

TREX – SAP NetWeaver's Search and Classification Engine



SAP NetWeaver Product Management
July 2008

Agenda



Introduction to TREX in SAP NetWeaver

TREX Functions and Features

TREX Architecture and Details

TREX Plattform, Sizing Guidelines, ...

Summary

Search Engine for SAP



SAP NetWeaver

TREX

THE BEST-RUN BUSINESSES RUN SAP



- TREX is the **one** search technology in SAP solutions
- TREX is deployed in over a dozen SAP products
- TREX searches and analyses as well unstructured documents as structured business data
- TREX in knowledge management provides search access to an extensible number of document repositories
- TREX will provide the backend technology for Enterprise Search

Current use of TREX in SAP Solutions / Components



In SAP NetWeaver

- SAP NetWeaver Enterprise Search
- SAP Enterprise Portal
 - Knowledge Management (KM) platform
- SAP Business Intelligence (attachmenst, data aggregation in future)
- SAP KW (Training + Documentation solution)
- SAP Records Management

Further SAP solutions / components

- mySAP HR Expert Finder, e-Recruiting, Learning Solution
- mySAP PLM DMS (Document Management System)
- IS Automotive Vehicle Finder
- mySAP CRM
 - Internet Sales (Catalog Engine)
 - IC Web Client
 - Segment Builder
- ...more

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Introduction to TREX in SAP NetWeaver

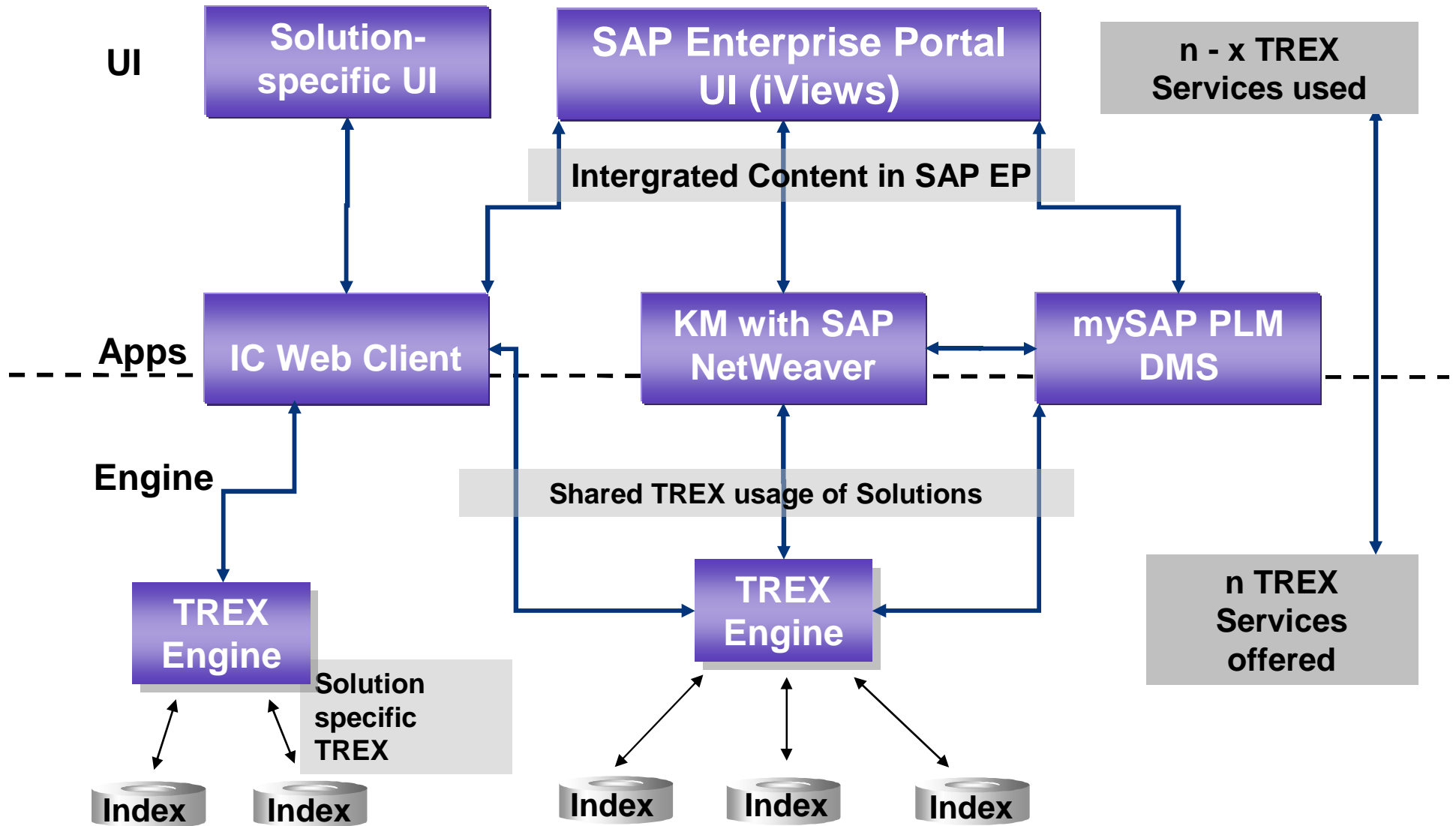
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TREX is a service provider for SAP solutions



TREX - Search Services offered



Search in

- Unstructured data (documents)
- Structured data (business objects)
- Full text
- Attributes

Different search modes

- Exact
- Linguistic: stemming, etc.
- Fuzzy: Search error tolerant
- Wildcards and truncations (* or ?)
- Phrase search for complex expressions
- Boolean operators (AND, OR, NOT...)
- Highlighting / HTML conversion
- Content Snippets (Abstracts)
- Federated search
- ...

TREX Text Mining Engine - Services offered



Document Feature extraction

- ▶ Find characteristic keywords (noun phrases)

Find similar documents

- ▶ Based on document features

Document classification

- ▶ Assign a document to predefined categories

Term search

- ▶ Find better search terms; discover interesting relationships

Document clustering

- ▶ Discover sets of related documents

Term clustering

- ▶ Discover sets of related terms in the current corpus



Search for all types of attribute

- String, integer, floating point, date, and so on

Sort query results by any attribute

- For example, sort documents by date or by author

Support range search

- For example, find sales orders from the last two months

New:

- Multihost enabled
- Attribute search enabled not only for case-insensitive ASCII but also for case-insensitive Unicode

Additional Services - Example: Interactive Search



1 User enters search keyword Berlin

Berlin	
Name	(26)
...	(...)
Street	(5)
<u>A-D</u>	(42 hits)
...	(...)
<u>M-P</u>	(35 hits)
...	(...)
Age	(5)
<u>0-18</u>	(314 hits)
...	(...)

2 Search results:
Hits grouped by attributes (overlapping) and listed by attribute value ranges (disjunct)

3 User clicks on group M-P in Street

M-P < Street < Berlin	
Street	(...)
...	(...)
<u>Pariserstr</u>	(3 hits)
...	(...)
Name	(26)
<u>A</u>	(35 hits)
...	(...)
<u>Z</u>	(...)

4 Search results:
Groups ordered by relevance for this search
All hits are in M-P streets in Berlin

5 User clicks street and sees hits

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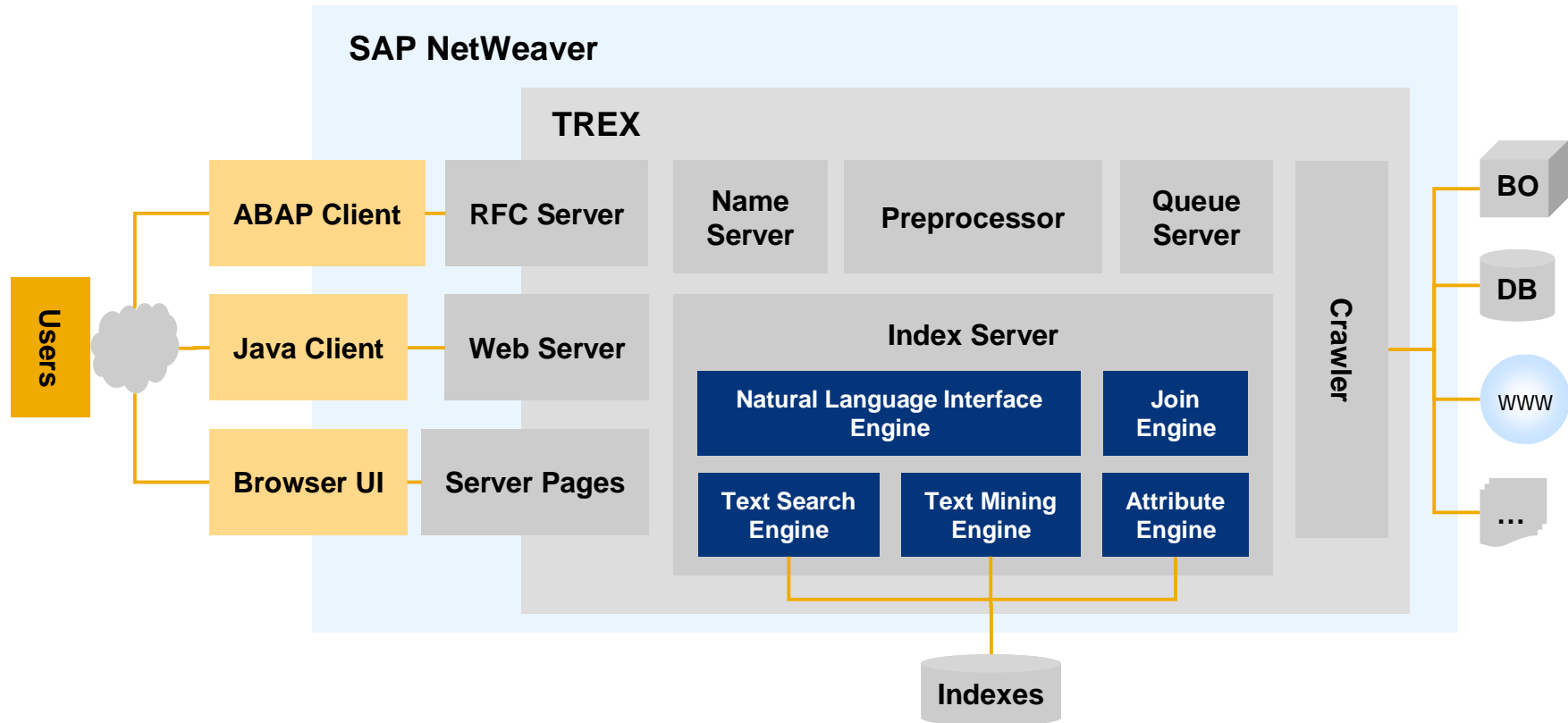
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SAP NetWeaver TREX



TREX APIs...



...may only be used SAP-internally

- ▶ Cannot directly be used by customers or partners

...can indirectly be accessed via other APIs

- ▶ e.g. the KM IMS API or the ABAP search engine service

TREX - Supported Languages



- **Arabic**
- **Chinese trad.**
- **Chinese simpl.**
- **Czech**
- **Danish**
- **Dutch**
- **English**
- **Finnish**
- **French**
- **German**
- **Greek**
- **Hebrew**
- **Hungarian**
- **Italian**
- **Japanese**
- **Korean**
- **Polish**
- **Portuguese**
- **Norwegian bok.**
- **Norwegian nyn.**
- **Romanian**
- **Russian**
- **Spanish**
- **Swedish**
- **Thai**
- **Turkish**
- **...more**

Indexable MIME Types



ANSI Text (7 & 8 bit)	All versions	
ASCII Text (7 & 8 bit versions available)		All versions
Corel WordPerfect for Windows	Versions through 9.0	
DEC WPS Plus (DX)	Versions through 4.0	
DEC WPS Plus (WPL)	Versions through 4.1	
DisplayWrite 2 & 3 (TXT)	All versions	
DisplayWrite 4 & 5	Versions through 2.0	
Enable	Versions 3.0, 4.0 and 4.5	
First Choice	Versions through 3.0	
Framework	Version 3.0	
HTML	Versions through 3.0 (some limitations)	
IBM FFT	All versions	
IBM Revisable Form Text	All versions	
IBM Writing Assistant	Version 1.01	
JustWrite	Versions through 3.0	
Legacy	Versions through 1.1	
Lotus AMI/AMI Professional	Versions through 3.1	
Lotus Manuscript	Versions through 2.0	
Lotus WordPro (Win16 and Win32 / Intel platforms)		SmartSuite 96, 97 and Millennium
Note: The Lotus WordPro filter is for Win32 on the Intel platforms only, and is provided to SAP "as is", without any representations or warranties.		
Lotus WordPro (Non-Windows platforms - text only)		SmartSuite 97 and Millennium
MacWrite II	Version 1.1	
MASS11	Versions through 8.0	
Microsoft Rich Text Format (RTF)	All versions	
Microsoft Word for DOS	Versions through 6.0	
Microsoft Word for Macintosh	Versions 4.0 through 98	
Microsoft Word for Windows	Versions through 2000	
Microsoft WordPad	All versions	
Microsoft Works for DOS	Versions through 2.0	
Microsoft Works for Macintosh	Versions through 2.0	
Microsoft Works for Windows	Versions through 4.0	
Microsoft Write	Versions through 3.0	
MultiMate	Versions through 4.0	
Navy DIF	All versions	
Nota Bene	Version 3.0	
Novell Perfect Works	Version 2.0	
Novell WordPerfect for DOS	Versions through 6.1	
Novell WordPerfect for Mac	Versions 1.02 through 3.0	
Novell WordPerfect for Windows	Versions through 7.0	
Office Writer	Version 4.0 to 6.0	
PC-File Letter	Versions through 5.0	
PC-File+ Letter	Versions through 3.0	
PFS:Write	Versions A, B, and C	
Professional Write for DOS	Versions through 2.1	
Q&A for DOS	Version 2.0	
Professional Write Plus	Version 1.0	
Q&A Write for Windows	Version 3.0	
Samna Word	Versions through Samna Word IV+	
SmartWare II	Version 1.02	
Sprint	Version 1.0	
Total Word	Version 1.2	
Unicode Text	All versions	

e.g.

- MS Word
- HTML
- XLS
- QuattroPro
- PDF
- Lotus Manuscript
- MS Rich Text

...approximately 200 text-containing file types

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TREX 7.1 in next major release of SAP NetWeaver



Focus platform support on:

- Linux for x86_64
- Windows for x86_64

In Detail: <http://service.sap.com/pam>

The screenshot shows the SAP NetWeaver 7.1 interface with the 'Operating Systems' tab selected. The table below lists the supported operating systems and their release dates.

Operating System Version	Status (Internal)	Date (Internal)	Status (External)	Date (External)	System Status	Remarks
LINUX REDHAT EL4/X86_64 64BIT	Released	19.09.2008				
LINUX REDHAT EL5/X86_64 64BIT	Released	19.09.2008				
LINUX SUSE SLES10/X86_64 64BIT	Released	19.09.2008				
LINUX SUSE SLES9/X86_64 64BIT	Released	19.09.2008				
WINDOWS SERVER 2003/X64 64BIT	Released	19.09.2008				

Reasons for platform reduction



- Optimize scalability and performance for fewer platforms more efficiently
- Ensure a highly performance-optimized TREC for our customers
- Ensure completeness of 64-bit coding for next release
- No negative or limiting impact on other SAP solutions expected, because of TREC's internal client/server architecture and planned appliance delivery
- Reduce cost of development and support and focus on available expertise at TREC development

Previous TREX releases upto 7.0



- Platform support of previous releases is of course valid and remains so until their end of maintenance
- **TREX 7.0** for SAP NetWeaver 2004s thus comes to **2014** in 5+2+1 model.

TREX releases in current use

- TREX 5.0 Out of maintenance
- TREX 6.0 End 2006
- TREX 6.1 2013
- TREX 7.0 2014

Current intention is to move 6.0 and 6.1 installations mostly to 7.0

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Summary



- Future TREX platform focus on Windows and Linux is a decision that has been made in relation to available development resources and expertises in TREX development.
- It will enable more focussed development to optimize TREX performance and supportability.
- It **does not express** any general platform preference trend at SAP.



Configuration and Administration

TREX Search and Indexing

Landscape Configuration

Excursion: TREX Sizing

RFC Connection

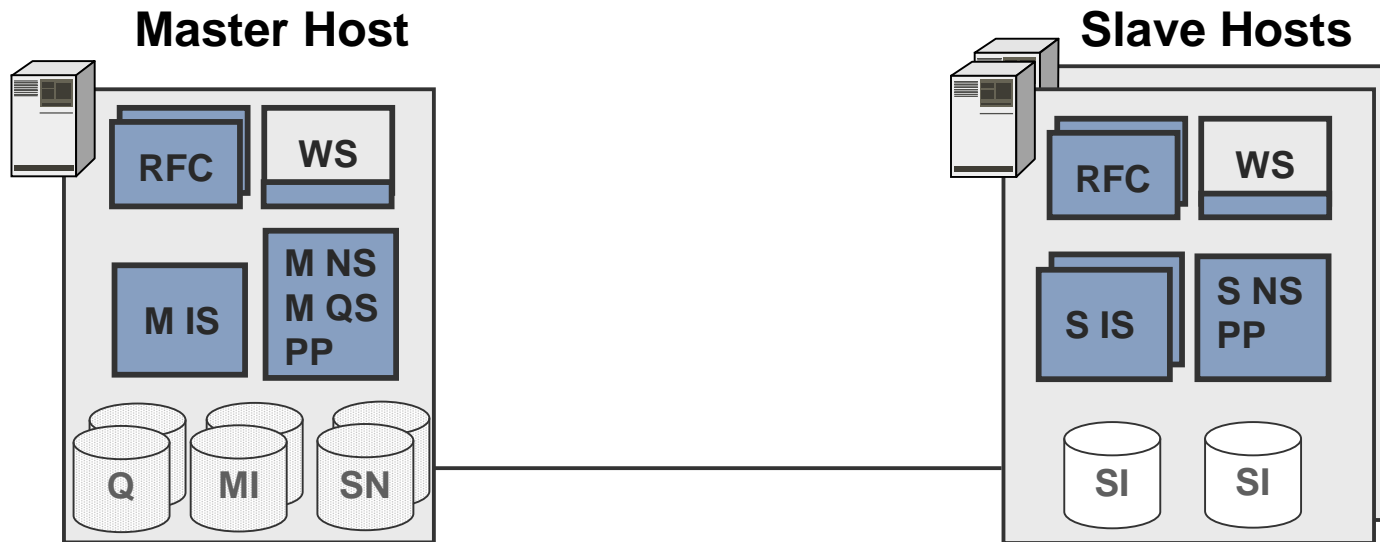
Administration and Monitoring

TREX is Highly Scalable



- **TREX** can be distributed on multiple hosts
- **TREX** hosts can have dedicated roles (Indexing, searching, backup....)
- **TREX** processes can run multiple times within the same TREX instance on one host
- **TREX** hosts can be added any time

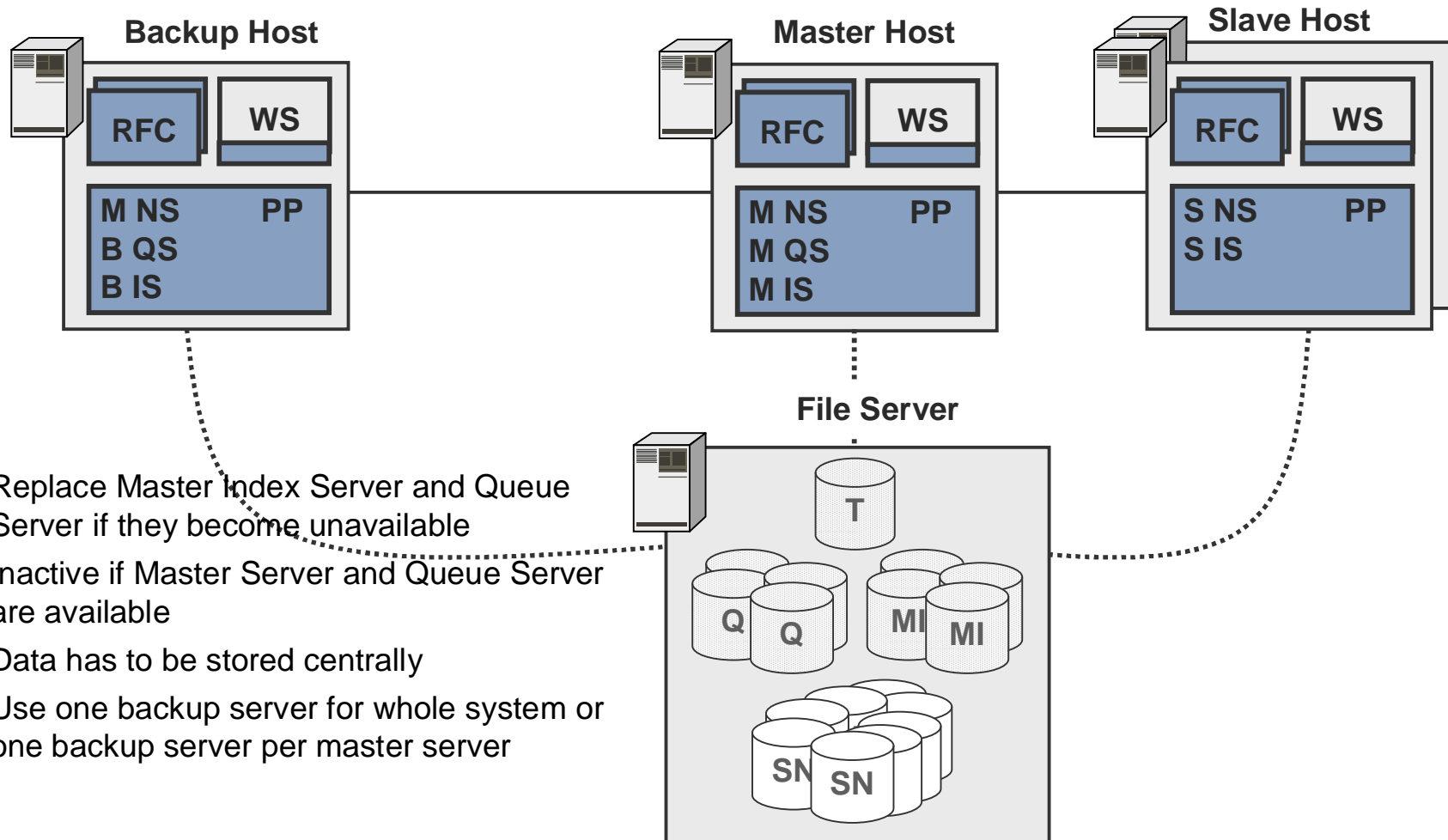
TREX Hosts - Master and Slave



- Responsible for indexing
- Can also be used for searching but not in default configuration
- manages original version of index

- Responsible for searching
- Ensure performance during indexing times
- Manages copy of master index
- Index is created and updated using replication procedure

TREX Hosts - Master, Slave and Backup

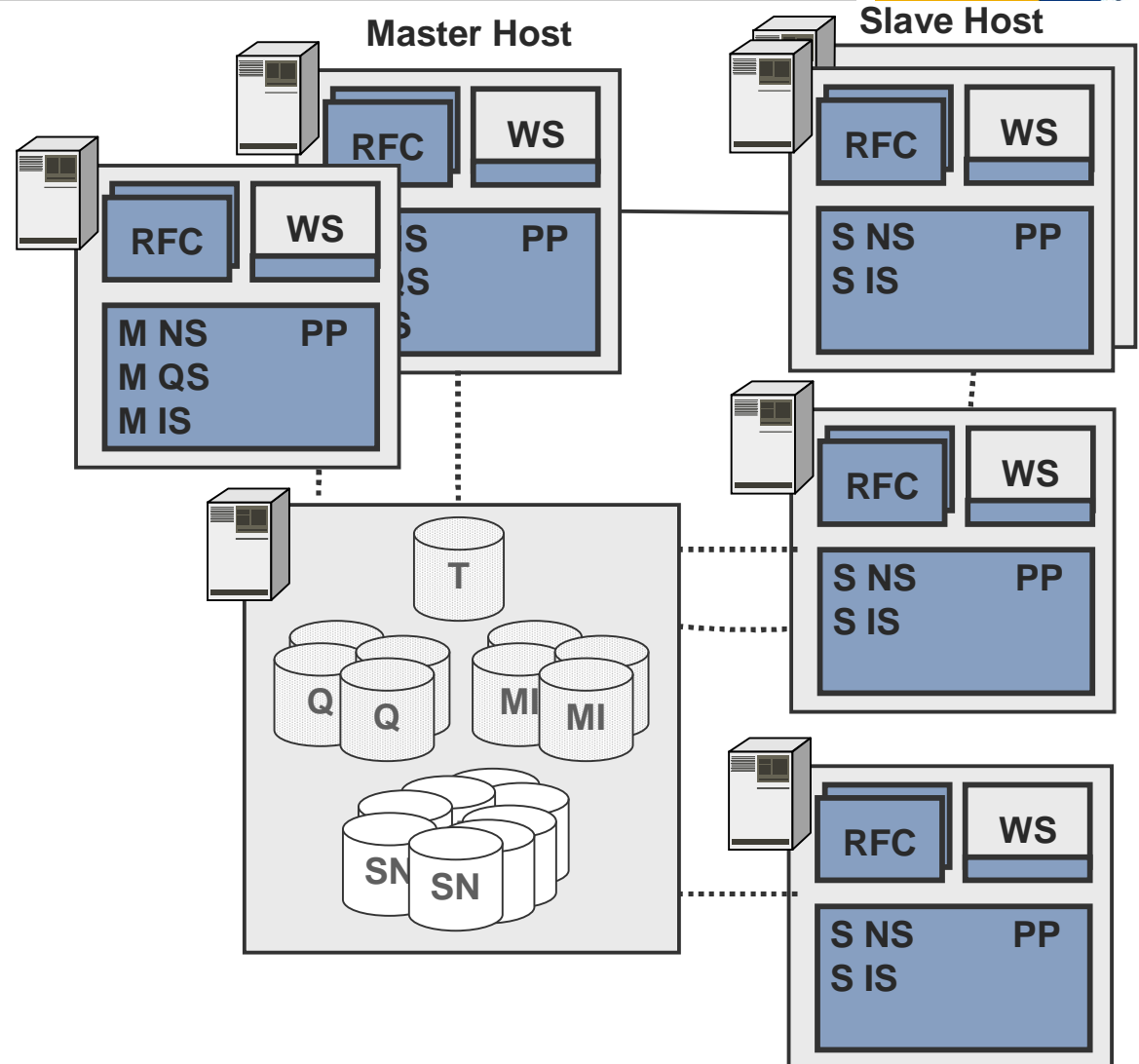


- Replace Master Index Server and Queue Server if they become unavailable
- Inactive if Master Server and Queue Server are available
- Data has to be stored centrally
- Use one backup server for whole system or one backup server per master server

TREX Hosts - Scalability



- Load Distribution for Searching and Indexing
- High availability for Searching
- Indexing larger data sets
- TREX is:
 - Scalable
 - Provides load balancing
 - Provides HA Solution for Search



Landscape Example



TREX Administration - Landscape Configuration - [INP : 00@ls2110,ls2111,ls2112,ls2125,ls2126,ls2127,ls2128,ls2154]

File Topic Action Options Help

SAP Queue: Admin Content Landscape | Index: Admin Landscape Usage Search Mining | Cruiser: Admin Landscape
 Landscape: Alert Configuration Reorg Tree Ini | Hosts Services Trace Perf.Trace RFC | Preprocessor: Admin View Docs.

Scenario

Use Backup Index/Queue Servers
 Use Slave Index Servers
 Use a File Server

Scenario Details

Use One Shared Backup Server
 Assign Existing Indexes/Queues to New Backup/Slave Servers

Index

Search Version: majority
 Search on Master/Backup Server
 Auto-Replication after Optimize

Landscape

ID: 1c369cd1-486a-db11-87c6-001185133f8d SID: INP Description: INP Landscape [Productive]

Hosts

...	Host ▲	Name Server Port	Name Server Mode	Master Index/Queue Server	Backup Index/Queue Server	Slave Index Server for ...	Preprocessor Mode	Base Path	Services
<input checked="" type="checkbox"/>	ls2110	30001	slave	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	index	/usr/sap/INP/TRX00	nameserver,preprocessor1
<input checked="" type="checkbox"/>	ls2111	30001*	2nd master	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> ls2125	search	/usr/sap/INP/TRX00	nameserver,preprocessor1,indexserver1,indexserver2,apache,alertserv
<input checked="" type="checkbox"/>	ls2112	30001	slave	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> ls2126	search	/usr/sap/INP/TRX00	nameserver,preprocessor1,indexserver1,indexserver2,apache,alertserv
<input checked="" type="checkbox"/>	ls2125	30001	1st master	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	search	/usr/sap/INP/TRX00	nameserver,preprocessor1,indexserver1,indexserver2,queueserver,apa
<input checked="" type="checkbox"/>	ls2126	30001	slave	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	search	/usr/sap/INP/TRX00	nameserver,preprocessor1,indexserver1,indexserver2,apache,alertserv
<input checked="" type="checkbox"/>	ls2127	30001	3rd master	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> ls2126	search	/usr/sap/INP/TRX00	nameserver,preprocessor1,indexserver1,indexserver2,apache,alertserv
<input checked="" type="checkbox"/>	ls2128	30001	slave	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> ls2125	search	/usr/sap/INP/TRX00	nameserver,preprocessor1,indexserver1,indexserver2
<input checked="" type="checkbox"/>	ls2154	30001	slave	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	index	/usr/sap/INP/TRX00	nameserver,preprocessor1,indexserver1,indexserver2,alertserver

Add Host Remove Host Copy Base Path Edit Custom Base Path Edit Servi

Refresh Check Deploy



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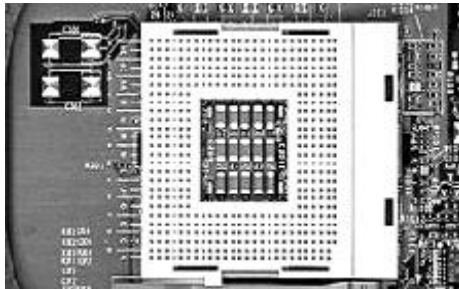
Administration and Monitoring

An Approach to Sizing – Detailed Agenda



- KPIs for TREX sizing
- Quick information on BIA sizing
- Sizing Methods and Tools
 - Structured Data
 - Unstructured Data
- Example for document based TREX landscape
- Different landscapes for different stages

Key Performance Indicators for Sizing TREX



CPU

- Processing time: load during indexing and search
- Expressed in SAPS

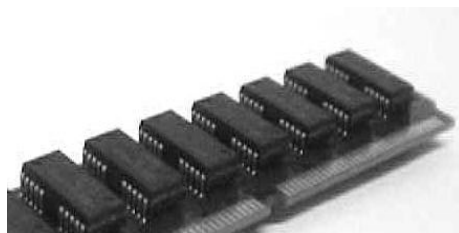
Disk

- Storage of indexes and queues
- Expressed in MB



Memory

- Memory consumption during indexing and search
- Expressed in MB



Network Load

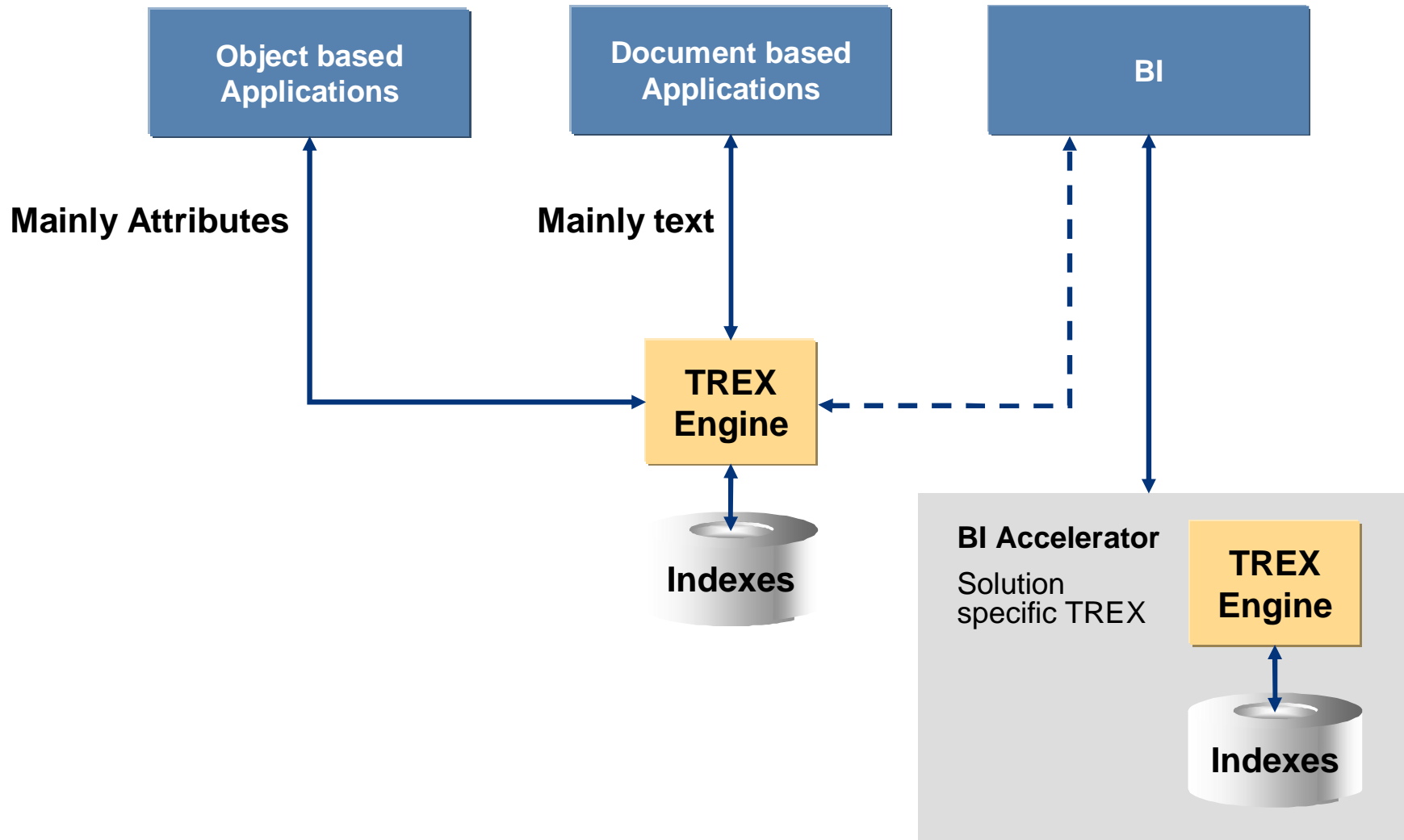
- Transferred amount of data
- KB per server request

Parameters Influencing TREX Sizing



- Amount of indexed data
- Search load
- Type of indexed data
- Number of languages
- Amount and frequency of delta indexing
- High availability needs

TREX Processing Structured and Unstructured Data



Possible Sizing Methods and Tools



Rule of thumb

- “A typical CPU can process 4000 scenarios”

T-Shirt Sizing

- Simple algorithms with many assumptions

Formulas

- Simple or more complex

Offline Questionnaires

- For structured questions

Quick Sizer

- Based on users and throughput



For our sizing, we assume the following:

- There are no configurable products
- Group conditions are included

3.1 Sizing the IPC for the E-Selling B2B Scenario

In this case, we assume that customers enter the article numbers directly and only do one pricing step for the shopping basket.

Category	Up until # line items per hour	SAPS
Small	20,000	300
Medium	40,000	600
Large	80,000	1200
Extra Large	320,000	4800

The following formula is intended to give you a basic idea of what network load may be expected. Note, however, that we strongly recommend that you conduct measurements on the most important transactions yourselves.

$$C = X * N * D * 0.25$$

The parameters are as follows:

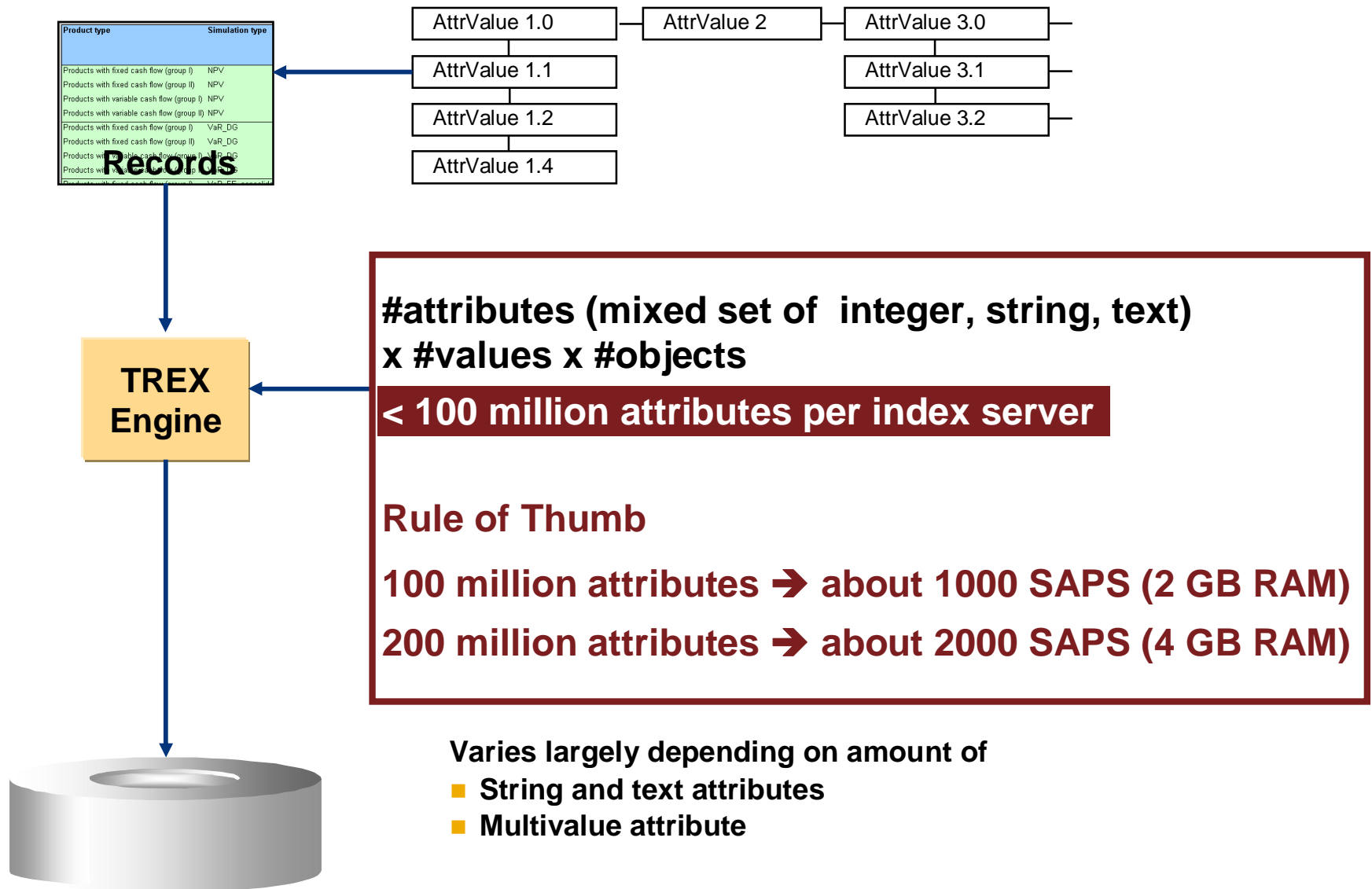
- C: Bandwidth in kbps that is needed for the SAP GUI
- X: Amount of data per dialog step in kB
- N: Number of active users (independent of the number of sessions)
- D: Average number of dialog steps per minute per user⁸
- Numerical factor: $-0.25 = 8 \text{ (kB/kB)} * 1.25 \text{ (protocol overhead)} * 1/60 \text{ (min/s)} * \text{safety factor } 1.5^9 \text{ (response time, peak load, different technologies)}$

Product type	Simulation type	Number of transactions	Average number of payments in cash flow	Average number of risk factors	Number of simulations
Products with fixed cash flow (group I)	NPV				
Products with fixed cash flow (group II)	NPV				
Products with variable cash flow (group I)	NPV				
Products with variable cash flow (group II)	NPV				
Products with fixed cash flow (group I)	VaR_DG				
Products with fixed cash flow (group II)	VaR_DG				
Products with variable cash flow (group I)	VaR_DG				
Products with variable cash flow (group II)	VaR_DG				
Products with fixed cash flow (group I)	VaR_FE_consolidated				
Products with fixed cash flow (group II)	VaR_FE_consolidated				
Products with variable cash flow (group I)	VaR_FE_consolidated				
Products with variable cash flow (group II)	VaR_FE_consolidated				

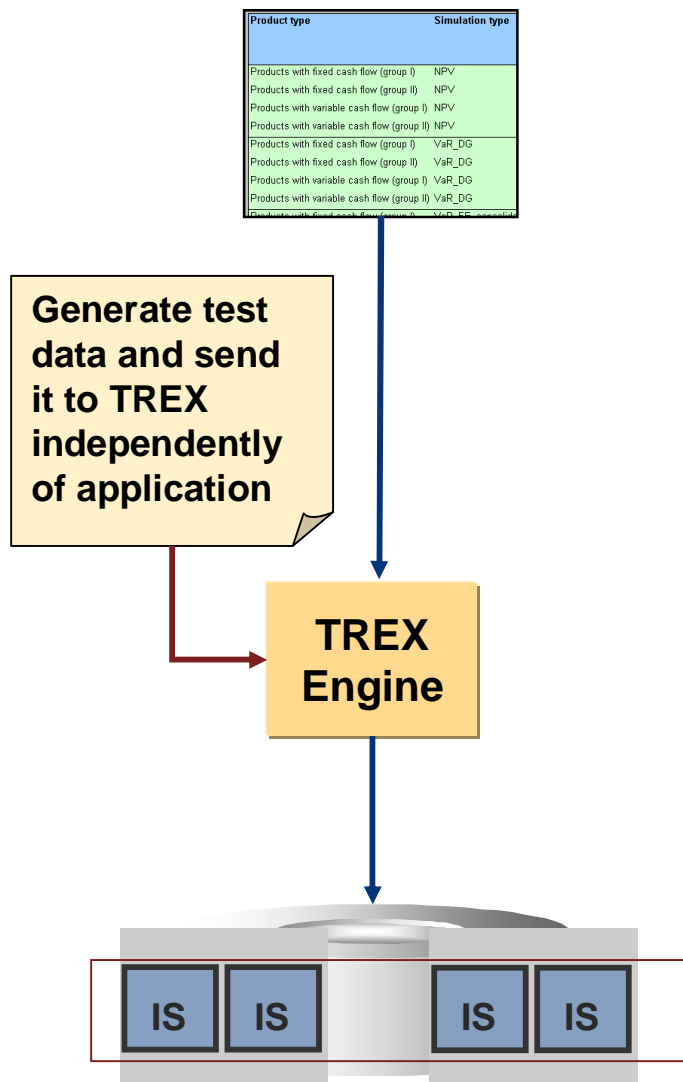
Table 5: Throughput - Standard Sizing w/o Line Items

Delete/Clear		Insert		Objects *	% chg.	% dsp.	Mon. *	Arch.	S
Element	A/P	TI							
CRM-ACT	A	Y							09
CRM-ACT	P	P							12
CRM-OPP	A	Y							09
CRM-OPP	P	P							12

Sizing TREN for Structured Data - Rule of Thumb



Sizing TRES for Structured Data – Approach





1. Use questionnaire to get an overview of your szenario
2. Use given formula to get a rough idea how many indexservers you need
3. Do hands on sizing by either
 - Using testdata from the application
 - Generating testdata on TRES machine, if you know datasets
4. Test indexing and search performance by monitoring CPU load and RAM consumption
5. Come to conclusion if your datasets allow larger amounts of attributesets per indexserver or smaller ones
6. Split index or design landscape with different indexes

Assumptions

- 80% mixture of predominantly office documents
- 20% PDF HTML and ASCII
- Data volume of indexed content: 100GB



Leads to

- Compression ratio of 1:40 from size of source data (documents) to index size in main memory
- Searching: Up to 18 000 per hour  2000 SAPS / 6 GB RAM
- Indexing: 24 hrs time consumption  4000 SAPS / 20 GB RAM



Required Disk Space – rule of thumb

	HTML/text Documents	Mixed set of Documents
Index size + queue (permanent)	Document set size x 2	Document set size x 0.5
Index snapshot size (permanent) <i>in distributed scenarios without central storage</i>	(Document set size x 2) x 0.7	(Document set size x 0.5) x 0.7
Temporary disk space	Document set size x 1.5	Document set size x 0.5

(Document set size x 3.5)

(Document set size x 1)

(Document set size x 4.9)

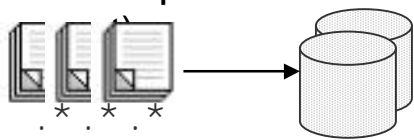
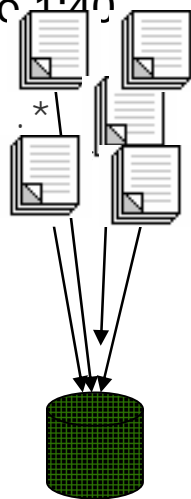
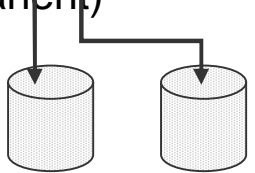
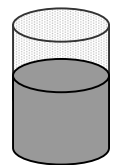
(Document set size x 1.35)

Sizing TREC for Unstructured Data 3



Required space – rule of thumb for a Mixed Set of Documents

Example: 50 GB of office and html/text documents

	Disk Space	Main Memory
Index size + queue (perman) 	Document set size x 0.5 25 GB (50 GB x 0.5)	Compression ratio 1:40 
Index snapshot size (permanent) 	Document set size x 0.5 x 0.7 17.5 GB (50 GB x 0.5 x 0.7)	
Temporary disk space 	Document set size x 0.5 25 GB (50 GB x 0.5)	

67.5 GB

An Example 1: Large Document Based TREX Landscape



2 Sets of Documents



Notes

- Basic quantity: 1.6 million / 800 000 documents per language
- Languages: 3 (E/G/J)
- Growth: 2000 per day new or changed

Search requests

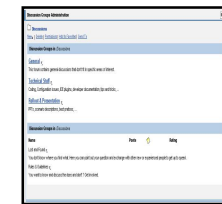
- 150 000 per day

Discussion threads

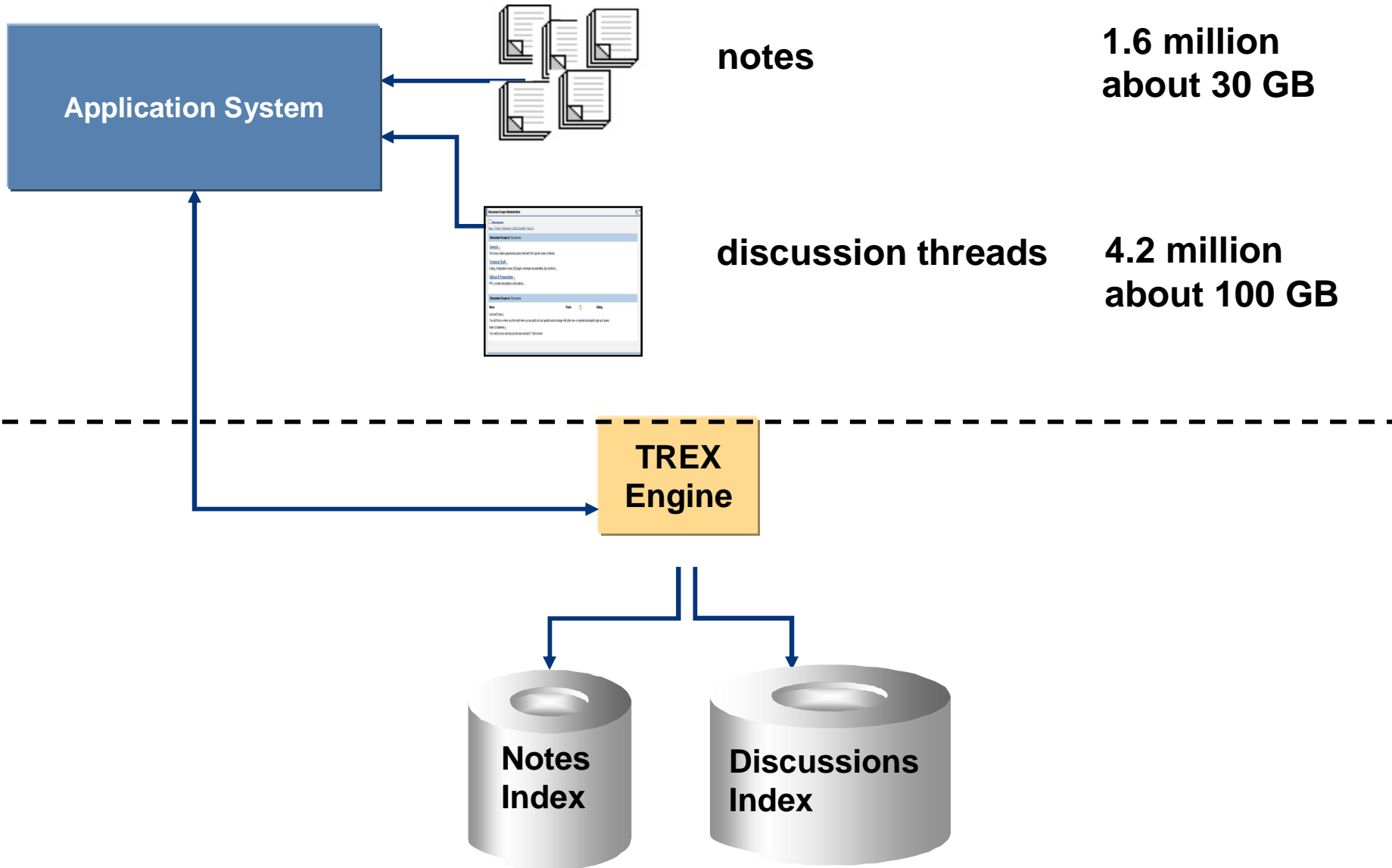
- Basic quantity: 4.2 million
- Languages: 40
- Growth: 20 000 per day new or changed

Search requests

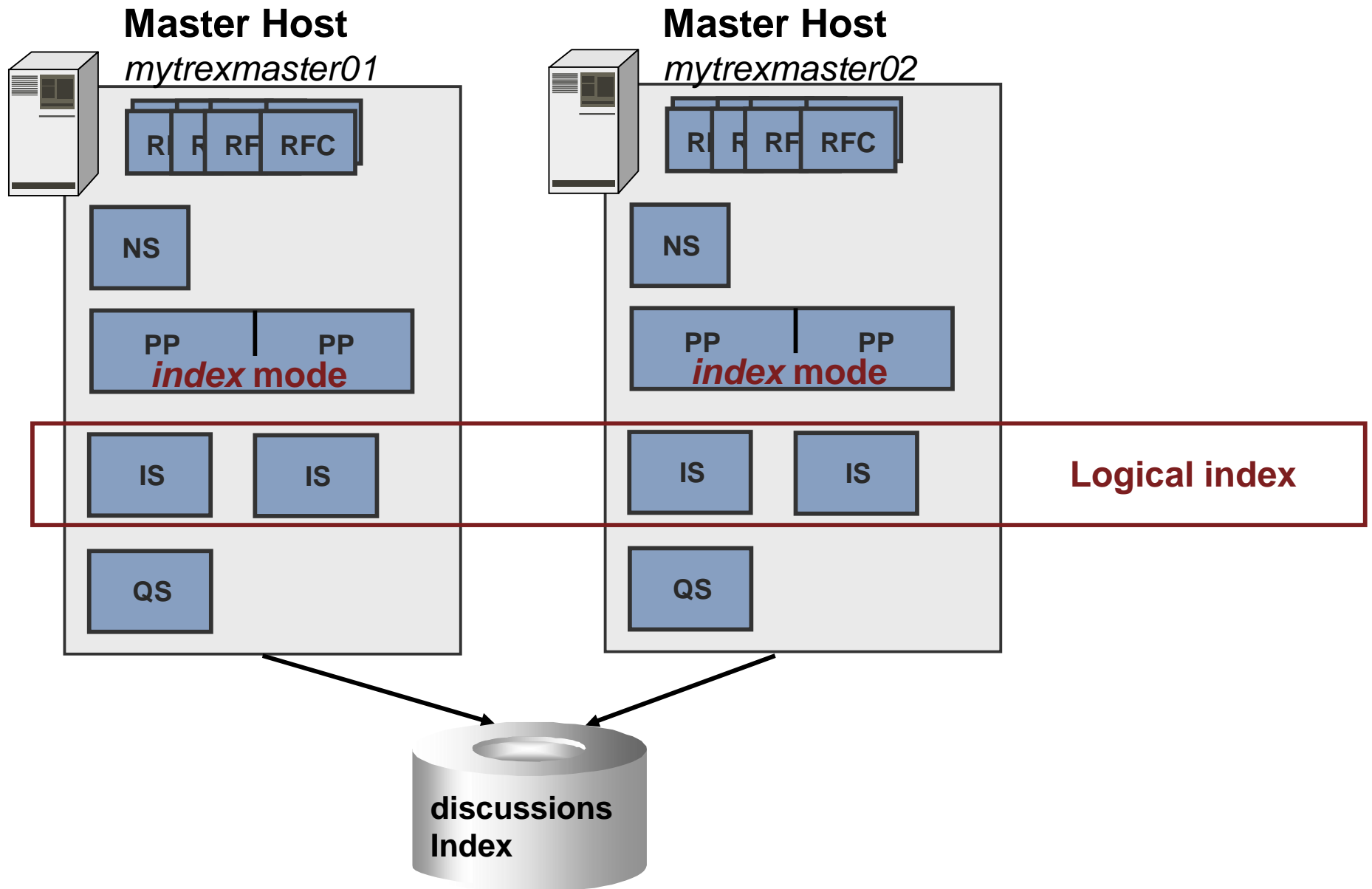
- 20 000 per day



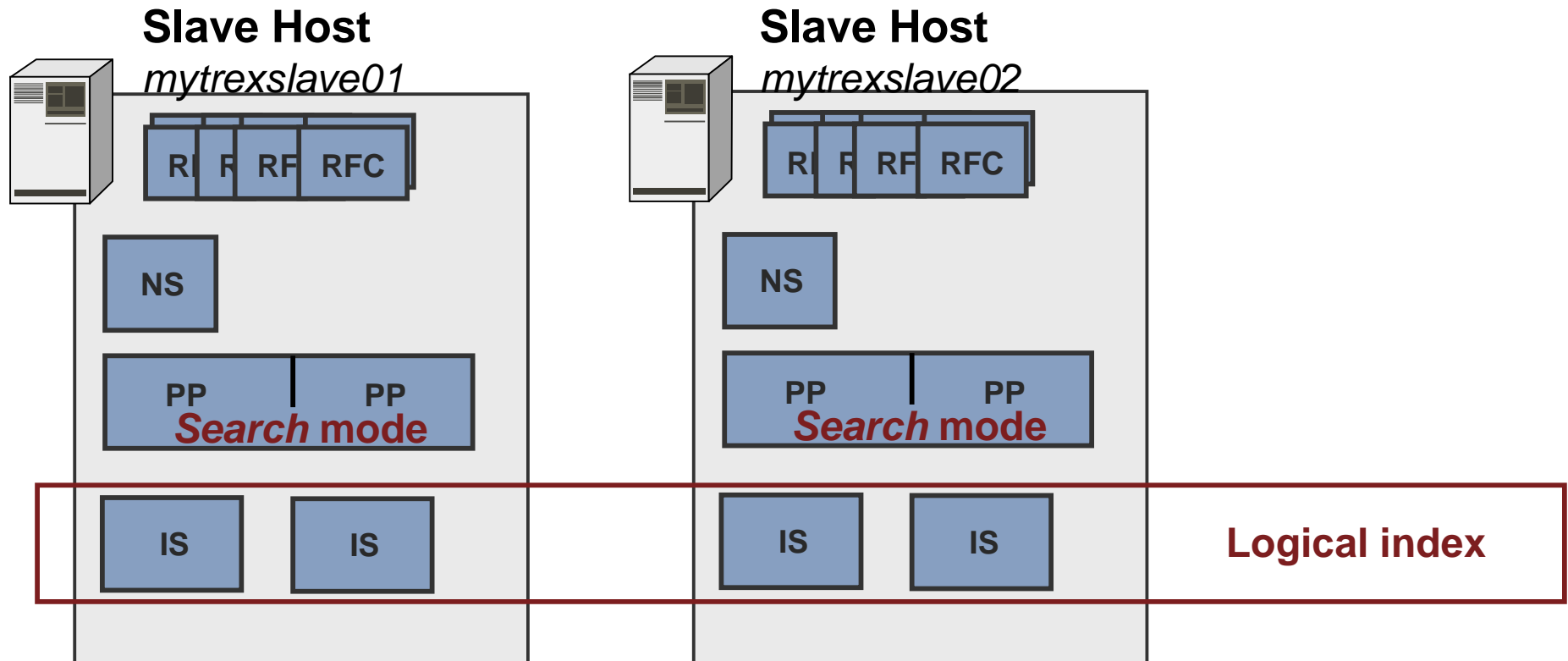
An Example 2: Component Information System



An Example 3: Master Hosts

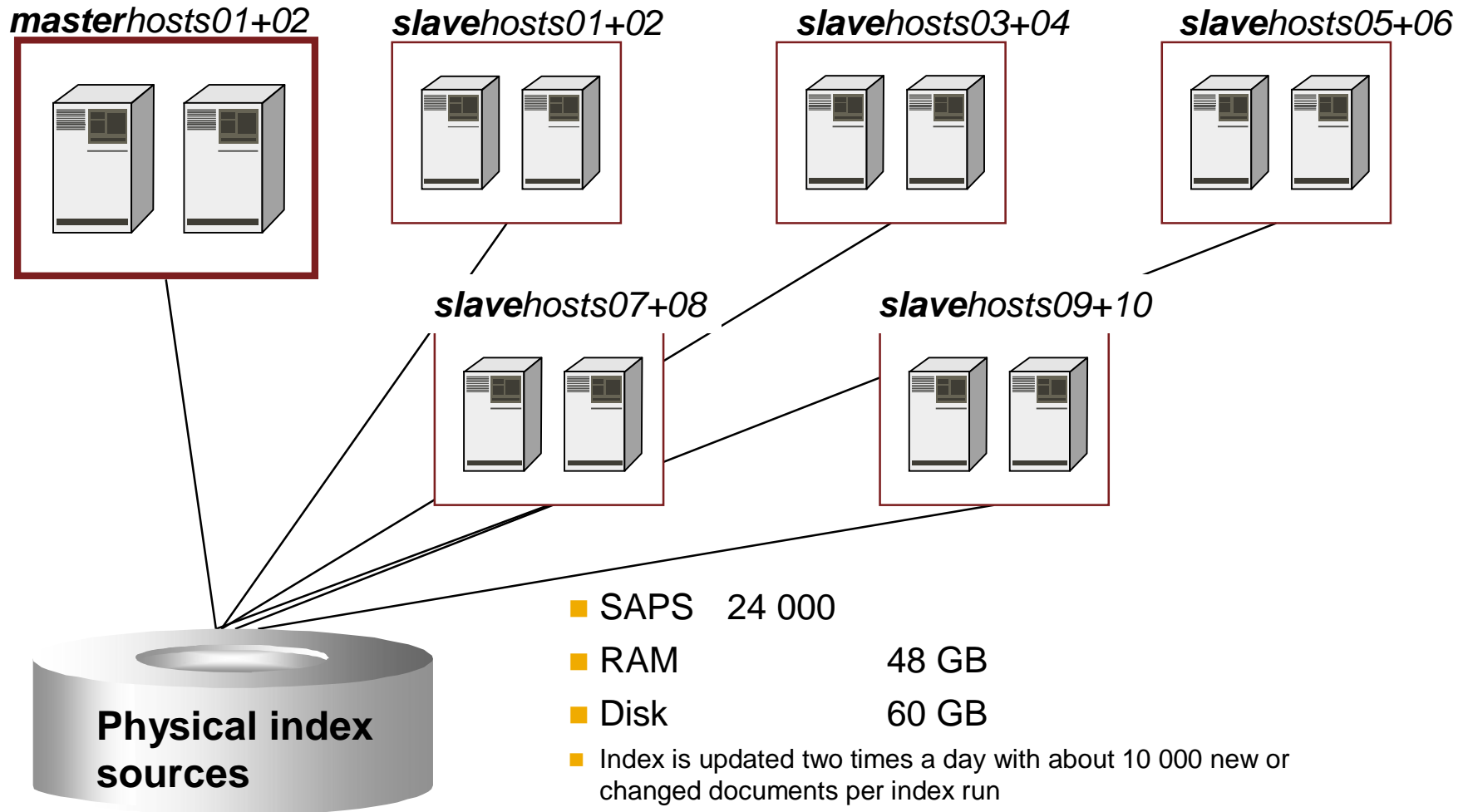


An Example 4: Slave Hosts

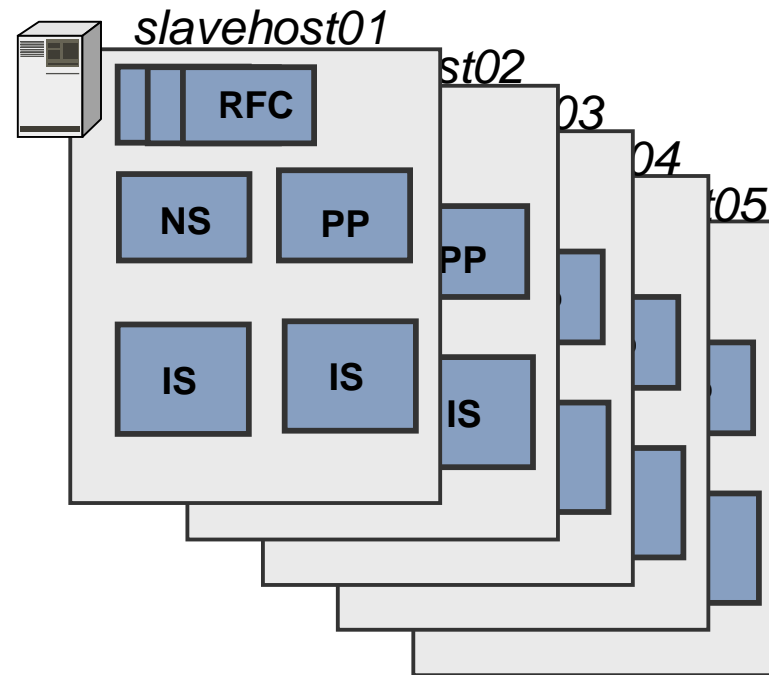
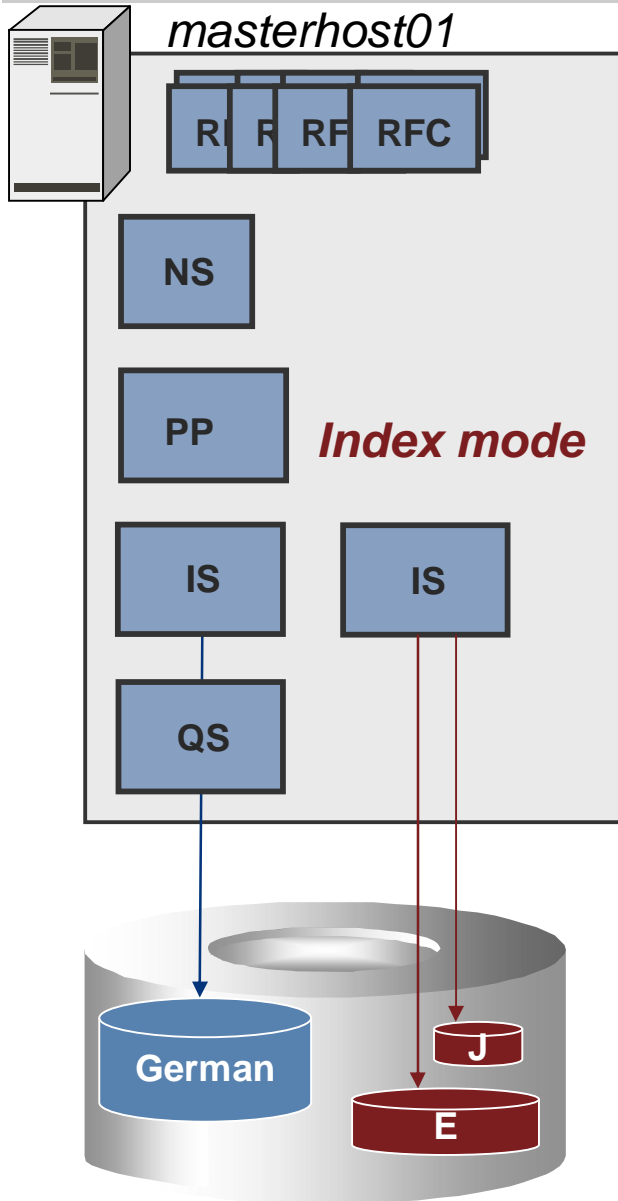


- 2 slave hosts supporting master host system
- All in all 5 slave host systems (10 servers)

An Example 5: Discussion Threads Servers



An Example 6: Notes



- Using a delta index
- Merges every hour
- Indexsize:
 - German 7GB
 - English 8GB
 - Japanese 1GB

An Example 8: Summary



- 5.8 million objects
 - More than 20 000 new or changed documents per day
 - 35 000 users
 - 170 000 search requests per day
 - 25 languages to be processed
- requirements**
- CPU: 36 000 SAPS
 - RAM: 48 GB
 - Disk: 200 GB
 - 80 GB index size
 - 120 GB temporary space for index update
 - Index updates twice a day for discussion threads and every hour for notes
- solution**

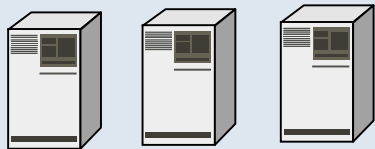
TREX in Different Stages - Two Examples



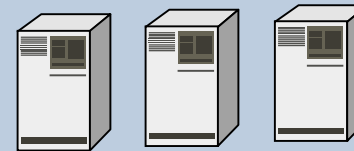
Stage I

Stage II

Initial Indexing

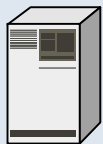


- High load during initial indexing stage
- Multiple Master Indexservers and preprocessors to speed up initial indexing



- Less indexing and preprocessing required
- Use Master host (indexing) Slave host (searching) Concept
- Remove one host from landscape

Adding more applications or content



- Start with small installation
- One host for indexing and searching due to little update frequency and search requests



- Add Master and/or Slave hosts
- More search load than expected and/or backup server necessary

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