



Feature Focus

The **CommuniGate Pro**  
*Dynamic Cluster*

July 2010



**CommuniGate**  
SYSTEMS

**Feature Focus | The CommuniGate Pro Dynamic Cluster**

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## Feature Focus | The CommuniGate Pro Dynamic Cluster

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### 1. Executive Summary

This paper discusses the unique and powerful benefits of the **CommuniGate Pro** Dynamic Cluster feature for SaaS hosting providers.

For large scale, in-the-cloud (SaaS delivered) Unified Communications solutions with exceptional performance, efficiency and reliability, **CommuniGate Pro cannot be beaten**; indeed, CommuniGate Pro has achieved numerous world records for scalability.<sup>1</sup>

Supporting over 150 million subscribers at more than 12,000 customers around the world, the single system image architecture is proven in the field to reduce operational cost dramatically compared to other technologies.

CommuniGate Pro delivers exceptional features and dependability, in a massively scalable, industry proven architecture that is ideal for Cloud Computing, or SaaS providers. CommuniGate Pro manages deployments in excess of 100,000 individual domains or “virtual instances of customers”, each having their own set of users, branded logon pages, features, administrators and users all within the single system image Dynamic Cluster.

### 2. Why is the Dynamic Cluster important?

By the very nature of being a SaaS solutions delivery business implies there is a highly dependable infrastructure behind the applications servers to the subscribers. The trend towards SaaS also means that Network Operators and ISPs have to consider platforms that are truly made for hosting and virtualization of many customers on a single system that is manageable at extreme scale.

On-premise or “Enterprise Class” platforms are not typically designed by nature to be a hosting platform. These technologies are meant to be in a single enterprise with a large IT department managing the system. These systems can have “planned downtime” and change management windows unlike a large SaaS platform which must be operational 100% of the time. Furthermore, on-premise solutions do not have the APIs and other technologies a SaaS provider needs for their most important application; billing - since most Enterprises are not billing anyone externally!

The CommuniGate Pro Dynamic Cluster technology is a unique clustering architecture in that all of the nodes in the cluster are “active”. Many cluster technologies are “fail over” or hot spare architectures. The Dynamic Cluster is completely the opposite; all systems in the cluster join together to form a single entity, and all the nodes share loads. Also, every node in the Dynamic Cluster has a unique capability to be removed or added into the Cluster, allowing for the administrator to add capacity or remove nodes for change management. The capability to add nodes while the system is hot or running is the dynamic nature of the technology and allows expansion of system capacity to occur on the fly.

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<sup>1</sup> <http://www.communiGate.com/carrier/scalabilityleader.html>

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The CommuniGate Pro Unified Communications platform is built to be a hosting platform for highly efficient large scale SaaS delivery. The key benefits of the Dynamic Cluster and topics of discussion in this document are:

1. Change Management
2. Single system image
3. High density and efficient use of servers
4. Predictable and near linear scaling
5. High availability

### 2.1 Change Management

Hardware or software maintenance changes or updates can impact the uptime of systems. This impact is often called “scheduled downtime” in the Enterprise IT world. Unfortunately, it is not possible to have periods of service interruptions in the carrier class SaaS marketplace. Can you imagine your home phone provider calling you to say there will be scheduled downtime on Saturday?

To eliminate Scheduled Downtime, the CommuniGate Pro Dynamic Cluster uses a Rolling Updates feature to allow software or hardware changes to occur without any interruption of subscriber services. The rolling updates feature allows system administrators to deactivate a cluster member and dissipate open connections onto other cluster members until the server is fully offline and can be serviced.

### 2.2 Single System Image

CommuniGate Pro is an extremely reliable SaaS delivery platform. It provides a Dynamic Cluster feature to enable the provider to see the entire system as a “single image”, even if the system is 40 or more servers. The CommuniGate Pro Dynamic Cluster provides a huge advantage for hosting because at scale the management is many magnitudes less intensive when compared to enterprise class systems.

When providing Unified Communications to micro and small businesses the provider must have sheer scale in order to make a profit. Therefore, it is easy to imagine a case where the provider might have 20,000 small companies of 5-30 users each virtualized in the CommuniGate Pro Dynamic Cluster. Management of such a quantity of subscribers on the CommuniGate Pro platform is common practice for our customers, as the technology allows the administrator to see the system as one and use the powerful Class of Services tools and self-care delegation features. However, an IP PBX or Messaging product that is not designed to be a SaaS delivery platform becomes very problematic to manage and monetize at scale because there are so many “moving parts” – Proxies, DB servers, directory servers, media gateways, and much more.

CommuniGate Pro’s Dynamic Cluster is an elegant solution at scale that can grow with your business in a predictable manner.

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### 2.3 High Density and Efficiency

The CommuniGate Pro Unified Communications platform is extremely efficient, which results in a higher density of subscribers per server compared to Enterprise Class technology. Density in the data center is crucial to reducing complexity, administration efforts, power, cooling, and more. By having a high density per server capability, CommuniGate Pro can maximize profits for the hosting provider.

On most carrier class 64bit operating systems such as Solaris, Linux and BSD, CommuniGate Pro can reach over 90,000 connections per system. CommuniGate Pro has field proven deployments in excess of 450,000 users per system. The density and performance of CommuniGate Pro is world renowned and unchallenged. CommuniGate Pro holds world records for density under Spec.org and has publically released various benchmarks attesting to its superior performance, efficiency and density capabilities. These results and publications can be read at:

<http://www.communiGate.com/carrier/scalabilityleader.html>

### 2.4 Predictable Scaling

The CommuniGate Pro Dynamic Cluster is a horizontally scaling architecture. To increase system capacity all that is required is to add low cost blades or “pizza box” style servers. Unlike more computationally intensive architectures, it is not recommended to use large capacity servers like 8way machines. As an example, a 4x4 Dynamic Cluster with 2CPU servers is more ideal than a 2x2 Dynamic Cluster with 4CPU systems. The reason is that in the 2x2 Dynamic Cluster you have 50% of your capacity on the backend level on a single system and if it fail, you have 100% of the load on a single machine. In the 4x4 Dynamic Cluster, you have only 25% of the load for either the front or back layer on any one server.

Since CommuniGate Pro is very efficient and highly threaded taking advantage of all CPU and Memory resources scaling is predictable and near linear. Every node in the Dynamic Cluster runs the same CommuniGate Pro software binary and as a result there is no mismatch of performance from one server to the other. In other architectures, where there are many different types of servers and software running, you find that performance form server to server can radically differ. The elegance of the CommuniGate Pro Dynamic Cluster allows the ISP or Network Operator to chose and predict resources, whether it be blades, servers or storage requirements for future growth.

### 2.5 High Availability

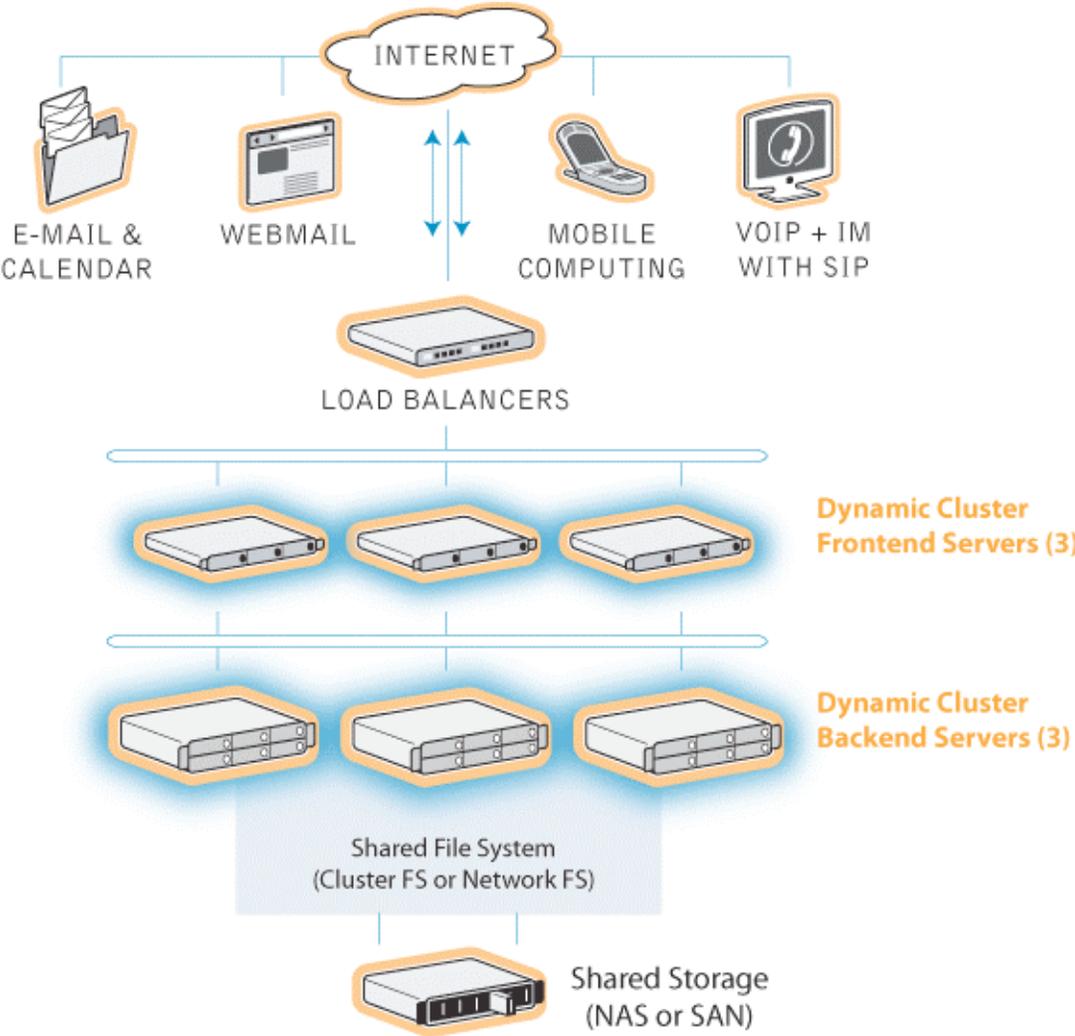
The Dynamic Cluster has one more powerful feature apart from those we have discussed already; to ensure uptime in the event of failures of server/s, the Dynamic Cluster nodes are all active. In the event one or more servers fail, the other nodes in the Dynamic Cluster assume the load of subscribers on the system.

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### 3. Dynamic Cluster Architecture

The basic layers needed to build a Dynamic Cluster solution include the following elements:

- 1. Load Balancer/s
- 2. Network Topology
- 3. Frontend Servers
- 4. Backend Servers
- 5. Shared Storage System NFS/CFS



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### 3.1 Load Balancer

Because the Dynamic Cluster can contain many servers it is necessary to use a load balancer so subscribers can access the services from one URL or IP. The CommuniGate Pro Dynamic Cluster is deployed in over 100 sites around the world using a variety of load balancer technologies and brands. We recommend using a quality high throughput device with Layer four features such as Cisco, F5, or Foundry. More information about configuration tips and recommendations for load balancing equipment can be found at:

- <http://www.communiGate.com/CommuniGatePro/ClusterSignals.html#SIPSingleIP>
- <https://support.communiGate.com/docs/CommuniGatePro-Best-Practices-Ports-Firewalls-LBs.pdf>

### 3.2 Network Topology

The Dynamic Cluster should have several networks in this topology for security, performance, and manageability. You will need to have a least four separate networks and dedicated high speed switches for optimal performance of a CommuniGate pro Dynamic Cluster. We recommend Cisco, Foundry, HP, or similar switches that have Gigabit speeds and backplane interconnects when spanning more than the physical ports. There are lots of switch of models in the market than can be adequate. To help you with some reference points a Cisco Catalyst 4948 10GE is a good high-speed switch than can be used for the various networks used with CommuniGate Pro. However, for the "Storage Network" we recommend fiber connections to the NAS head or 10G Ethernet. If you have a larger Switch that is modular, for example the Catalyst 6500 series, it is possible to use WS-X6716-10G expansion cards for 16 ports of 10G.

Each Server in the cluster should have at least three Network ports available for configuration. The following Networks should be established for the proper Dynamic Cluster Network Topology:

- Public Network – This is the externally facing Network, on a routable IP block, normally with one or more IPs assigned to the Loadbalancer on the "external interface" All Frontend Servers in the Dynamic Cluster will have one Network Interface with an IP on this network and a DNS entry. As an Example, you might have 3 Frontend servers, and one Loadbalancer. So the IPs might be something like this:

Loadbalancer IP 64.10.x.x. resolving to UnifiedComs.domainname.com

Frontend1.domainname.com ---→ 64.10.x.x

Frontend2.domainname.com ---→ 64.10.x.x.

Frontend3.domainname.com ---→ 64.10.x.x.

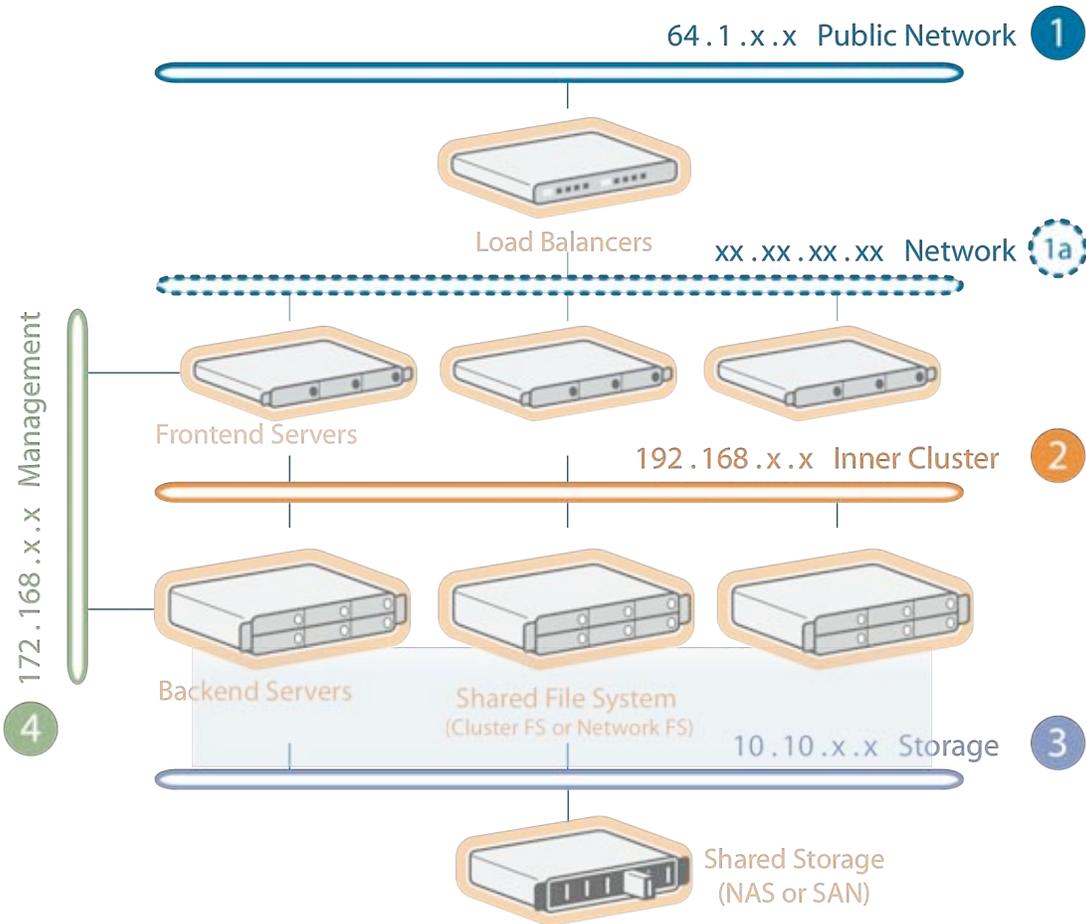
External subscribers to the system would configure their clients to use UnifiedComs.domainname.com in their IP Phones, Pronto! or e-mail clients. The Loadbalancer would distribute these requests across the three active frontend servers.

- Inner Cluster Communications Network – This private network, using non-routable IP address blocks (such as 192.168.x.x.) is used for the cluster members to communicate with each other. No other traffic should be put on this private network. Frontend servers should have a second interface configured with an IP.

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- Storage Network – This private network, with a non-routable IP block (such as 10.10.x.x) is used only by the backend servers to communicate with the shared storage system. This network should be high speed, Fibre or 10GE.
- Management Network – This private network might be the shared LAN of the Operator or ISP NOC (Network Operations Center). This could be another non-routable Network (such as 172.16.x.x.) Each server should have another network interface configured so administrators can have access to the Administration UI or APIs for provisioning, billing, and other management duties.

Note: There may be times when a fifth network is used for management of the server at the OS/BIOS level. Many Sun and HP servers have a “lights out” port that can be connected to secure VPNs or terminal servers used to gain access to the machine in the cases where there are connectivity issues or the server hardware or power has failed.



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### 3.3 Frontend Servers

In a CommuniGate Pro Dynamic Cluster, the frontend servers have the following tasks:

1. Perform SMTP mail exchange with other servers on the Internet (SMTP MX).
2. Handle real-time communications like SIP signaling and PBX voice applications. (On real-time clusters these functions are synchronized between nodes; this is called a SIP-Farm.)
3. Manage the border security for incoming connections. This include all the Edge-Gate Controller functions like RBLs, Flow control counters, network black/white listings, and RFC reading, to name a few.
4. Host client-server incoming user connections (such as IMAP, POP, HTTP and XIMSS). The frontend server then connects to the backend servers for just the “pure” data.
5. Process SSL connections.

### 3.4 Backend Servers

In a CommuniGate Pro Dynamic Cluster, the backend servers are the core of the platform.

The backend servers are responsible for storing and managing:

1. Domains configuration
2. Accounts, ACLs and preferences
3. Account messages and objects
4. Additional cluster objects
5. Cluster management
6. Authentication
7. Provisioning
8. Web data files served (WSSP)

A feature of CommuniGate Clusters is “Account-Level Synchronization” which guarantees that only one backend server will access an account at any point in time (within each 6-second period). CommuniGate Pro therefore **eliminates (filesystem-based) file locking** (except the heartbeat.data file which does use a file lock to allow the Cluster Controller to “hold” Cluster control). Because the Dynamic Cluster controls files itself and does not rely upon File Locking from the OS/FS performance on NFS can be 5-7x higher. Thus, we recommend using NFS to reduce complexity costs and to apply more budgets to spindles that increase performance dramatically.

CommuniGate Pro’s Cluster technology supports rolling updates and automatic recovery from the failure of any node of the cluster in any given time; the minimum recommended configuration for this is a 3x3 Cluster (three frontend servers and three backend servers). However, for maintenance or any intentional downtime it is still recommend to shut down systems “gracefully” with the “Make Not-Ready” option from the Webadmin page Monitors/clusters.

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### 4. Cluster Configuration Installation Step By Step

The most critical hardware component in a Dynamic Cluster is the storage system.

Either an Appliance based NAS solution or SAN solution are greatly recommended for a high capacity cluster.

Some operating systems are better suited for NAS or SAN depending on the available options for the data storage like network file system protocols (native and third party), advanced file systems, and CFS (cluster file systems).

1. Network
2. Operating system tuning
3. File system selection and Shared Storage configuration
4. Operating System pre-requisites
5. CommuniGate Pro configuration

#### 4.1 Network

CommuniGate Pro Dynamic Clusters are very flexible about network topologies and configurations such as:

1. Full NATed sub-network setups (load balancer, router or firewall routed).
2. Direct WAN IP addresses setups.
3. Mixed networks setups like leaving the frontend servers on a DMZ and the backend servers in a more restricted private network.

CommuniGate Pro can handle hundreds of IP addresses allowing IP binding to specific domains.

The safest approach to a Dynamic Cluster network is to NAT within the Load Balancer the services from a private network block leaving plenty of local IP addresses to assign to domains, servers administration, OS control, and Storage management.

The load balancer only publishes a WAN IP or a group of WAN IPs for the Cluster.

#### 4.2 Operating System Tuning

Depending on the Operating System used the administrator can enhance the performance of the Cluster without adding more hardware. Typical things to adjust include:

1. Number of open files limits
2. Number of processes allowed for a user
3. Network buffers and cache
4. Kernel Network handlers and counters
5. Memory settings for file system cache

The exact settings are different for each installation, concurrency expected, shared storage used, and OS/hardware selection.

Always check with your OS vendor about side effects of the additional tunings proposed.

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### 4.3 File System Selection

The file system options to use in a CommuniGate Pro Cluster really depend on the Operating System and Shared Storage technology used. Any candidate has to be able to:

1. Support concurrent multi-node read-writes to the same directories
2. Handle millions of small files in the same file system
3. Support 10000~ files in a single directory
4. Support paths much longer than 255 Bytes
5. Support multi-bytes characters in files and folders

### 4.4 Operating Systems Pre-Requisites

The Operating System pre-requisites for a CommuniGate Dynamic Cluster installation are:

1. Setup the Hostname of the server node accordingly with the main domain name of the master key (For example: frontend1.dominame.com).
2. Every administration IP address assigned before installing CommuniGate Pro.
3. No other MTA server installed or active in the system.
4. Hosts file definitions according to the administration IP addresses for the cluster nodes.
5. DNS servers configured in the host OS.
6. No firewall enabled on the platform at the time of install. (This can be enabled later.)

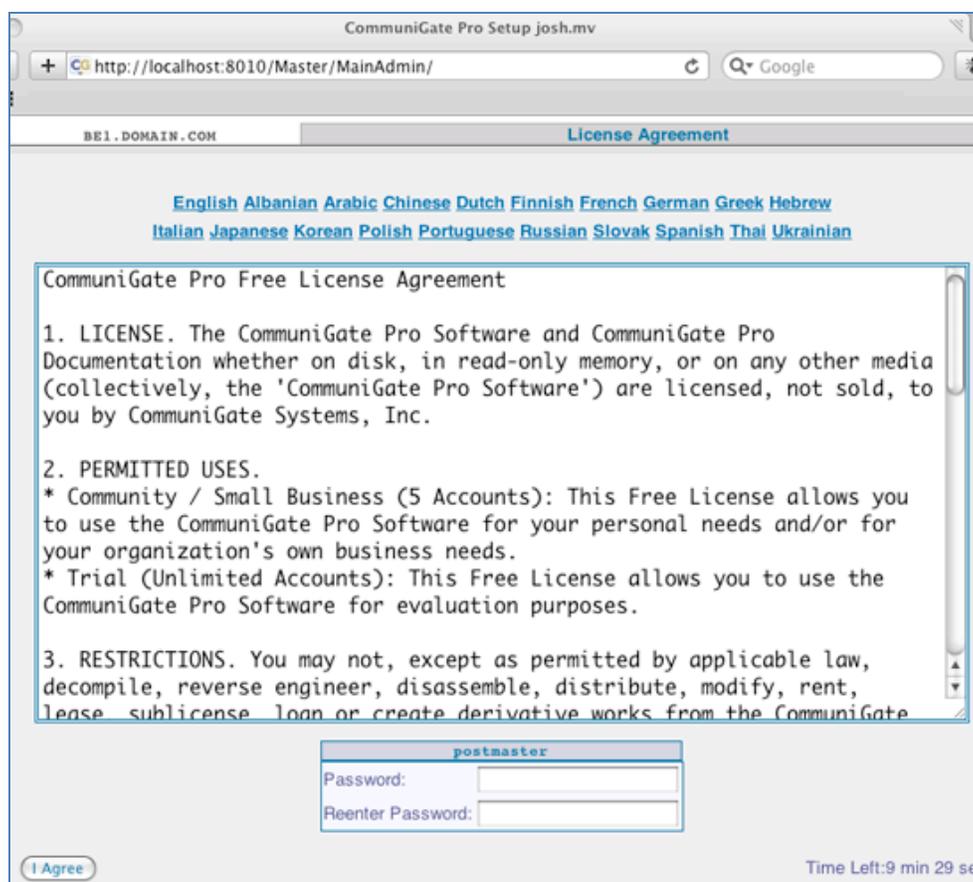
**It is also highly recommended for the backend nodes that the Shared Storage is tested and benchmarked thoroughly before installing CommuniGate Pro and setting up the Shared directory mount point.**

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### 5. CommuniGate Pro Cluster Configuration Part 1

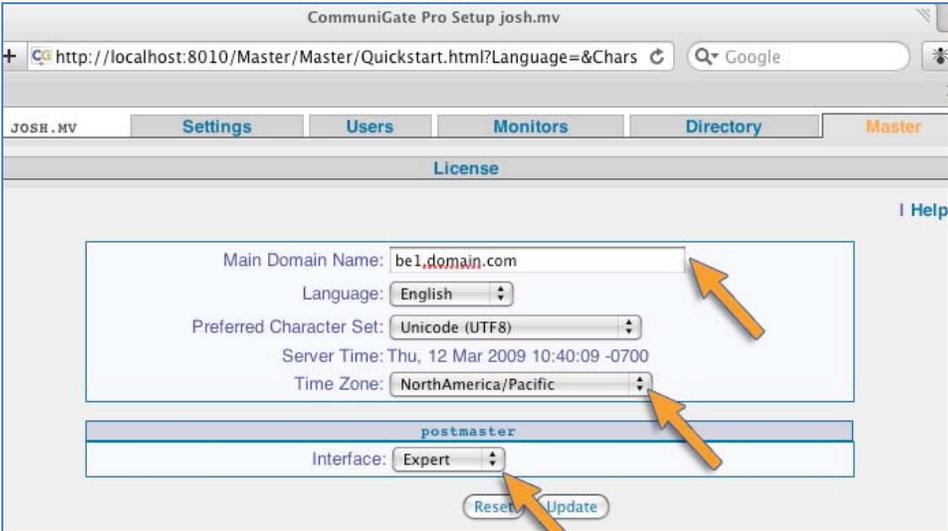
Steps for setting up a cluster:

1. Install CommuniGate Pro on every node, without starting the COMMUNIGATE PRO service.
2. Configure only one node at a time.
3. Start CommuniGate Pro.
4. Accept the license agreement and set the postmaster password.

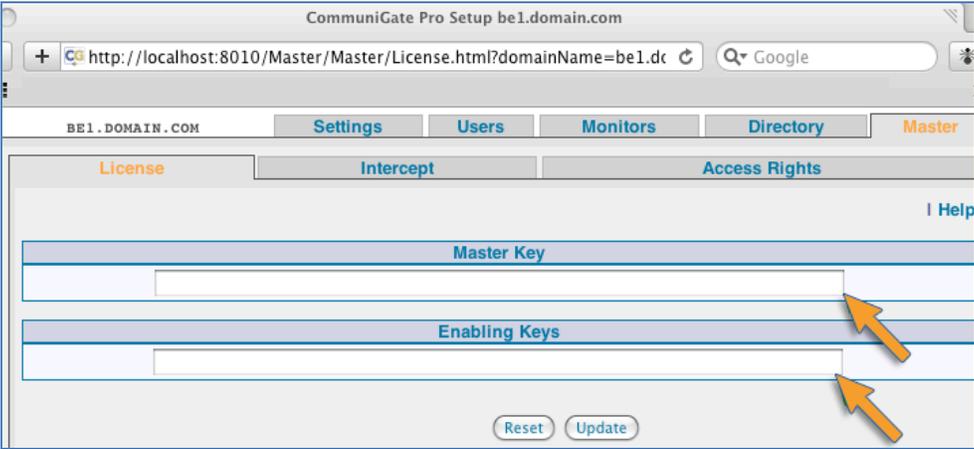


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- 5. Set the main domain of the node according to the \*.domain.com present in the master key.
- 6. Define the time zone and set the interface layout to expert.

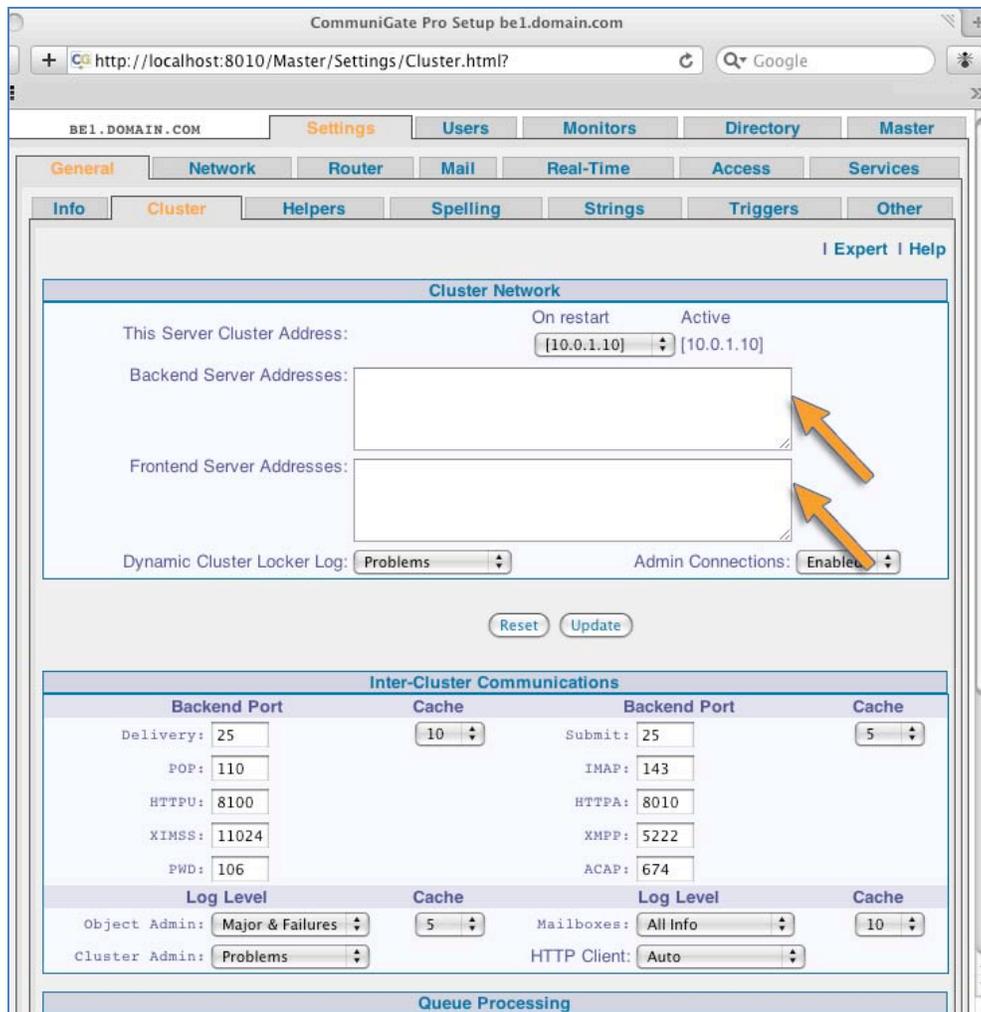


- 7. Install the license numbers on the node (Webadmin> Master/license).



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8. Add the IP addresses of every backend and frontend server in the Webadmin>Settings/Cluster page of the node including their own.



9. Shut down CommuniGate Pro.

Then proceed to the next node and repeat this procedure.

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### 6. CommuniGate Pro Cluster Configuration Part 2

```
Terminal — vim — 64x28
SUPPLPARAMS="--ClusterBackend"
"Startup.sh" 2L, 32C written
```

Create a startup file (Startup.sh) inside the CommuniGate Base directory.

On the backend servers modify the startup script (Startup.sh) to include inside the SUPPLPARAMS line:

```
--ClusterBackend
```

Modify the same startup file on the frontend servers. Replace the last parameter with:

```
--ClusterFrontend
```

Set up the shared storage mount points on the backend servers (/“CommuniGate Pro Base directory”/SharedDomains ). Frontend servers do not need to mount anything from the Shared Storage.

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(Optional) Create a flag file in a backend server under the shared storage and then check it on a different backend server. If this simple test works the shared mount points are correct and you can proceed with the next steps.

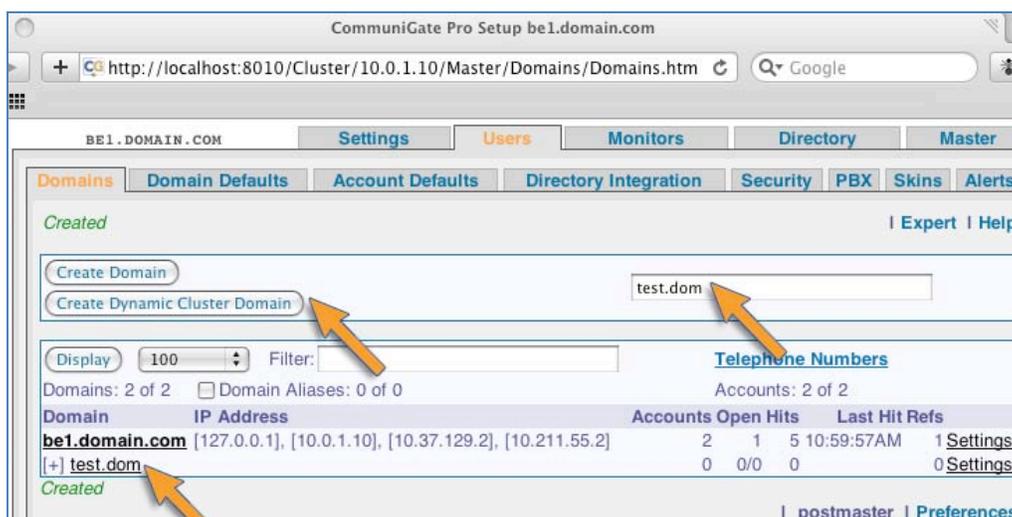
For additional information about the startup file or related tuning settings refer to:

- <http://www.communiGate.com/CommuniGatePro/Scalability.html>

### 7. CommuniGate Pro Cluster Configuration Part 3

Start CommuniGate Pro ONLY on one or the first backend server. This will activate the server as the controller. The other nodes will know this server as the “controller backend” as they come online. This role is dynamic and will be automatically passed to another backend server if the controller fails.

1. Login to the Web Admin Interface and go to the Users tab. A new button entitled “Create Dynamic Cluster Domain” should appear.
2. Create a dynamic cluster domain: test.dom.

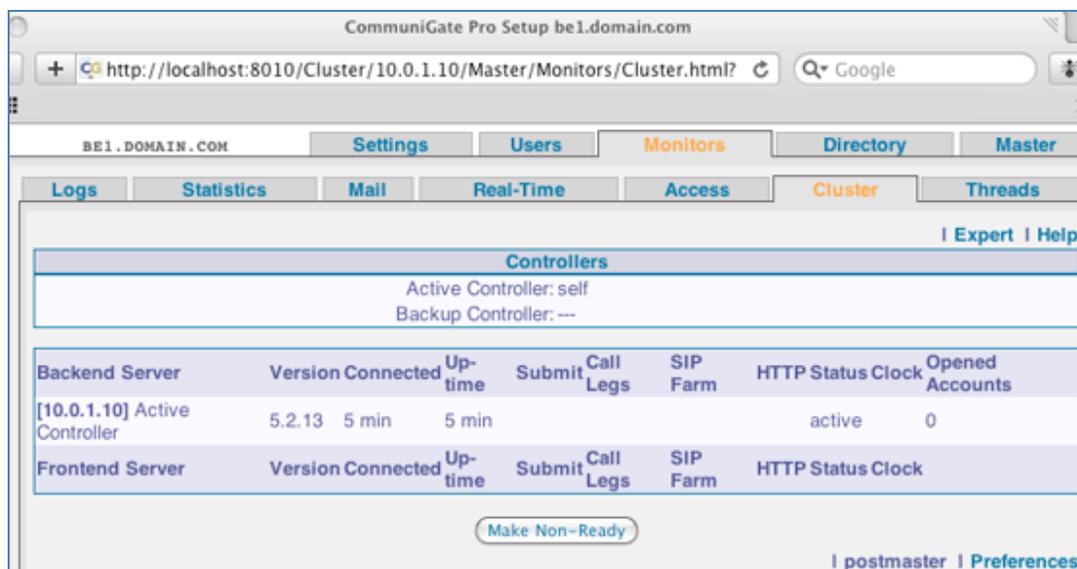


3. (Optional) Go to the OS and check if the domain was created well under the shared storage: `"/COMMUNIGATE PRO Base Directory"/SharedDomains/test.dom`.

(Optional) Check that the shared domain exists from another backend server. If it's visible then everything is OK.

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### 8. CommuniGate Pro Cluster Configuration Part 4



Start all the frontend nodes one by one about one minute apart.

On the controller backend, go in the admin to Webadmin>Monitors/Cluster and check for the frontend servers you just started. Their status should be "READY".

Start one additional backend server and check it on the controller's Webadmin>Monitors/Cluster. If the backend server was added properly it will be named as "Backup Controller".

Start additional backend servers one by one a couple minutes apart.

At this point the Webadmin>Monitors/Cluster page should report every node up and running.

### 9. Conclusion

The CommuniGate Pro Dynamic Cluster technology is the best choice for large scale SaaS providers that require extreme efficiency and reliability. Not only does the hosting platform hold the current world records for scalability, but the single system image architecture is proven in the field to reduce operational cost dramatically compared to technologies that are made up of various interfaces and management consoles. To learn more [contact one of our regional offices today](#).

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### APPENDIX Hardware Best Practices

The hardware platform definition depends, obviously, on many parameters. The platforms recommended below are based on two standard profiles in order to provide a high level idea of what types of equipment and architectures are “best practices” known to work well in the field. Below are situations that must be taken into consideration for capacity planning:

- The type of services that will be provided by the Dynamic Cluster (Email, VoIP, Mobile Synchronization, HD Audio/Video, Flash Client Pronto!, Number of Conference Rooms, and file storage (eDisc) load ...).
- For “real time” (VoIP/ IM / Presence services) traffic, the use of Media relaying/transcoding features will have. In standard or ideal situations, the audio and/or video media streams are going point to point. But depending on the network topology (NAT/Firewall) or the type of client used (using and incompatible CODECs ..) some or all the media streams might have to be handled by CommuniGate Pro Dynamic Cluster, therefore impacting the H/W dimensions.
- The number of subscribers, with a break down per features should be put into a profile matrix, with concurrency rates at peak hours defined.
- The usage pattern (how many concurrent connections, at the busy hours, number of call attempt per second, number of mobiles synchronized at a given moment in time, number of IMAP connections, average number of download & download size on eDisc).

All these parameters need to be computed in order to build the best “base” system to support the necessary features. Based on these parameters and our large customer base with deployments of Dynamic Clusters, the CommuniGate Systems team can assist you dimensioning the most appropriate platform matching your subscriber base service footprint (real or projected).

You can find sample hardware configurations below based on some “real world” cases.

#### CASE1: Email Service with Push Capabilities and Instant Messaging

Subscriber Type	Subscribers
Total Subscribers	70000
POP (POP/POPS)	70000
IMAP (IMAP/IMAPS) & Collaboration (MAPI/MAPI-SSL)	70000
Webmail (HTTP/HTTPS) & Pronto!	70000

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Subscriber Type	Subscribers
Mobile Subscribers	5000
Instant Messaging (SIP/XMPP) & Presence	70000
Internet Telephony (VoIP) end to end	0
PSTN Telephony (VoIP) DID/Extension	0
Voicemail	0
PBX-Auto attendant-IMS	0
Conference calling	0
Antispam/Antivirus	0

Expected type of traffic and its % on the total:

Protocol/Access Method	Approximate Percentage of Total Traffic (%)
POP (POP/POPS)	20,00%
IMAP (IMAP/IMAPS)	20,00%
MAPI (MAPI/MAPI-SSL)	5,00%
Webmail (HTTP/HTTPS)	35,00%
Signal	20,00%

The total number of estimated concurrent users (how many users logged on at any point in time): **4.000**

### Recommended Architecture:

The initial system is configured to support up to 70.000 users and will comprise **three** Frontend servers and **three** Backend servers (3 x 3 layout) based on the unique field-proven CommuniGate Pro's Dynamic Cluster technology.

#### Frontend Servers

##### **HP DL380G6 X5550**

Processor(s): 2 x Intel® Xeon® Processor X5550 (2.66 GHz, 8MB L3 Cache, 95W, DDR3-1333, HT, Turbo 2/2/3/3)

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Memory: 12 GB

Network Controller: 2 x HP NC382i Dual Port Multifunction Gigabit Server Adapters

Storage Controller: HP Smart Array P410i/512MB with BBWC

O.S.: SuSE or Redhat Linux 64bit

### Backend Servers

#### **HP ProLiant DL580G5 X7460 16GB (4P)**

Processor(s): Intel® Xeon® X7460 (6 core, 2.67 GHz, 16 MB L3, 130W)

Memory: 16 GB

Network Controller: 1GbE NC373i Multifunction 2 Ports

Storage Controller: Smart Array P400i/512MB BBWC

O.S.: SuSE or Redhat Linux 64bit

Growing up to 100.000 the architecture suggested is Four Frontend servers and three Backend (4x3) and in case of 200.000 users Six Frontend servers and Four Backend (6x4) are suggested.

### **CASE2: VoIP Platform with Pronto! As Softphone Client, High Definition Audio with Media relaying**

Subscriber Type	Subscribers
Total Subscribers	2,000,000
Internet Telephony (VoIP) end to end	90,000

Expected type of traffic and its % on the total:

Protocol/Access Method	Approximate Percentage of Total Traffic (%)
RTP (Audio, iSAC Codec)	80,00%
XIMMS (Signaling, tcp connection)	20,00%

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The total number of concurrent calls: 9,000 calls  
The total number of open client sockets (open clients): 90,000

### Recommended Architecture:

The initial system is configured to support up to 2,000,000 users and will comprise three Frontend servers and three Backend servers (3 x 3 layout) based on the unique field-proven CommuniGate Pro’s Dynamic Cluster technology.

#### Frontend Servers

**DELL PowerEdge R710**

Processor(s): 2 x Intel® Xeon® Processor X5550 (2.66 GHz, 8MB L3 Cache, 95W, DDR3-1333, HT, Turbo 2/2/3/3)  
Memory: 24 GB  
Network Controller: 2 x HP NC382i Dual Port Multifunction Gigabit Server Adapters  
Storage Controller: HP Smart Array P410i/512MB with BBWC  
O.S.: SuSE or Redhat Linux 64bit

#### Backend Servers

**DELL PowerEdge R710**

Processor(s): 2 x Intel® Xeon® Processor X5550 (2.66 GHz, 8MB L3 Cache, 95W, DDR3-1333, HT, Turbo 2/2/3/3)  
Memory: 16 GB  
Network Controller: 1GbE NC373i Multifunction 2 Ports  
Storage Controller: Smart Array P400i/512MB BBWC  
O.S.: SuSE or Redhat Linux 64bit

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### APPENDIX Storage Best practice

Inside CommuniGate Pro, it is a prerequisite that all Account storage should be shared (with exception of Accounts in the "Main Domains" or other non-shared Domains, which usually do not exist).

CommuniGate Systems recommend to use NAS (Network Attached Storage) with NFS (Network File System) protocol. With its unique clustering solution CommuniGate Pro does not make use of file system lock making NFS the best fit for CommuniGate Pro Installation.

Many mount points, and many NFS servers can be utilized within the same CommuniGate pro installation (see below).

Sample NFS Solutions:

NETAPP FAS2000		EMC Celerra NS-120		SUN Storage 7110	
					
Technical Highlights		Features	Benefits	Maximum Storage Capacity	2 TB or 4.2 TB (16 x 2.5 in. 146 GB or 300 GB disks)
SAN Protocol Support	Fibre Channel Protocol (FCP) for SCSI (4/2/1 Gb); fabric-attached and direct-attached; IP SAN (iSCSI); Fibre channel over Ethernet (FCoE)	<b>Unified storage</b>	Consolidate NAS, MPFS, FC-SAN, and iSCSI storage in a single system.	File system	ZFS (128-bit capacity)
Network Protocol Support	NFS V2/V3/V4 over UDP or TCP, PCNFSD V1/V2 for (PC) NFS client authentication, Microsoft® CIFS, HTTP 1.0, HTTP 1.1 virtual hosts	<b>Scalability</b>	Scale to 120 drives, and upgrade easily from one to two X-Blade servers to move more data from disk to network.	File level protocol	NFS v2/v3/v4, CIFS, HTTP, WebDAV, FTP/SFTP/FTPS
LUNs	Up to 1,024	<b>Integrated high availability</b>	Protect your information with the standby X-Blade and EMC CLARiON's proven high availability.	Block level protocol	iSCSI
FlexVol® Volumes	Up to 200 per controller on FAS2020 and FAS2040. Up to 500 per controller on FAS2050.	<b>VMware and Microsoft certification</b>	Virtualize with confidence, and use iSCSI capabilities to consolidate your Exchange and SQL data.	Data compression	Four levels of data compression available
Snapshot™ Copies	Up to 51,000 per controller on FAS2020 and FAS2050. Up to 127,000 per controller on FAS2050.	<b>Web-based management with virtual provisioning</b>	Set up, manage, and monitor your Celerra NS-120 quickly and easily. Simplify provisioning and improve utilization.	Replication	1:N, N:1, manual, scheduled, continuous
Number of Supported Hosts	Up to 2 ports per controller configured as front-end (host) connectivity ports Up to 4 directly connected servers per active/active configuration Up to 24 SAN host connected servers on FAS2020. Up to 32 SAN host connected	<b>Deduplication with compression</b>	Reduce filesystem capacity requirements.	Monitoring	DTrace Analytics (for system tuning and debugging); dashboard monitoring for key system performance metrics
		<b>File-level retention</b>	Tap disk-based WORM functionality with a compliance option for filesystem archiving.	Automated serviceability	"Phone Home" capability with automatic case creation, configurable alerts
		<b>Celerra FAST</b>	Automate storage tiering to lower costs and deliver higher service levels.	RAID	Striping, mirroring, single-parity RAID, double-parity RAID, wide stripes
				Remote management	HTTPS, SSH, SNMP v2/v3, IPMI
				Snapshots	Read only, read/write (clone), restore
				Directory services	NIS, AD, LDAP
				Data security	Checksum data and metadata, antivirus quarantine
				Network services	NTP, DHCP, SMTP

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NETAPP FAS2000		EMC Celerra NS-120	SUN Storage 7110	
	servers on FAS2040 and FAS2050.		services	
			Standard and Optional Interfaces	
Supported Configurations	<a href="#">Controller Configurations</a> Single controller, active/active controller with clustered failover (CFO) <sup>1</sup> <a href="#">Back-End (Disk) Configurations</a> Dual-path, <a href="#">multipath HA storage</a> (PDF)		Integrated network	Four 10/100/1000 Base-T Ethernet ports
Reliability	Redundant hot-swappable controllers, cooling fans and power supplies		Optional network connectivity	Dual GigE UTP; Dual GigE MMF; Quad Gigabit Ethernet UTP; Dual 10 GigE Fiber XFP (requires fiber transceiver)
Management	Full-duplex 10/100 Base-T Ethernet onboard console, diagnostic LED, Maintenance Center, SNMP, telnet, SSH, HTTP, Web (SSL), host scripting, e-mail alerts		Optional tape backup HBA	Dual channel 4 Gb FC HBA; Dual channel Ultra320 SCSI HBA
Security	Virus protection, SecureAdmin, IPSec, CHAP authentication, role-based access control (RBAC)			

### CommuniGate Shared File System structure and settings

The accounts in shared domains are stored in the following directories:

SharedDomains/domainName/accountName.macnt/ - in the simplest case, like in:

SharedDomains/company.com/jsmith.macnt/

Storing 10,000 accounts in one directory is not optimal, as all operations will become slow on most file systems. So, one can add "**Account - level foldering**", when account directories are stored inside sub directories inside the domain directory:

SharedDomains/company.com/**j.sub**/jsmith.macnt/

or

SharedDomains/company.com/**j.sub**/s.sub/jsmith.macnt/

or

SharedDomains/company.com/**js.sub**/**m.sub**/jsmith.macnt/

CommuniGate provides several methods for foldering.

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If there are many (5000 and more) domains, one may add "**Domain –level Foldering**":

SharedDomains/**c.sub**/company.com/jsmith.macnt/

SharedDomains/**c.sub/o.sub**/company.com/jsmith.macnt/

Or use **both domain** and **Account** foldering:

SharedDomains/**c.sub**/company.com/**j.sub**/s.sub/jsmith.macnt/

When an approximate number of domains and accounts is known, the foldering methods should be selected. Unlike other systems, in CommuniGate Pro it is possible to switch foldering on the fly, so it's not a big deal if the foldering will have to be changed later.

On large systems several NFS servers are used. Those NFS servers are mounted on different leafs of the CommuniGate tree structure.

For instance, in the example of a large company with 6 NFS Servers:

Without domain foldering and 2-level account foldering inside that domain, then accounts will be stored as:

SharedDomains/company.com/**j.sub/s.sub**/jsmith.macnt/

Now, it is possible make 4 directories **a.sub, b.sub, c.sub, d.sub** on the NFS server #1, and mount them on all backends as

- SharedDomains/company.com/a.sub
- SharedDomains/company.com/b.sub
- SharedDomains/company.com/c.sub
- SharedDomains/company.com/d.sub

On the NFS server #2 create e.sub, f.sub, g.sub, h.sub directories and mount them as

- SharedDomains/company.com/e.sub
- SharedDomains/company.com/f.sub
- SharedDomains/company.com/g.sub
- SharedDomains/company.com/h.sub

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on all backends, etc.

This way we distribute our accounts on all 6 NFS servers.

### APPENDIX Fast Storage Optimization (SSD)

CommuniGate Pro has a special feature to leverage on SSD technology. It can improve a lot the performances for real time or premium services. Here is a description on how to use the service.

Each account directory usually contains the **account.settings** and **account.info** files. These files are read every time an account is being opened, and the .info file is modified when some account meta-data changes. For example, when a SIP client is registered.

One may want to store them separately. These files are not large (1-2K for .settings), 1-20K for .info, so for 1M accounts all info files take about 5-20GB (most likely - less than 5GB).

By default the account.settings and account.info files are stored inside the account .macnt directory:

SharedDomains/company.com/a.sub/albert.macnt/account.settings

Administrators can specify in the configuration the "Fast Storage Type" as a non-zero value, (for instance "1"), then the path for the account.settings and account.info file will be:

SharedDomains/company.com/**fast**/a.sub/albert.settings

i.e. the system inserts the path element "**fast**" after the Nth path element, and removes the "accountName.macnt" path element.

In this case, it is possible to have a "fast" (SSD) NFS server for the company.com domain, and mount it as

SharedDomains/company.com/**fast**/ - and all .settings and .info files will be stored in it.

For a real case of real time services (like VoIP) with very few domains but large number of subscribers, the simplest setup:

- no Domain foldering
- 2-level Account foldering
- one NFS server to store all account data:

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Account path is:

SharedDomains/company.com/a.sub/l.sub/albert.macnt/

All paths are relative to CommuiGate Pro "base directory", which is usually /var/CommuniGate/, so the full account path is:

/var/CommuniGate/SharedDomains/company.com/a.sub/l.sub/albert.macnt/

Mount the "main" NFS server (its "SharedDomains" directory) as

/var/CommuniGate/SharedDomains/ on all backends.

Then, set the Fast Storage Index for the most important Domains to "1", so the .settings and .info paths are:

**/var/CommuniGate/SharedDomains/fast/company.com/a.sub/l.sub/albert.settings**

Then have an NFS server with SSD, and create a directory "fast" on it, and mount it as

**/var/CommuniGate/SharedDomains/fast/** on all backend servers.

CommuniGate Pro will then store all .settings and .info files on that special NFS server.

To switch to several NFS servers, unmount the "SharedDomains", and mount individual SharedDomains/company.com/a.sub/ directories on all backends. While doing that some directories can be moved to other NFS servers.

**Please note that "fast" NFS mounting option should not be changed during this transition.**

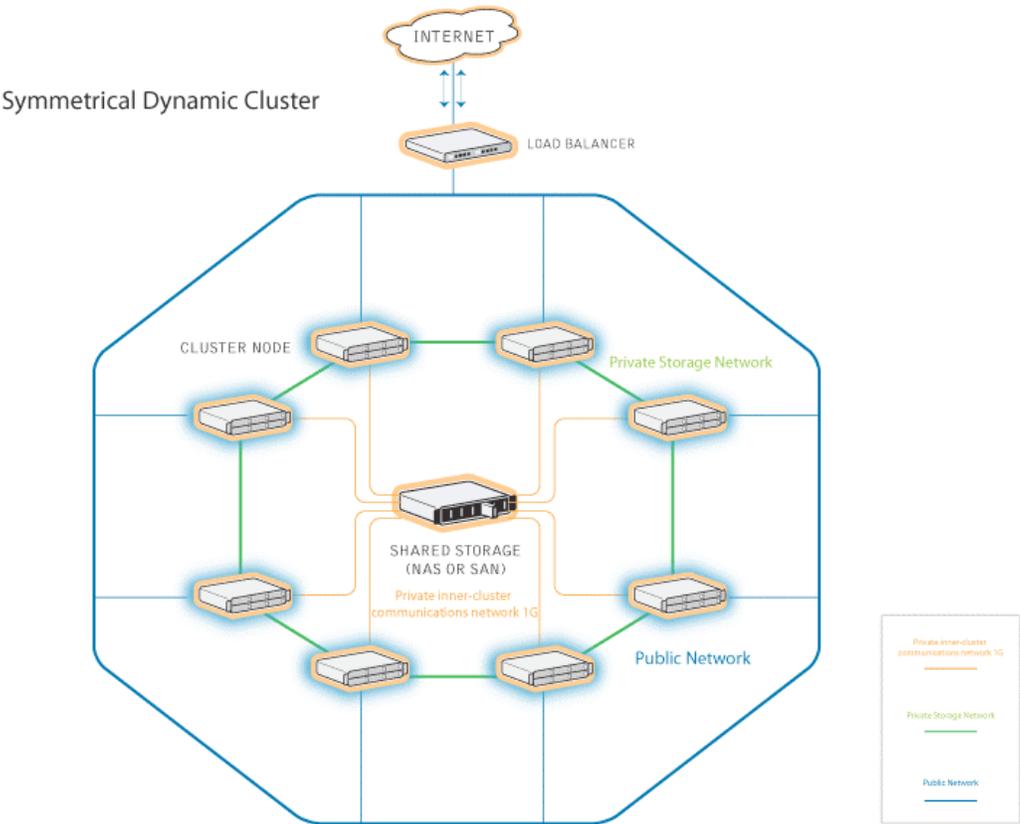
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## APPENDIX Symmetrical Dynamic Cluster

With CommuniGate’s cluster technology it is also possible to deploy an architecture where Cluster nodes are implementing both Frontend and Backend functionality. Therefore all cluster members have access to the Storage.

Both Static and Dynamic Clusters can work without dedicated Frontend Servers This is called a *symmetric configuration*, where each Cluster Server implements both Frontend and Backend functions.

This technology has an impact.



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### APPENDIX Dynamic Cluster SIP Farm

SIP FARM© is CommuniGate Systems' technology for clustering VoIP and enabling 99.999% uptime, redundancy, and scalability.

Both Dynamic Cluster and Super Cluster deployments can be clustered with SIP Farm, and the members of a cluster allocated to the SIP Farm can be based on traffic or regional geographic node placement.

The CommuniGate Pro Dynamic Cluster maintains the information about all servers enabled for SIP Farm.

Incoming SIP UDP packets and TCP connections are distributed to those servers using regular/simple load balancers.

The receiving server detects if the received packet must be processed on a certain SIP Farm server - if the packet is a response or an ACK packet for an existing transaction or if the packet is directed to a task created on a certain server.

In this case the packet is relayed from one SIP Farm cluster member to the target member.

Packets not directed to a particular SIP Farm server are distributed to all SIP Farm members based on the CommuniGate Pro cluster algorithms and the currently available set of the active SIP Farm cluster members.

In the case of the addition or loss of a SIP Farm member (such as a hardware failure), the traffic is redistributed to other SIP Farm members to maintain consistent signaling.

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## APPENDIX Cluster of Cluster (Super Cluster), Scalability and Regional Placement

CommuniGate Super Cluster technology enables:

- Regional placement to enable both Geographical redundancy, and local service for of subscribers.
- Extreme scalability (beyond 15+ Millions accounts) to segment the load between multiple Dynamic clusters.

