Makani Hierarchical Memory®

Makani's Hierarchical Memory® technology is known by several different terms including Dictionary Compression, Transparent Data Reduction, Molecular Sequence Reduction, or Network Compression. Regardless of name, Hierarchical Memory® is a technique for replacing repetitive bytes of data with shorter "tokens" prior to transmission over the network. Because Hierarchical Memory® is not protocol specific, it can be performed on *any* traffic not just TCP traffic and is completely transparent to the client and servers.

Benefits of Hierarchical Memory®

For users accessing data from remote sites or centralized servers that need to be accessible across the WAN, minimizing the amount of data traversing the WAN not only reduces bandwidth consumption, but also reduces the impact of latency due to WAN congestion. The ability of Hierarchical Memory® to minimize data using tokens and compression results in faster response time, which leads to a more productive environment in which end users spend more time working and less time waiting on applications.

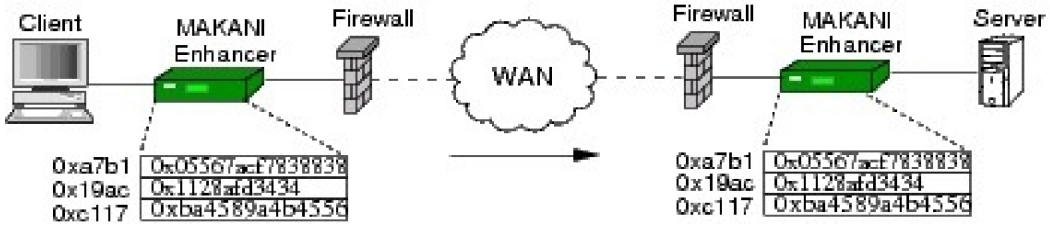
Hierarchical Memory® is one of the key features of Makani Latency Buster™ Architecture that effectively optimizes WAN utilization in your network while improving performance to the end user at the same time. Because it is performed on any traffic and is protocol independent, all application data traversing the network can benefit from Hierarchical Memory® technology. Users in the network who access business-critical applications, such as e-mail or file services, see a significant decrease in response time when Hierarchical Memory® is used. For bandwidth intensive applications such as backup and datacenter-to-datacenter disk synchronization, bandwidth usage can be dramatically reduced.

Hierarchical Memory® is bidirectional, meaning that the technology applies to data both sent or received without requiring the data to be sent once in each direction. Once the dictionary is populated, it automatically applies to data in both directions.

Increasing WAN Capacity with Hierarchical Memory®

At the heart of Makani hierarchical memory® is a patented compression and caching technology to gain instant WAN capacity on the existing network. Two techniques are crucial in hierarchical memory®:

- **Online Byte Reduction™ (OBR™)** technology, which uses a highly efficient in-memory based pattern dictionary to detect and eliminate data repetitions that occur across a range of applications. Depending on the application mix, many fold increase in capacity on existing WAN links is realized by eliminating repetitious data with a small compressed token (called rabin chunk hash); in some cases between 5x-100x increase.
- **Network Byte Caching™ (NBC™)** technology, which dramatically increases WAN capacity by recognizing much larger data patterns than OBR™ compression. This technology relies on embedded hard disks to store longer data patterns for longer periods of time, replacing them with a token for transmission over the WAN.



Makani replaces longer data patterns with a hash (fingerprint)

Traditional file caching is designed to eliminate large redundant file transmissions, but it often fails to deliver because of two key limitations. First, file caching works only on a single application; because enterprises have a heterogeneous mix of applications, the overall impact that file caching has on reducing WAN transmissions is limited. Second, file caching operates only on exactly repeated files. In contrast, Makani's NBC™ technique recognizes repeated data patterns and eliminates them, even when a file has been modified. In addition, the use of on-board hard disks provide tens to hundreds of gigabytes of persistent storage; hence sequences seen several days earlier can be eliminated.

A key attribute of OBR™ is its compression capabilities even on very large amounts of bandwidth. This attribute is mutually exclusive when using compression techniques such as Lempel-Ziv, or its derivatives.

Online Byte Reduction and Network Byte Caching techniques reduce traffic for *any* IP traffic — not just TCP. The efficiency of traditional compression is limited, since they can buffer only a limited number of repeated patterns. In contrast, Online Byte Reduction and Network Byte Caching techniques store many more and longer repeated data that dramatically reduce traffic flows while adding only a negligible amount of latency.

Conclusion

Makani's Hierarchical Memory® technology allows IT organizations to accelerate and secure the delivery of business applications to all users across the distributed enterprise - including those near Internet gateways, as well as in branch offices, data centers, and even individual end points. As an integral part of the Makani's Latency Buster™ Architecture, Hierarchical Memory can be implemented across the network to increase productivity and profits by improving user performance while reducing costs.

Makani offers high-performance, easy-to-use and technically innovative solutions for next-generation wide-area networked data services. Makani Enhancers™ are deployed for wide-area data acceleration and optimization. Makani Mobilizer™ appliances are deployed in the customer's network for blazing-speed data access over a wide-range of access networks. Founded in 2006, Makani is headquartered in San Francisco with regional offices all over the world.