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Swiss Exchange
ERM Technical Requirements

I-ERM-TRQ-100A/E, Draft Version 1.0A, 29 Apr 98

This document describes the technical requirements for ERM. It covers performance, resilience, availability and other requirements not related to business functionality.

Identification

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Revision History

Version, Date	*Change Description*
Draft Version 1.0A, 24 Apr 98	New document

Table of Contents

1. Introduction

1.1 Purpose & Scope

This document describes the technical requirements for ERM. It covers performance, resilience, availability and other requirements not related to business functionality.

1.2 Changes Since Last Version

This is the first version.

1.3 Structure of this Document

Section 2 has the system overview.

Section 3 has the requirements.

1.4 Relationship to Other Documents

1.5 Definitions & Abbreviations

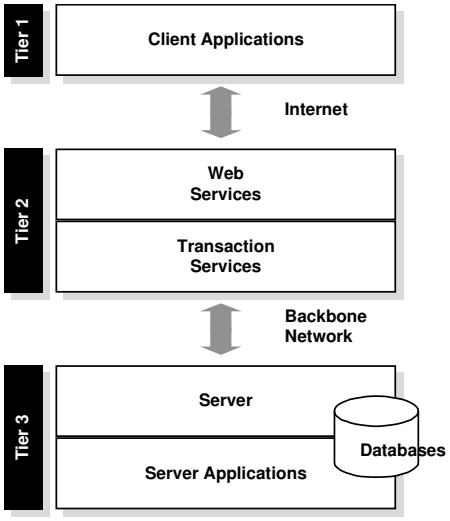
1.6 References

reference & document title	applicable version and reference
1 ERM Systemkonzept	I-DEV-ERM-100D/D
2 ERM Business Plan	I-ERM-BUS-100/D
3 Functional Requirements for ERM	I-ERM-FRQ-100A/E
4 Java Feasibility Study	I-ERM-JFS-100

1.7 Outstanding Issues

2. ERM Overview

2.1 Applications Overview



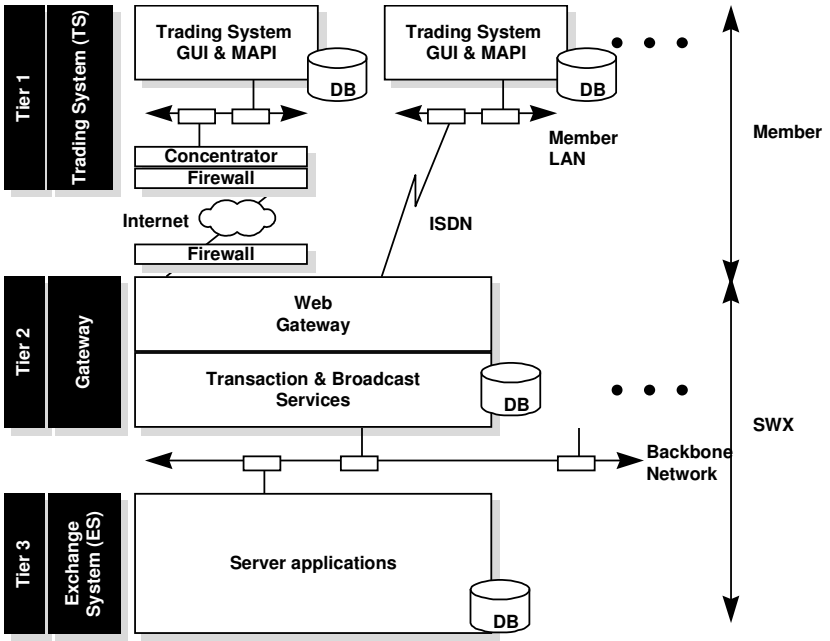
The ERM architecture is described in more details in I-DEV-ERM-100D/D1.

The Trading Systems (TS) (GUI & MAPI) main goal is to interface with the traders, I.e. entering, modifying, and display of orders and trades. The trading systems are connected through the local network of the member to the WEB Gateway, either through the Internet or a dedicated SWX ISDN line.

The WEB Gateway provides distribution to the members and transaction management capabilities.

The Exchange System (ES) provides normal handling of orders and trades. The Exchange System provides also services such as the transmission of trades to SEGA, the control and supervision of the exchange, and archiving services.

2.2 Infrastructure Overview



The ERM architecture is described in more details in 1.

The Trading Systems (TS) (GUI & MAPI) main goal is to interface with the traders, I.e. entering, modifying, and display of orders and trades. The trading systems are connected through the local network of the member to the WEB Gateway, either through the Internet or a dedicated SWX ISDN line.

The Concentrator collects and distributes the services to the TS clients.

The WEB Gateway provides distribution to the members trough Internet and ISDN (Web Server) as well *transaction and broadcast services*. The Gateway provides some business functionality related to broadcasting and transaction services, such as system recovery.

The Exchange System (ES) provides normal handling of orders and trades (matching). The Exchange System provides also services such as the transmission of trades to SEGA, the control and supervision of the exchange, and archiving services.

3. ERM Requirements

3.1 Hardware / Software Environment

tbd

3.1.1 Trading System

3.1.1.1 MAPI and Object Interface

Ref	Description
1	an object interface middleware (DCOM, EJB) is available.
2	Simplicity: the interface development complexity is minimized by the use of high abstraction level API.
3	Persistence of data is provided on the client system
4	There is a Member Application Programming Interface (MAPI) which allows members to build Member Own Applications (MOAs).

Multi-platform support:

Ref	Description
5	it runs on Windows NT 4.0 or later
6	it runs on Windows 95 or later
7	it runs on additional UNIX platforms (unspecified)
8	the portability costs between these systems are minimised.

3.1.1.2 GUI Client

The user Interface must fulfil the following:

Ref	Description
9	It runs as a stand-alone application
10	It runs as a component within a Web browser (for example applet)
11	It supports multiple Web browsers (unspecified)
12	It has copy/paste and drag/drop functionality
13	It has to maintain profiles for look and feel, sorting and filtering
14	It must synchronise windows
15	It must support up to 20 windows to be updated and displayable in the appropriate sequence
16	It needs drop down selection menus

3.1.2 Gateway and Transaction Server

The overall job of the Gateway is to transfer Messages across the ES-TS boundary, it does this by encapsulating them inside Frames. The Gateway sends and receives Messages between the Exchange System, and sends and receives Frames between the Trading System.

When appropriate, the Gateway uses the header fields of a Message to determine the appropriate service on the ES to which the Business Message should be routed. The non-header contents of a Message are generally opaque to the Gateway.

Ref	Description
17	It runs either on Windows NT 4.0 or on Digital OpenVMS (alpha server)

The following transaction services must be provided:

Ref	Description
18	Session mode transaction (enter with reply)
19	Reliable broadcast
20	Datagrams ?
21	Stability ?
22	An object interface middleware (DCOM, EJB) is available.
23	Relational mapping to transparently store objects in relational databases?

The following Web Server Functionality is required:

Ref	Description
24	It needs HTTP services to provide HTML pages etc.
25	It receives orders which are forwarded to internal Applications.
26	It stores information received from internal applications to a database.
27	It applies filters to information received from internal applications and forwards them to one client.
28	It has to maintain all profiles which are set by the client Trader.
29	It maintains relationships between the Members Organisation, Member and its Traders.
30	It maintains the recoverable data for each of the relations.

3.1.3 Exchange System (ES) technical requirements

The ES architecture is based on the following building blocks:

- Server
- Applications

3.1.3.1 Server

Server Interface: USP Request Broker

The USP (Universal Server Control Process) is a request broker, providing fundamental services for distributed applications.

The USP acts as a dispatcher for incoming requests from clients and pass them to the appropriate server. The configuration table tells the USP which service is located where, which services can serve what and how many servers should be available. The start-up and shutdown of server instances is dynamically maintained by the USP. The functionality of the server is application specific and is fully under the control of the developer.

The major *features* of the USP Request Broker are: (Note: these are features already provided by the system, not requirements.)

- Transparent support for multiple protocols (TCP/IP, DECnet, HTTP)
- Server functionality fully under business control (you write your own servers)
- Support for applicational and transactional server types (explained later on)
- Dynamic control of multiple instances of the same server. (USP decides when to start or stop a service)
- Cascading of servers (server can act as a client for another server)
- Support for remote or local services
- Dynamic RPC (transport of dynamic data types)
- Error isolation (crash of a server instance has no impact on other instances)
- Location transparency (the location of the service is configurable)

The USP Request Broker is currently available on OpenVMS (VAX and AXP) and will be available on NT mid of 1998.

3.1.3.2 Server Applications

Ref	Description
31	NTB interface: The applications will be reading and writing to the Network Transaction Bus (NTB).
32	Some of the transactions which access databases and the NTB must be committed in the same commit operation.
33	Multi-processing. The main purpose of this applications (processes) is to allow the entering of orders, filtering information to the Members and to provide recoverable data to the members driven by the specific filters. Based on the software architecture chosen we will have one or more processes (images) running.

3.2 Capacity Requirements

3.2.1 Server and transaction services

The following table defines the required capacity:

Name	***Plan 1999***	***Design Limit***
# of Members	50	1000
Maximum # of Members per market	50	300
# of contracts	18	1000
Maximum # of contracts per market	18	500
# of limits	4410	4485000
# of limit adjustments per day	441	2242500
# of orders entered per day	2,500	~~25~~1,000,000
# of trades per day	500	~~25~~120,000
# of repurchases per day	1,000	240,000

The ***"Plan 1999"*** figures represent the expected requirements for the introduction of ERM Phase I~~SOFFEX~~, whereas the ***"Design Limit"*** specifies the requirements for ERM long term to support international business. ERM will be tested against the values defined in the ***"Design Limit"*** column.

The limits figures are calculated as follows:

Step	1999		Design Limit	
	Number	Result	Number	Result
Counterparty limits - 1 per member	50	2450	300	89700
Limits by contract - 0.1 per contract	18	4410	500	4485000
Number of markets	1	4410	5	22425000
Limit adjustments per day	10%	441	10%	2242500

The limits are the extreme cases. If members hold limits by contract group and time rather than by individual contract there is scope to reduce the total. The limit adjustments figure assumes members change x% of their limits each day.

The ***"Plan 1999"*** trades figure is from 2 (standard + special Repo = 245) * 2 (for a peak day) and rounded up. 2 assumes that volumes will double by 2001 in the best case scenario. The ***"Design Limit"*** trades figure is this number * 10. The repurchases numbers should be about the same as the trades numbers. They are twice as big to allow for peaks, e.g. at month ends.

The orders figures are the trades figures * 5. This is approximately the EBS production ratio in 1998.

The transaction server performance requirements are:

Ref	Description
34	number of simultaneously open connections : 200 connections
35	number of Transaction Per Second (TPS) 20 TPS – average
36	number of Transaction Per Second (TPS) 100 TPS – peak
37	*scalability to [missing ?] TPS within 2 years*

3.2.2 Clients and enquiries

Name	***Plan 1999***	***Design Limit***
Maximum # of concurrent clients per member	10	100
Maximum # of concurrent clients – whole system	250	10,000
# of limit enquiries per day	500	10,000
# of other enquiries per day	100	2,000

The client users include traders and credit risk managers.

The plan 1999 maximum concurrent clients assumes an average 5 clients per member. The design limit assumes on average 10.

The number of limit enquiries per day is 2 per client. The number of other enquiries is a guess.

3.3 Performance

3.3.1 Responsiveness (real time)

Responsiveness is a measure of the ability of ERM to react to events:

- the throughput and system conditions are as defined in section 3.2
- the Server hardware is a ? with ? CPUs, ?GByte memory, up to ? spindles and no solid state disks ???
- the system is configured with replication and active standbys as they would be in production
- there is user enquiry activity as in normal use. ~~50~~

The boundary of ERM depends on the configuration:

- for an ISDN link the boundary is the Trading System MAPI
- for an internet link (which cannot be assumed to be reliable or fast) the boundary is the web server.

The 'request response' time is the time between the transaction request reaching the boundary of ERM and the response reaching the boundary of ERM. The response contains:

- acknowledgement of the transaction
- final results of validation (i.e. the transaction is accepted or not and this will not change during later processing). This includes error information.

The 'request result' time is the time between the transaction request reaching the boundary of ERM and the final processing result being available.

The 'broadcast response' time is the time between the transaction request reaching the boundary of ERM and the final processing result reaching the boundary of ERM and being available in the database for enquiries and other transactions.

The 'plan' times are the required mean responsiveness for the whole day. The 'worst limit' is the mean responsiveness for the 5 minutes with the worst responsiveness during the day. The 'maximum' times are the limit for the transaction with the worst responsiveness. These are set at 3 times the 'worst limit'.

The times apply to all clients and gateways. No client or gateway shall have worse responsiveness than the requirements.

For responses to ERM client user requests, the scenario is considered as follows:

- There are n ERM clients identified as location 1 to location n.
- Location x (x in the range of 1 to n) delivers a transaction or enquiry request to the boundary of ERM at time $t_{1(x)}$.
- Location x receives the response to the transaction request at the boundary of ERM at time $t_{2(x)}$.
- Location x has the results of the processing of the transaction request or the result of the enquiry available from ERM at time $t_{3(x)}$.

Request Response is the time between getting a transaction request and sending its response to the boundary of the ERM ($t_{2(x)} - t_{1(x)}$).

Request Result is the time between getting a transaction request and broadcasting its processing result to the boundary of the ERM ($t_{3(x)} - t_{1(x)}$).

The requirements will be tested with built in statistics which record times at the boundaries.

3.3.1.1 Transactions

The requirements for transactions are as follows. The MAPI to MAPI results only apply to the configuration with an ISDN link.

Name	***web server - web server*** ***Request Response***	***web server - web server*** ***Request Result***	***MAPI - MAPI*** ***Request Response***	***MAPI - MAPI*** ***Request Result***
Plan	1.2 sec's	1.5 sec's	1.5 sec's	2.0 sec's
Worst Limit	2.4 sec's	4.0 sec's	3.0 sec's	5.0 sec's
Maximum	7.2 sec's	12.0 sec's	9.0 sec's	15.0 sec's

3.3.1.2 Enquiries

The requirements for a standard enquiry on the member's own limits are as follows. The MAPI to MAPI results only apply to the configuration with an ISDN link.

Name	***web server - web server*** ***Request Response***	***web server - web server*** ***Request Result***	***MAPI - MAPI*** ***Request Response***	***MAPI - MAPI*** ***Request Result***
Plan	1.6 sec's	6.0 sec's	2.0 sec's	8.0 sec's
Worst Limit	3.2 sec's	12.0 sec's	4.0 sec's	15.0 sec's
Maximum	9.6 sec's	36.0 sec's	12.0 sec's	45.0 sec's

3.3.2 Regular processing (batch)

The daily repurchases (see the numbers in section 3.2) must be processed quickly enough to allow overnight processing to complete and have contingency for problems.The target is that they are processed in 1 hour on a normal day (with < 10,000 repurchases) or 2 hours on a peak day.

3.4 Resilience and Configurability

Resilience is the ability of the system to continue operation or partial operation following the failure of one component (no single point of failure).

Configurability is the ability to distribute the executable software over the available hardware resources. Any restrictions (such as hard coded node names, system ids ...) hindering this approach shall be avoided.

3.5 Availability Requirements

Availability is quantified by the number of times, and for how long the services provided by the system are unavailable.

Loss of service includes:

- process failure
- failure to receive or deliver information within the required time (hanging or a very slow system)
- any other failure which stops a user (member or SWX) using the system according to the functional specification (for example data corruption caused by a bug).

The system design shall allow for the provision of redundant components at various levels so that loss of service does not result from the failure of a single component. The decision whether to install such redundant components can then be made on a cost/benefit basis.

Exchange and transaction server

Ref	Description
38	The exchange is not always available. Outside of the Business Day (period when a trading system can submit messages), it will need to be 'out' from time to time for operational reasons.
39	During the Business Day, the availability is guaranteed.

"Loss of Service" requirements will be assessed using the following criteria:

- no loss of service during the tests of capacity, process capacity and responsiveness
- the probability of known errors which cause loss of service happening in normal use (i.e. use according to user manuals with no workarounds for system errors).

3.6 Expandability and Extendibility

Expandability is the ability to absorb changes in applied workload quickly. Increase in the workload is to be handled by replication of hardware and/or software components rather than by the use of more powerful hardware or by application modifications. Associated with this is the ability to upgrade the provided resources quickly.

Extendibility is the ability to add functions without disturbing current functions.

In order to achieve the required performance for today and also to get the freedom to expand, it is important to get a solution which is scaleable. The design shall foresee the possibility for partitioning applications based on different elements like member, security and so on. It shall also be possible to run several web Gateways in parallel.

3.7 Operational Requirements ~~erver~~

tbd

3.8 Maintainability Requirements

Maintainability is a measure of the resources required to keep the system operational.

Documents and standards shall be fit for purpose to allow SWX development, Configuration Management, Operations and user teams to keep the system operational and make enhancements:

- Development teams will use analysis, design, naming, coding, test and documentation standards and system documents.
- Configuration Management and Operations will use system documentation.
- User documents are needed as handbooks and electronically available. They are used by Operations and users (such as GBM).

Acceptance will be by customer review of the design, code, documents and standards.

Software layering and modularity shall be such that it is possible to replace a layer without a major redesign of the whole system. Acceptance will be by a technical design review.

3.9 Audit / Control Requirements

It is a requirement to record (audit) modifications to the database. This is not only to fulfill legal requirements but also to keep sufficient information about the history of the database for problem solving purposes.

It is also required to have application level security violations be audited continuously.

The successful completion of all necessary clearing processing performed during the daily processing is supervised by the ERM "Controls system". These Control procedures aid in identifying error conditions within batch processing and help ensure the integrity of the database.

The following is an example of processed entities to be controlled:

- # of members processed
- # of trades to be processed

complete list of required controls tbd.

3.10 Security Requirements

The system should provide strong security of communication, resource control, and system integrity. Security on the application level (like KERBEROS) is not required. There is no need of field encription, as in EBS, allowing a specific member to access a specific field with a public broadcast. The basic security features expected are

Ref	Description
40	Encryption of data traffic (for example SSL). The encryption of various fields in messages that are broadcasted from the Exchange to all members.
41	User authentication. The submission of information that allows a Member to identify itself to the Exchange.
42	Message authentication. The addition of information to transactional messages that are transmitted between the member and the Exchange. This information allows the reliable identification of the source of the message, i.e. the member, to the Exchange and vice versa.
43	It has to maintain the access security (privileges) for all members and services.

Security requirements applicable to the communication between ERM Server and the Member GUI are addressed within ERM.