivery ecosystem where 3rd party service developers co-exist with grid & hosting companies and network service providers. RSG™ Utility software provides (1) accounting and security indelibly linked to service via leasing; (2) hosted connections, hosted containers and hosted services; (3) micro-payments covering multi-party transactions. Services deploy when triggered by users or events. As they deploy, services make use of their awareness of the service and communications grid, loading into servers and building network QoS connections as needed. RSG™ user driven, network aware software contains pre-built services that support: deployment, provisioning (customized for user/location), billing, and when their mission is completed, the clean up of software services. RSG™ provides a policy driven, coordinated use of compute resources that supports virtual resource market pools and positions the service provider to meet this emerging market with an order of magnitude lower systems TCO than competitors.