the Availability Digest

Telecom Italia's Active/Active Mobile Services

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Telecom Italia

The Telecom Italia Group (http://www.telecomitalia.com) provides fixed-line and mobile telephone services to the Italian marketplace as well as mobile services to subscribers in other countries. It is the predominant mobile service provider in Italy. It uses HP NonStop active/active systems to ensure the continuity of some of its critical mobile services.

The Telecom Italia Group's strategic guidelines include accelerating the convergence between fixed and mobile telephony, broadband internet, and media content. High-profile brands such as Telecom Italia, Olivetti, TIM (Telecom Italia Mobile) and others mark the Telecom Italia Group's activities in the entire advanced communications chain.

Telecom Italia Mobile

Telecom Italia is the largest cell phone service operator in Italy and provides coverage to over 95% of the country via its TIM-branded mobile services. The TIM brand is no longer just Italian. It is also recognized in Europe, the Mediterranean basin, and in South America.

The TIM network is a dual-band mobile network which provides GSM and 3G services. It supports prepaid roaming, WAP (wireless application protocol) navigation, high-speed data services, and international videophone.

TIM's Coverage Area

With almost 54 million mobile phone lines, 26 million of which are in Italy, TIM has become the major strength of the international presence of the Telecom Italia Group. Via TIM, Telecom Italia is a predominant provider of mobile services to Brazilian subscribers – it is Brazil's number two carrier and is its leading GSM mobile provider. Telecom Italia formerly provided mobile services to subscribers in other countries as well prior to divesting itself of operations in Peru, Venezuela, and Greece.

The Telecom Italia Group is a member of the FreeMove Alliance, which forms the largest mobile community in the world. The FreeMove Alliance provides seamless service to almost 300 million

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customers in 28 countries, such as Italy, Great Britain, France, Spain, the Netherlands, Germany, Belgium, and Switzerland. This explains TIM's motto, "Vivera senza confini" - "Living without borders."

Continuously Available Services

A critical attribute of telephone services is that they must be dependable. To provide extreme reliabilities in its network, TIM uses HP's Open Call Intelligent Network Server (INS), a NonStop system that provides telephone SS7 switching services. Highly reliable operation is provided by configuring INS as two or more nodes, which are kept synchronized by HP's mated-pair technology in an active/active-like configuration.

In addition to services provided by INS, TIM supports additional special services that have been implemented by Telecom Italia. Among these services are Small Message Services (SMS) and Unified Messaging Services (UMS).

SMS is a service for sending small text messages entered by one subscriber to another subscriber. SMS messages are stored in the system for forwarding to the recipient. If the receiving subscriber's cell phone is not currently communicating with the network, the message is held until the next time the cell phone logs on to the network. At that time, the text message is sent to the receiving subscriber.

UMS is a service that supports voice mail, email, and faxes. As with SMS, UMS stores these messages. Email and fax messages are forwarded to the user if he is currently connected, or they are held until he becomes connected. UMS notifies subscribers that they have voice mail waiting. As a subscriber moves in and out of coverage areas or first turns on his phone, a message is sent to his phone if there are one or more voice messages waiting for him. This notification generally results in an audible beep and an icon displayed on the cell phone's screen.

SMS and UMS support messaging from or to both mobile phones and fixed-line phones.

Redundancy Requirements

When Telecom Italia first implemented its SMS and UMS services on HP's INS running on an S74000 NonStop server, it found that the server was handling one thousand transactions per second; and this volume was growing. Clearly, the company had to prepare for future significant expansion.

Furthermore, though the HP NonStop servers were fault-tolerant, the company had to be prepared to recover from a technical, human, or natural disaster that might take down its processing center. Therefore, it decided to expand its INS system to a two-node active/active system. Each system normally processes half of the transaction load and sends updates via data replication to its companion system.

With this configuration, the TIM network can now withstand the loss of one of its data centers by simply rerouting all transactions to the surviving system. Also, capacity can easily be expanded by adding nodes to the active/active application network.

System Configuration

Telecom Italia installed one INS node in Milan and one in Rome. Milan is in north central Italy, and Rome is in the center of Italy's western coast. These locations provided sufficient separation for disaster tolerance and offered an efficient network topology to support cell tower networking.

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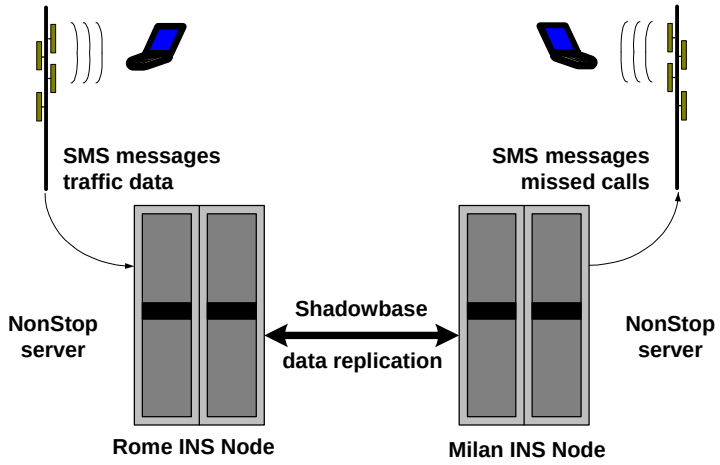
Both nodes are sized so that each can handle the entire network load. In this way, there will be no degradation of service should one node become unavailable.

TIM's cell towers are connected to the INS sites by a dedicated cell tower network. Each cell tower knows its primary INS node and normally routes all of its traffic to that node. Should that node fail (or be taken down for maintenance or upgrade), the cell tower will reroute all of its traffic to the surviving node.

The routing rules can be changed so that the system can be load balanced when necessary.



TIM's INS Services

Database Synchronization

Each INS node in the TIM network maintains a complete database for the entire system. As changes are made to a data item in one database, that change is replicated to the other database so that the two are kept in synchronism.

Data replication is asynchronous so that it does not affect the responsiveness of the application. It is bidirectional so that changes are replicated in both directions. Data replication for the services added to INS, such as the SMS and UMS applications, are provided by Gravic's Shadowbase asynchronous data replication engine (www.gravic.com), configured to provide bidirectional replication.

Data Collisions and Relative Replication

As cell tower traffic is received by an INS node, that node updates subscriber records with the number of calls, the number of minutes used, and other information such as roaming so that the subscriber can be billed. It also stores SMS and UMS messages for routing to subscribers and tracks voicemail messages awaiting delivery.

Though all traffic for a given subscriber is being routed to only one INS node at a time, depending upon the subscriber's location, there is still the possibility for data collisions. This is because there may also be administrative activity being carried out for that subscriber on the other node. For instance, a customer service representative may be adding services for that subscriber or modifying the attributes for services which the subscriber already has.

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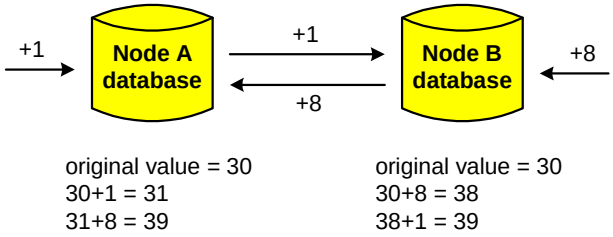
Alternatively, a batch job modifying a subscriber's record may be running on one node while the other node is processing that subscriber's cell phone traffic.

If an administrative or batch action modifies a row in the database at one node at the same time that a cell phone transaction modifies the same row in the other node, a data collision occurs. If the data replication scheme replicates entire rows, the bidirectional replication of the changed rows will overwrite the changes first made at each node. Both databases are now different, and both are wrong.

To solve this problem, Shadowbase uses *relative* replication rather than *absolute* row replication. If the change is numeric (such as adding five minutes to the subscriber's used time), his call time is incremented by five in the local database. Then, rather than sending the modified record to the other system, only the relative change to the numeric field is sent. In this case, the other system would be directed to add five to that data field for that subscriber.

Thus, if numeric changes are made to the same record, or even to the same data item, at the same time at two different nodes, only the relative changes are replicated.

For instance, let us take the case of a data field that initially holds a count of 30 in both databases. Node A adds one to that data field at the same time that Node B adds eight to the field. Node A increments its data field to 31 and replicates a change of +1 to Node B. Node B adds 8 to the data field, resulting in a new count of 38, and replicates a change of +8 to Node A.



Relative Replication

Upon receipt of the +1 directive from Node A, Node B increments its data field value from 38 to 39. Meanwhile, Node A adds 8 to its data field value of 31, resulting in a value of 39. Both nodes end up agreeing even though a data collision occurred.

If a textual data collision occurs, the processing is not quite that simple. One or the other of the changes must be accepted and the other rejected. TIM has implemented a business rule that accepts the latest change. Thus, if Node A changes the text field in a row, and one millisecond later, Node B changes that same text field, Node A will overwrite its change with that of Node B. This collision will be logged for later manual review.

Postscript

Telecom Italia is planning to upgrade its INS systems to the latest versions of the NonStop operating system with no interruption to subscriber services. This will be done by switching all traffic to one node while upgrading the other node.

Zero downtime migrations such as this are a hallmark of active/active systems since the traffic normally handled by a node can be switched to other nodes in the application network. That node can then be taken down for maintenance or upgrades.

TIM's active/active configuration also positions Telecom Italia to be able to add capacity easily by simply adding additional nodes to the TIM network and by then redistributing its cell tower traffic.

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