IBM WebSphere Distributed Caching Products

IBM WebSphere eXtreme Scale V8.5 and IBM WebSphere DataPower XC10 V2.1 Appliance

Highlights

- Provides a powerful, scalable elastic in-memory grid for your business-critical applications

- Helps reduce the risk of data loss by enabling automatic data replication, high availability and fault tolerance

- Enables a quicker and more effortless increase of cache capacity and data throughput as business needs grow

- Facilitates simplified administration with a flexible and simple user-management interface

- Supports a broad range of usage scenarios spanning an in-process cache to a powerful distributed grid

Our planet is becoming increasingly interconnected, instrumented and intelligent. Around the world, more and more people now use mobile devices to access a range of services. The proliferation of mobile devices is driving the exponential growth of transactions for everything from web commerce, to real-time financial interactions, to online social networking and gaming. Not only are enterprise systems seeing higher levels of traffic than ever before, but these systems are also experiencing more spikes in usage. These spikes are caused by a combination of social media and mobile device alerts that prompt immediate access to these systems. Today's enterprises face the challenge of scaling their business-critical systems in a cost-effective manner to meet increase in demand while enhancing application performance to keep pace with rising customer expectations.

The IBM® WebSphere® portfolio offers extreme transaction processing (XTP) capabilities that can help facilitate an IBM SMART SOA®-based application infrastructure. With WebSphere, you can take action to support your most demanding business-critical applications. The WebSphere family of products can help you improve your business agility by allowing you to overcome traditional IT performance limitations. The portfolio of products can help you generate the levels of global scale, process efficiencies and business intelligence that you need for smarter business outcomes such as sustainable competitive advantage, higher revenues and avoidance of potential fines that could stem from inconsistent response and service-level agreement violations.

The IBM WebSphere family of caching products is designed to enable business applications to process billions of transactions a day with high levels of efficiency and near-linear scalability. IBM caching products are designed to work in heterogeneous environments throughout leading application server platforms and virtualization environments. The IBM WebSphere eXtreme Scale distributed caching platform and the IBM WebSphere DataPower® XC10 appliance provide distributed object caching that is essential for elastic scalability and next-generation, high performance cloud environments.

The WebSphere eXtreme Scale platform operates as an in-memory grid that dynamically processes, partitions, replicates and manages application data and business logic throughout hundreds of servers. This IBM offering provides transactional integrity and transparent failover to facilitate high levels of availability, reliability and consistent response times. WebSphere eXtreme Scale is an essential distributed caching platform for elastic scalability and next-generation cloud environments. The WebSphere eXtreme Scale platform provides the technology to enhance business applications, including web commerce, supply chain, financial trading and even on-line gaming applications. You can form new, innovative classes of business applications by extending the data-caching concept with advanced features.

The IBM WebSphere DataPower XC10 appliance is a purpose-built, easier-to-use appliance designed for simplified deployment, robust performance and hardened security at the caching tier of your enterprise application infrastructure. The DataPower XC10 V2.1 appliance incorporates 240 GB of elastic cache into the DataPower line of appliances from IBM. The appliance adds elastic caching functions that can help

enable your business-critical applications to scale in a cost effective manner and to perform consistently. The DataPower XC10 appliance is designed for rapid, drop-in use in conjunction with WebSphere Application Server and other WebSphere family products. The DataPower XC10 appliance also is designed to provide simple support for non-WebSphere Application Server and non-Java environments through Representational State Transfer (REST) application programming interfaces (APIs). The appliance enables a cost-effective, distributed caching solution that supports data-oriented distributed caching scenarios.

Let us have a more in-depth look into the scenarios and configurations addressed by this family of products:

HTTP session management

The WebSphere eXtreme Scale platform and the DataPower XC10 appliance can help you virtually eliminate your need for costly databases to handle HTTP session persistence and can be used for multi-data center HTTP session failover. You can connect the WebSphere Application Server seamlessly to a WebSphere eXtreme Scale grid or WebSphere DataPower XC10 appliance session grid. You can configure WebSphere applications to store HTTP session data to an elastic cache through the WebSphere Application Sever administrative console. When you use an elastic cache for HTTP session persistence, you can replace other session replication mechanisms such as memory-to-memory replication. By off-loading the HTTP session cache to an elastic cache, you can reduce the memory requirements of your application server Java Virtual Machine. With this step, you can enhance memory utilization and tune your application server environment. It virtually eliminates the need for a database, which is traditionally used

for session persistence. For high availability scenarios, WebSphere eXtreme Scale distributed caching platform and the DataPower XC10 appliance enable HTTP session failover between WebSphere Application Server cells. You can also use WebSphere eXtreme Scale platform and the DataPower XC10 appliance to provide HTTP session persistence and session failover support for WebSphere Application Server Liberty Profile and WebSphere Portal servers.

Simple data grid

You can use the simple data grid on the WebSphere eXtreme Scale platform and the DataPower XC10 appliance to store data for faster, lower-cost access than a database. Java-based applications use the WebSphere eXtreme Scale ObjectMap APIs to perform simple create, read, update and delete operations on the simple grid. You can run applications within WebSphere Application Server or run them as stand-alone Java applications. You can install WebSphere eXtreme Scale client code outside of WebSphere Application Server to help enable stand-alone Java application access to simple data caches on the WebSphere eXtreme Scale platform or on the DataPower XC10 appliance. The REST gateway feature of the DataPower XC10 appliance enables non-Java applications to access simple data grids on the appliance. Using the REST APIs, non-Java applications can access the simple data grids on the appliance.

Simple data grid as side cache for the Enterprise Service Bus

The side cache offers you a straightforward way to integrate caching with an Enterprise Service Bus (ESB). An ESB is a critical component of a service-oriented architecture (SOA). The ESB connects and integrates applications, services and business process flows at the messaging layer. It performs protocol mediation, message transformation, routing and process choreography and provides quality of service in terms of security, reliable message delivery and transaction management.

In an SOA application infrastructure, application requests pass through the ESB before they are sent to the application. Therefore, if you can retrieve the result of an application request from the elastic side cache, you can reduce the application processing and processing latency for that request. The result is a significant decrease in response time and reduction of back end application processing. In the case of the elastic caching solutions, the side cache operation is added to the ESB flow. Therefore, you do not have to make changes to the application code. The ESB side cache is a common use case for the simple grid.

Here are three scenarios where the WebSphere eXtreme Scale platform and the IBM WebSphere DataPower XC10 appliance can be integrated with IBM ESB products to help you improve response time and increase total system throughput:

• **IBM WebSphere DataPower XI50 and WebSphere DataPower XI52 integration appliances**: With the REST gateway feature of the DataPower XC10 appliance you can allow non-Java-based clients access to simple data grids using a set of HTTP-based operations. You can configure the DataPower XI50/XI52 integration appliance to use the DataPower XC10 appliance as a side cache through the REST gateway. When you use the drag-and-drop features of the browser-based console of DataPower XI50/XI52 integration appliance, you can insert the side cache operation to access the DataPower XC10 appliance in a matter of minutes. For this scenario, there is no coding required.

- **IBM Business Process Manager, WebSphere Process Sever and WebSphere Enterprise Service Bus (ESB)**: The WebSphere eXtreme Scale V7.1.1 platform includes two mediation primitives that allow you to insert and retrieve data from a side cache with IBM Business Process Manager, WebSphere Process Server and WebSphere Enterprise Service Bus. You can also use these mediation primitives to access an elastic cache on the WebSphere eXtreme Scale platform or on the DataPower XC10 appliance. The WebSphere eXtreme Scale mediation primitives can be imported into the WebSphere Integration Developer. You can integrate the elastic side cache into your configuration without changing the business process itself by using the mediation flows that are provided by the WebSphere Enterprise Service Bus. You can extract results from the caches using read-only service requests and you can configure the results to load caches on misses. The mediations are of such a nature that this solution is both service and binding agnostic.
- **WebSphere Message Broker:** In this scenario, a Java compute node is added to the message flow to check the elastic cache for data. The code defines classes to represent the objects for caching and uses the WebSphere eXtreme Scale ObjectGrid APIs to interact with the simple data grid on a DataPower XC10 appliance.

In all three of these ESB scenarios, although there may be some coding involved, such as a custom node or the addition of mediation into the messaging flow of the ESB, there are no application code changes. This factor can help make simple the use of the WebSphere eXtreme Scale platform or the DataPower XC10 appliance as the caching solution for your ESB. When you use an elastic caching solution as the side cache, you can improve response times and enhance throughput since redundant calls are cached for rapid access. The addition of a side cache to an ESB can help you:

- Significantly reduce the load on the back end system by avoiding redundant requests
- Virtually eliminate costly million instructions per second (MIPS) by avoiding redundant requests
- Facilitate more real work to be performed
- Improve overall response time
- Reduce the need to scale hardware to increase processing capacity as the back end system no longer has to handle redundant requests
- Facilitate response time from elastic cache in milliseconds

Extension for WebSphere Application Server Dynamic Cache

The WebSphere eXtreme Scale platform or the DataPower XC10 appliance can help you enable a consistent, distributed cache for enterprise applications that run on your WebSphere Application Server. The Dynamic Cache API, which is informally known as DynaCache, is available to Java Extended Edition (Java EE) applications that are deployed in WebSphere Application Server. You can use the Dynamic Cache API to cache business data, generated HTML, or to synchronize the cached data in the cell by using the data replication service (DRS). Previously, the only service provider for the Dynamic Cache API was the default dynamic cache engine built into WebSphere Application Server.

With the WebSphere eXtreme Scale platform or the DataPower XC10 appliance, you can use the dynamic cache service provider interface in WebSphere Application Server to

plug into the Dynamic Cache. You can help enable applications written with the Dynamic Cache API or applications using container-level caching, such as servlets, to take advantage of the features and performance capabilities of the DataPower XC10 appliance when you set up this capability. These features and performance capabilities could include replication over the network, high availability, scalability and cache partitioning.

The IBM WebSphere Commerce solution is an industry-leading solution for web retail applications. It is a Java Enterprise Edition (JEE) application deployed in the WebSphere Application Server. WebSphere Commerce utilizes one of the key performance-related features of the WebSphere Application Server: DynaCache. You can improve application performance using the DynaCache by caching dynamically created data that contains the output results from the runtime program execution of code components, such as servlets and Java Server Pages (JSPs). WebSphere Commerce sites use the DynaCache to reduce database round trips. The reduction of database roundtrips is an important factor that can boost performance.

You can configure WebSphere Commerce to use the WebSphere eXtreme Scale platform or the DataPower XC10 appliance as a DynaCache provider. The elastic data grid topology has a single, logical instance of the cache that is shared among WebSphere Commerce servers. This cache is shared across servers. Therefore, you do not need multiple copies of the same pages and fragments for each server. Instead, you can create a single cache instance on the first request for that page or fragment, which can then be made available to all WebSphere Commerce servers sharing the cache.

Compared with DynaCache and disk offloading, an elastic cache can help you:

- Reduce the average response time by as much as 25 percent[1]
- Enable a more consistent user experience with the reduction of statistical variation in the response time
- Reduce the time needed to reach steady-state after full or partial site re-start, or after full cache invalidation by as much as 40 percent[2]
- Virtually avoid *warm-up* time for the cache when additional WebSphere Commerce servers are added, or when servers are stopped and restarted since WebSphere Commerce servers use the same grid
- Simplify tuning and operational maintenance
- Virtually eliminate the need for high-speed disk off-loading
- Enable a consistent cache—the same version of the page is always shown when each client Java Virtual Machine uses the same eXtreme Scale grid rather than a separate cache for each client JVM—to help you seamlessly add additional capacity to the grid

When you integrate the WebSphere eXtreme Scale platform or the DataPower XC10 appliance with WebSphere Portal configured with IBM Lotus® Web Content Management , you can use the elastic cache as a DynaCache replacement for portal content rendering. This combination can help you make the content available in a centralized location. With this integration, you can share the content and make it more easily available than when it is stored on a local DynaCache. You can

enable increased efficiency by making the content available when the server starts. Off-loading Lotus Web Content Management advanced DynaCache to an elastic grid can help:

- Reduce the average response time
- Enable a more consistent user experience with the reduction of statistical variation in the response time
- Reduce the time needed to reach steady-state after full or partial site re-start.
- Simplify tuning and operational maintenance
- Virtually eliminate the need for high-speed disk off-loading
- Enable a consistent cache—the same version of the page is always shown when each client Java Virtual Machine (JVM) uses the same eXtreme Scale grid rather than a separate cache for each client JVM—to help you seamlessly add additional capacity to the grid

In-line Data Grid

You can configure the WebSphere eXtreme Scale platform as an in-line elastic data grid to significantly reduce the load on your back end systems. With this configuration, you can enable your application clients to use the ObjectMap APIs to read and write from the in-memory data grid. The elastic data grid handles the interaction with the back end systems through a loader. A loader is a plug-in that runs in the elastic data grid. You can facilitate more easy integration with your databases with the Java Persistence API loaders (JPA Loaders) of the WebSphere eXtreme Scale platform. In addition, you can write customer loader plug-ins to work with your environment.

- **Read-through caching**: In a scenario where your application client reads data from the in-memory data grid and that data is either invalidated or is not in the grid, the in-memory grid reads the data from the back-end, populates the grid with the data and returns the result to the client.

- **Write-through caching**: Write-through caching propagates all changes from the in-memory grid to the database as part of the transaction. This method results in longer response times but can help guarantee that all changes are transmitted to the database. With this approach you can also facilitate synchronization between the cache and back end. This synchronization becomes more valuable in situations in which the data must be hardened to the back end data store before the transactions can be considered complete.
- **Write-behind caching:** With write-behind caching you can batch data updates and send the updates to the back end data store at a configured interval. This approach can help improve transaction response times further since the updates no longer need to manage the data store in a synchronous fashion. This approach can help you reduce the load on the data store and shield the application from back end outages. The grid can hold the updates in a fault-tolerant manner in the memory until the back end comes online.

In addition to loaders, the WebSphere eXtreme Scale platform can run custom agents. These agents run within the elastic data grid to perform parallel processing on the data in the grid. For example, agents are used to perform parallel map and parallel reduce programming patterns. Custom agents can help you further extend the capabilities of the elastic in-memory grid.

Along with these scenarios, the WebSphere caching family of products can provide a feature-rich elastic persistent store solution for business applications while enabling:

High performance
- **In-memory management:** The products provide in-memory management capabilities with the capacity to support terabytes of data spread throughout thousands of servers. This capability can help facilitate your business applications to scale up seamlessly with the growth of data.

- **Fast application performance:** Data is stored in memory so that applications have faster access to data—with the speed of access in milliseconds. When data is accessed from an in-memory data grid, you can enable applications to work faster and help reduce the workload of the supporting database servers and back-end systems.

- **Flexible definition of data location**: The products provide the capability to specify zones, for fine-grained control of data placement either within a server system, data center, or geography. A zone can be a chassis, a building or a different geography. As a general practice, synchronous replicas reside in the same zone as primary replicas, with asynchronous replicas residing in different zones. This arrangement can provide more granularity of shard placement to help facilitate enhanced fault tolerance. The enhanced fault tolerance can help your data store to support the availability constraints that are unique to your business.

Ease of use

- **Heterogeneous environment support:** The products are supported either in a standard Java Enterprise Edition-compliant server environment, or any Java Virtual Machine that is compliant with Java Standard Edition V 1.4 or newer versions. The WebSphere family of caching products provides a common data fabric approach that supports heterogeneous server environments.

- **Dynamic cache support for enterprise applications:** As a cache provider for the WebSphere Application Server dynamic cache service, the WebSphere family of caching products provides a consistent distributed drop-in cache for enterprise applications. This can help enable a higher quality of service, near-linear scalability and high availability for a broad variety of business applications. If your applications utilize the WebSphere Application Server dynamic cache service, or if you are considering the utilization of specific applications, you could experience a significant reduction in invasive changes.

- **Reporting and monitoring:** WebSphere eXtreme Scale includes implementations of metric access adapters to improve integration with IBM Tivoli® Monitoring or Hyperic HQ, to help enable detailed insight into the operational behavior of business solutions. DataPower XC10 includes a built-in console to help facilitate ease of management and metric tracking.

New features
WebSphere eXtreme Scale V8.5

- Enables the utilization of the system memory outside of the Java heap as elastic cache with eXtreme Memory. This feature helps facilitate smaller Java heap sizes of the WebSphere eXtreme Scale containers and helps reduce the effects of garbage collection pauses on transaction response time variability. eXtreme Memory is only limited by available RAM and the platform address space.

- Enables efficient memory-to-memory replication between WebSphere eXtreme Scale containers with eXtreme I/O. eXtreme I/O is a new transport developed to facilitate fault tolerance of the eXtreme Memory elastic cache since eXtreme Memory is outside of the Java Virtual Machine (JVM) environment.

- Includes data serializer plug-ins that can facilitate greater flexibility in choosing serialization performance versus memory density trade-offs. Serialization samples are included for Google Protocol Buffers and Binary JavaScript Object Notation (BSON).

- Facilitates the exposure of your plug-ins as open services gateway initiative (OSGi) services using OSGi framework so that the plug-ins can be used by the WebSphere eXtreme Scale run time. In addition, you can start WebSphere eXtreme Scale servers and clients in an OSGi container. This facility can help you to add and update WebSphere eXtreme Scale plug-ins in a dynamic manner to the runtime environment.

- Provides detailed help, flag and option recommendations with xscmd utility. With the xscmd utility, a simple command-line interface helps enhance control of WebSphere eXtreme Scale components. The xscmd utility, which replaces the xsadmin sample, supports internationalization.

- Supports HTTP session management for WebSphere Application Server Liberty Profile. In addition, WebSphere eXtreme Scale catalog servers, containers and clients can be deployed on WebSphere Applications Server Liberty Profile servers.

- Supports Dynamic Cache service (DynaCache) for IBM WebSphere Portal with IBM Lotus Web Content Management advanced cache.

WebSphere DataPower XC10 V2.1

- Enables asynchronous replication of maps throughout high-latency networks with *multi-master* key-based replication. The DataPower XC10 appliance supports key-based replication scenarios that are also referred to as multi-master or Availability Partition (AP) replication scenarios.
- Facilitates bonding of multiple network interfaces for higher bandwidth.
- Includes simple network management protocol (SNMP) and command-line interface (CLI) publishing updates to help facilitate ease of administration and improved serviceability. These updates can also help enhance overall product resiliency, data management intelligence and placement between the servers of a WebSphere eXtreme Scale grid.
- Enables Spring cache for customers who develop or maintain Java Spring applications. With the Spring cache, you can add the DataPower XC10 appliance cache transparently to an existing application with minimal impact on the application code.
- Supports HTTP session management support for WebSphere Application Server Liberty Profile.
- Supports Dynamic Cache service (DynaCache) for WebSphere Portal with Lotus Web Content Management advanced cache.

Key features
- **Offers ease of use for common transaction tasks:** WebSphere eXtreme Scale can help you handle many of the common retry and exception logic tasks within the grid middleware. The request timeout for clients removes the burden from developers for boiler plate retry logic for most map interaction operations. This IBM offering can help you handle most retry conditions automatically. This capability can help you enable developers to focus on the business logic aspects of application development.

- **Helps provide accelerated time to value:** The WebSphere DataPower XC10 appliance is designed to reduce the time necessary for the installation, set up and configuration through default settings, drop-in use for HTTP session management and to help facilitate higher levels of efficiency and quality of service to the WebSphere Application Server dynamic cache service.
- **Offers simplified management and administration:** The WebSphere DataPower XC10 appliance offers a built-in, simplified administration and monitoring console to help enable efficient set up, configuration and management of the appliance and transaction load within your datacenter.
- **Offers simplified monitoring of the runtime and health of the appliance:** The WebSphere DataPower XC10 appliance includes status widgets to report key metrics pertaining to your transaction load and memory. Two examples of the reported metrics are memory usage and average response time.
- **Supports multi-master key-based replication:** WebSphere eXtreme Scale and the DataPower XC10 appliance can support key-based replication scenarios, which are also referred to as multi-master or Availability Partition (AP) replication scenarios. With this feature you can facilitate maps to be asynchronously replicated across high-latency network connections.
- **Offers non-Java client support:** WebSphere eXtreme Scale can help facilitate non-native, non-Java (C,C++, .NET) client access to its caching features through REST APIs, implemented on ADO.NET Data Services V1 specification. The REST gateway of the DataPower XC10 V2.1 appliance allows non-Java-based clients to access simple data grids using a set of HTTP-based operations.
- **Helps enable improved reporting and monitoring:** WebSphere eXtreme Scale is instrumented to work with IBM DB2® performance monitoring tools. WebSphere eXtreme Scale statistics are enhanced to enable querying to work better with other monitoring consoles. A native administrative console is now included.

- **Supports data grid optimizations:** WebSphere eXtreme Scale has a smaller footprint of data in the grid. This attribute can help you reduce memory costs, optimize cost of ownership and enhance performance. Additionally, it can help you facilitate a reduction in grid infrastructure overhead through footprint and path length.
- **Helps facilitate high availability and fault tolerance:** If a primary server fails, a replica is automatically promoted to be the primary. The solutions can support multiple replicas. This can be done asynchronously or synchronously and is transparent to the application. This approach can help enable business applications that are available whenever the clients require them to be available.

- **Provides near-linear scalability:** As data or transaction volumes grow, more servers can be added in a seamless fashion to handle the additional data and workload while still helping you enable effective application access to data and consistent, predictable response times.

For ease of reference, the table below outlines the same key scenarios and features for a comparison of the two WebSphere caching family products:

	WebSphere eXtreme Scale V8.5	WebSphere DataPower XC10 V2.1 Appliance
Optimized for:	Developers and architects or businesses leaders who wish to support transaction intense services in a cost-effective manner; those who wish to extend the functionality of existing applications and achieve fast and efficient transaction response times	Leaders at businesses of any size who seek a drop-in application scaling solution; those who wish for quick and efficient handling of data-oriented scenarios such as HTTP session management, elastic dynamic caching and web-side cache
Scenarios:		
Simple data and database cache	●	●
Client grid with near cache	●	○
Side cache	●	●
Real-time data and event mining	●	○
Map reduce support	●	○
Appliance Enhanced Value (for three supported runtime scenarios):		
Elastic dynamic caching	●	●
Session management	●	●
Web-side cache	●	●
Large cache capacity per appliance	**n/a**	●
Immediate use scenario support	**n/a**	●
Native appliance management and administration	**n/a**	●
Simplified monitoring of the run time/health of the appliance	**n/a**	●

Key functional offers:		
High Performance		
In-memory/SSD management	●	●
Fast application performance	●	●
Flexible definition and data location	●	○
Ease of Use		
Heterogeneous environment support	●	●
Dynamic cache support for enterprise WebSphere Application Server applications	●	●
Reporting and monitoring	●	●
Ease of use for common transaction tasks	●	●
Key features		
Enhanced extreme transaction processing (XTP) capabilities	●	◕
Write-through caching	●	○
Write-behind caching	●	○
JPA Loaders (OpenJPA L2 cache support)	●	○
HTTP session replication	●	●
Key-based replication (Asynchronous replication)	●	●
Non-Java client support — C/C++, .NET (ADO.Net data service/REST support)	●	○
Improved reporting and monitoring	●	●
Enhanced foundational capabilities	◕	●
High availability and fault tolerance	●	●
Near-linear scalability	●	●

Other comparisons:		
Distributed object cache throughout multiple servers in a LAN	●	●
Distributed object cache throughout multiple servers in a WAN	●	●
Advanced placement rules for primary or replica	●	●
Uses TCP/IP	●	●
Easy POJO programming	◒	◒
Embeds in existing platform	●	○
Spring Support	◒	◒
Tight integration with Java EE Application Servers	●	●
Hibernate L2 cache support	●	○
Bidirectional link to DB	●	○
SCN support for DB invalidation	◒	○
Single grid throughout data centers	●	●
Multi-master data center replication	●	●
Transactional Support	◒	◒
Elastic Scaling	●	●

Key: ○ = not supported, ◒ = mostly support, ● = fully supported

For more information

To learn more about the IBM WebSphere eXtreme Scale and WebSphere DataPower XC10 Appliance products, please contact your IBM sales representative or IBM Business Partner, or visit the following websites:

- **ibm.com**/software/webservers/appserv/extremescale
- **ibm.com**/software/webservers/appserv/xc10

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[1] Mikhail Genkin, Billy Newport and Stacy Jones, "Enhancing WebSphere Commerce performance with WebSphere eXtreme Scale": **ibm.com**/developerworks/websphere/techjournal/1008_genkin/1008_genkin.html, August 2010.

[2] Mikhail Genkin, Billy Newport and Stacy Jones, "Enhancing WebSphere Commerce performance with WebSphere eXtreme Scale": **ibm.com**/developerworks/websphere/techjournal/1008_genkin/1008_genkin.html, August 2010.

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