BoF-PSS2

Payment and Settlement System Simulator

- A tool for analysis of liquidity, risk and efficiency

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Hll

Presentation structure

1. Background

2. Input generation sub-system

3. Simulation execution sub-system

4. Output analysing sub-system

5. Special functions

6. Requirements and user support

Presentation structure

1. Background

2. Input generation sub-system

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5. Special functions

6. Requirements and user support

Many dimensions in payment systems

- **Complex processes**
  - **Settlement account characteristics**
  - **Processing and settlement algorithms**
  - **Behavioural patterns and incentives**
  - **Rules defined by user community and authorities**
- **Interdependency**
  - **A network of ancillary systems and main settlement systems**
  - **PVP and DVP processing**
  - **International relationships**
- **Susceptible to external shocks**
  - **Technical, criminal, liquidity, financial and other shocks**
- **Payment systems have hidden characteristics**
  - **Internal credits and counterparty obligations**

Why simulate?

- **Simulation models are suitable for analysis of a number of payment system issues**
  - Incorporation of relationships that are complex and close to reality
  - Real and massive data sets can be used
  - Results generally reliable when behavioural effects can be controlled or anticipated
  - Models based on enumeration rather than calculus
- **Multiple scenarios can be simulated; impossible in real systems**
  - Various risk scenarios
  - Possible changes in settlement conventions, methods and pricing
  - Changes in behavioural patterns and official policies

New tools needed to understand the complexities and risks in this increasingly critical area

Where is simulation applicable?

▶ **Payment/settlement system policy**
  – **Developing liquidity programs**
  – **Developing advanced settlement services**

▶ **Payment/settlement system oversight**
  – **Analysing settlement, credit and systemic risks**
  – **Assessing impacts of proposed regulation**

▶ **Payment/settlement system-related research**
  – **Gridlock-resolution and liquidity-saving algorithms**
  – **Changes in payment flow patterns caused by international consolidation and electronification**
  – **Relationships between liquidity circulation and monetary policy**

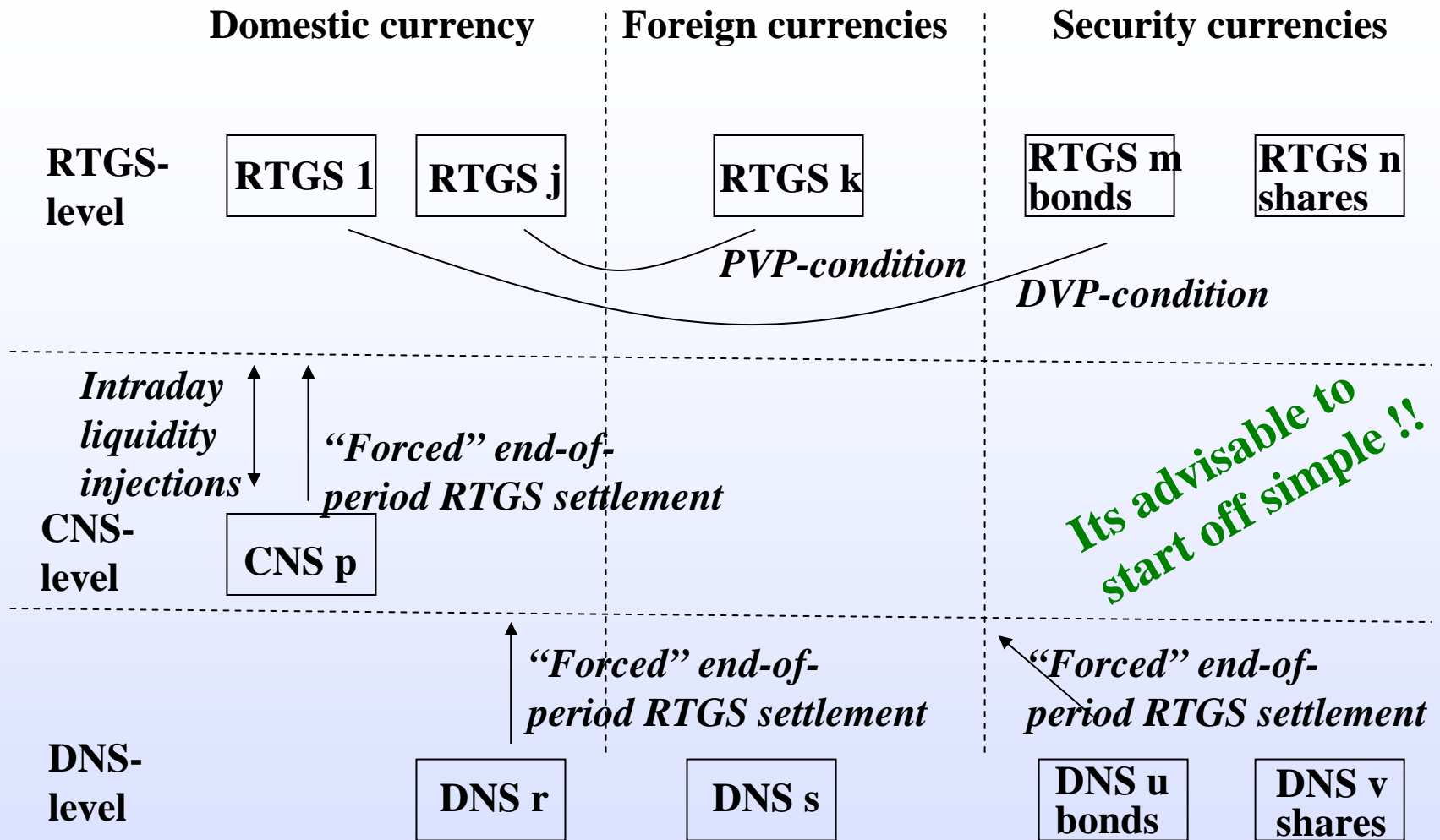*Simulation models can be adapted to many research topics*

BoF-PSS Simulator development objectives

- **Professional tool for payment and settlement research**
  - analyses of most common payment and settlement issues
  - large data sets and processing as in real systems
- **Basic services**
  - input, simulation and analysing support
  - most common settlement conventions and algorithms
  - multiple system and currency support
- **Open and common interfaces and standard**
  - Java and MySQL development tools
  - CSV and Excel interface
  - User module expansion possibility
- **User-friendliness**
  - easy-to-use user interface
  - user guide, help-function and tooltips
  - format conversion support (separators, date, time, file format)

Balancing act between desires, resources and timetables (output and input is partly rough and ext. editors are needed.
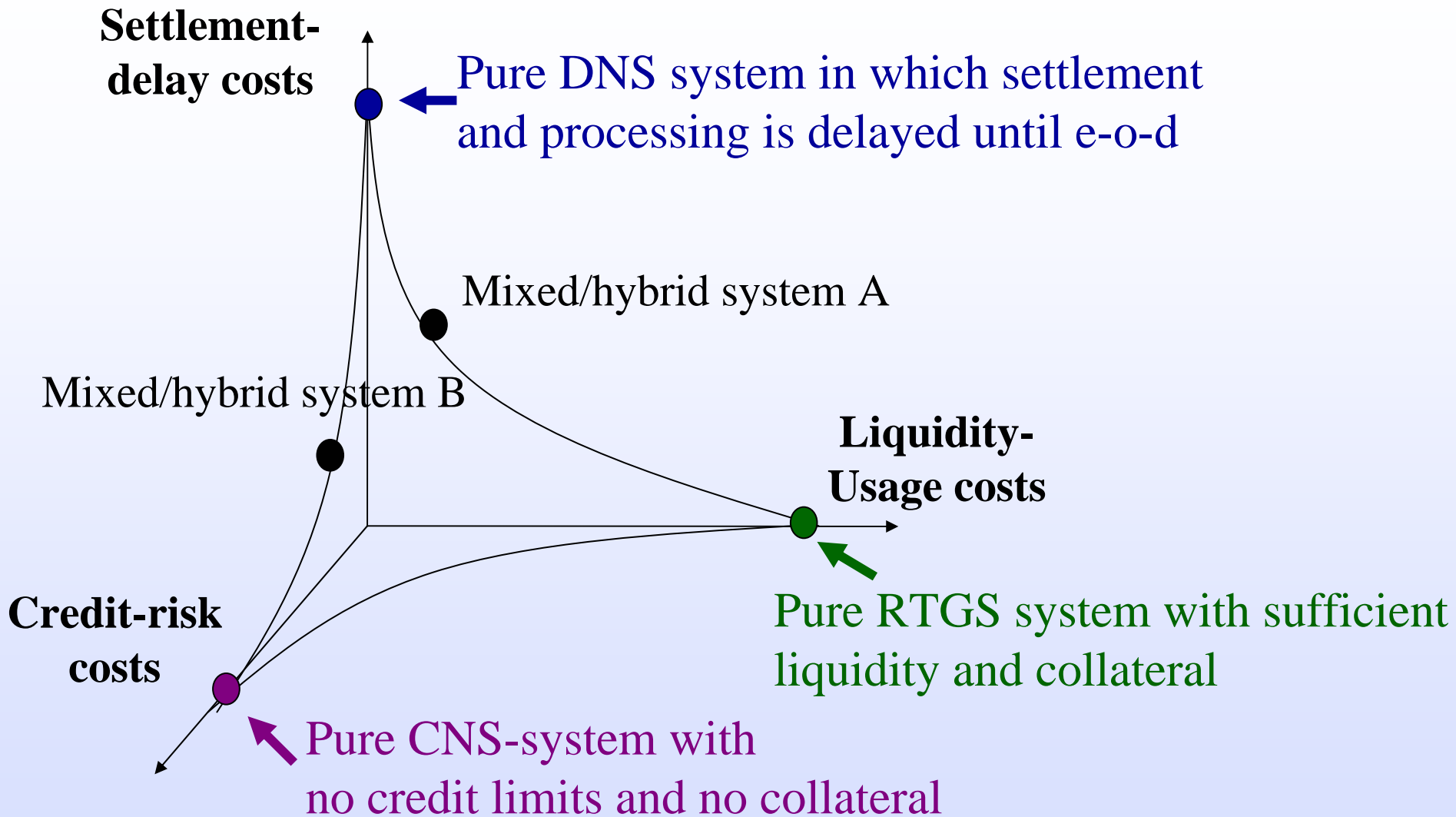
Possible system structures in BoF-PSS2

	Domestic currency	Foreign currencies	Security currencies

RTGS-level

RTGS 1   RTGS j   RTGS k   RTGS m bonds   RTGS n shares

PVP-condition

DVP-condition

CNS-level

Intraday liquidity injections

"Forced" end-of-period RTGS settlement

CNS p

Its advisable to start off simple !!

DNS-level

"Forced" end-of-period RTGS settlement

"Forced" end-of-period RTGS settlement

DNS r   DNS s   DNS u bonds   DNS v shares

The simulator supports a large combination of different systems on same and different levels and in different currencies.

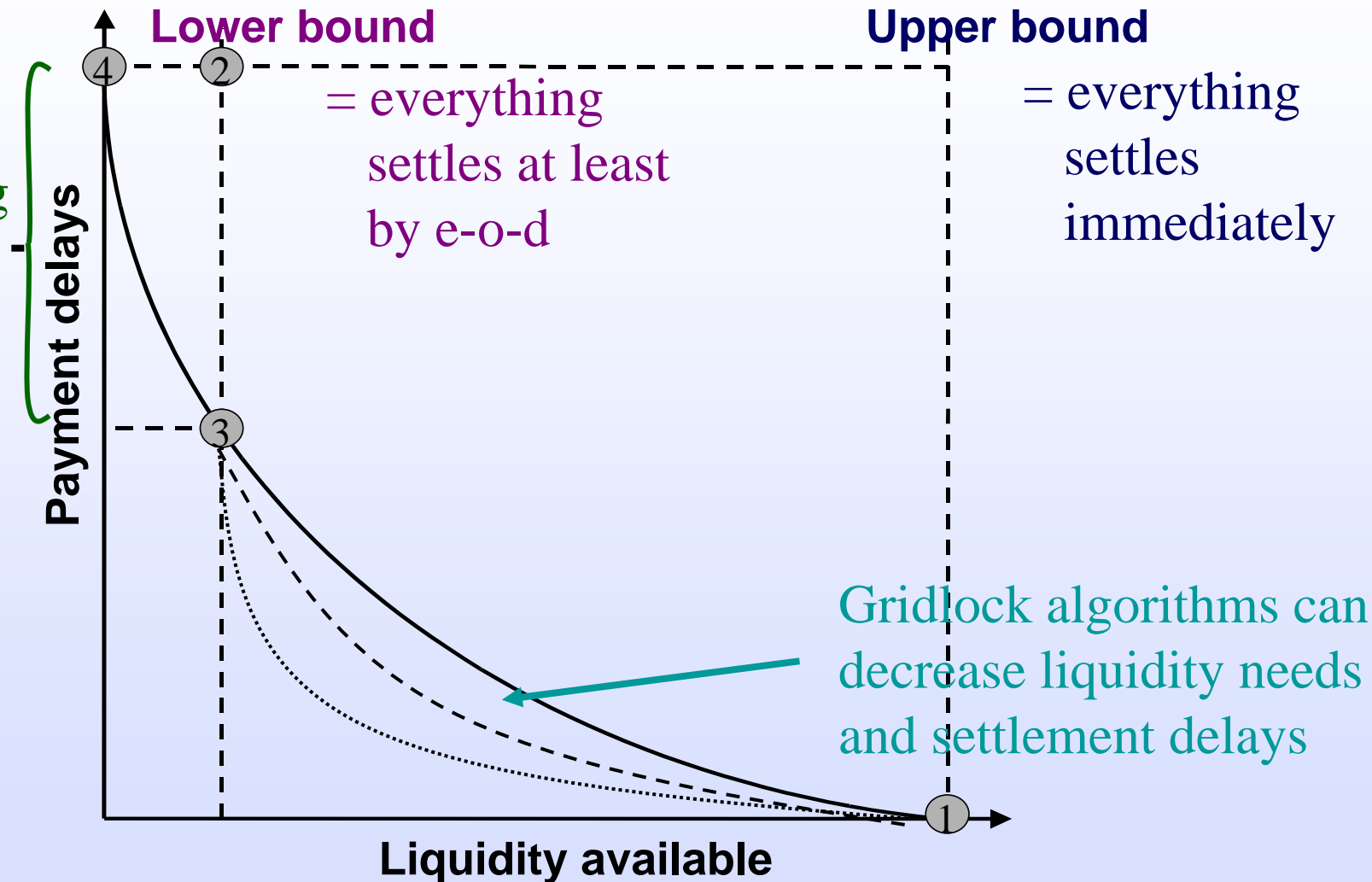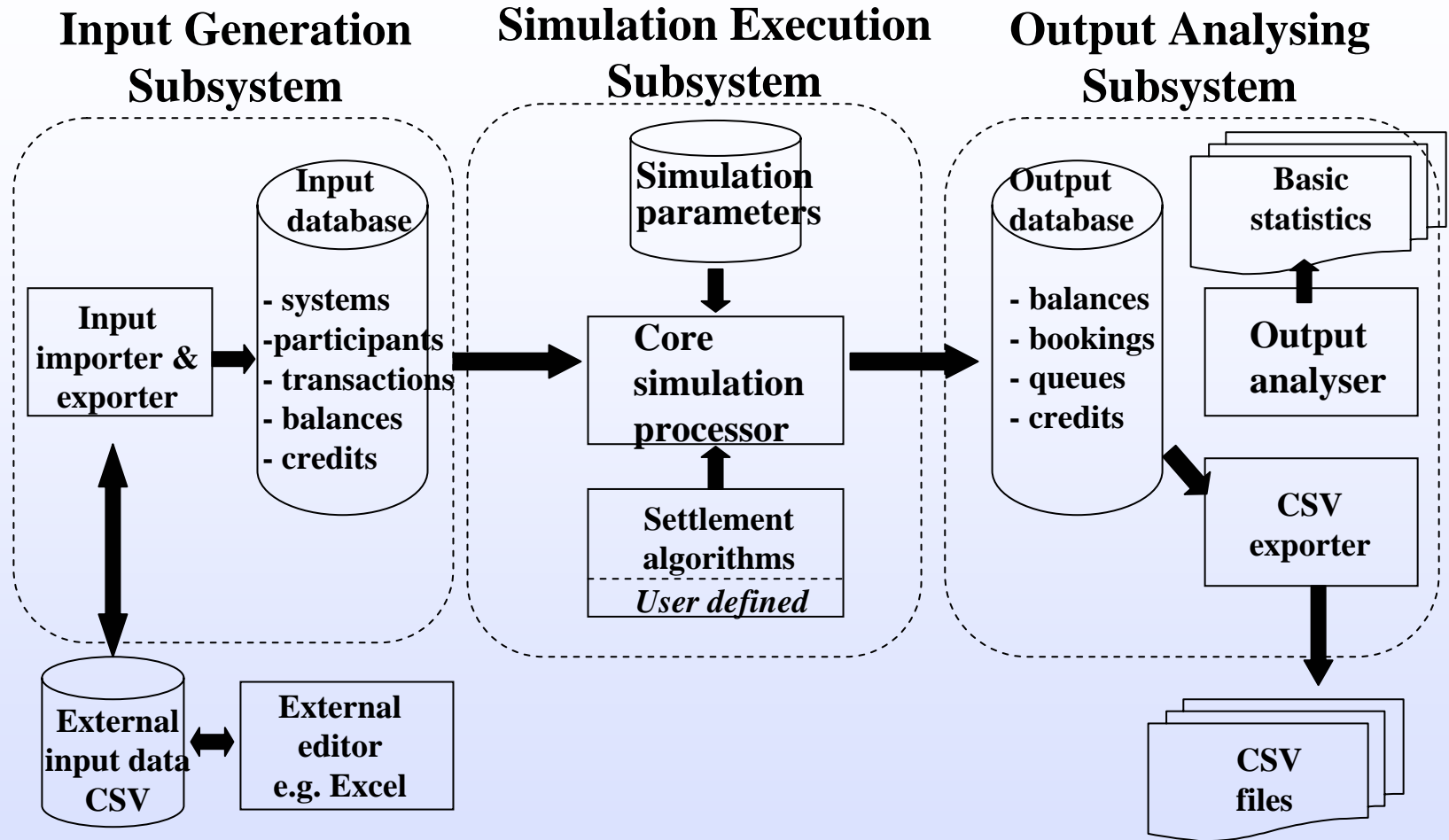Bank of Finland Payment and Settlement Simulator

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System type and cost structures

Settlement-delay costs

Pure DNS system in which settlement and processing is delayed until e-o-d

Mixed/hybrid system A

Mixed/hybrid system B

Liquidity-Usage costs

Credit-risk costs

Pure RTGS system with sufficient liquidity and collateral

Pure CNS-system with no credit limits and no collateral

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Mixed systems balance cost factors
RTGS speed up processing

RTGS benefit over DNS when same liquidity is used during the day

Lower bound

Payment delays

(4) (2) = everything settles at least by e-o-d

(3)

Upper bound

= everything settles immediately

Gridlock algorithms can decrease liquidity needs and settlement delays

(1)

Liquidity available

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Simulator structure

Input Generation Subsystem

Simulation Execution Subsystem

Output Analysing Subsystem

Input importer & exporter

Input database
- systems
- participants
- transactions
- balances
- credits

Simulation parameters

Core simulation processor

Settlement algorithms
User defined

Output database
- balances
- bookings
- queues
- credits

Basic statistics

Output analyser

CSV exporter

External input data CSV

External editor e.g. Excel

CSV files

The Simulator is event driven

Events are occurring in the same sequence as in real-systems, but in some processing phase to simulator is faster and in other slower.

Payment and settlement system

Incoming transactions

Liquidity transfers

Booked transactions

Settlement account balance

Booking step

Impulse on added liquidity

Participant's system

Participant's internal transaction queue

Submission step

System entry step

Settlable

Non-settlable

Gridlock resolution and netting step

Queue release step

Next day, discard

End-of-day end-of-cycle step

Queue entry step

Queued transactions in the system

The Simulator can record events for each .001 s

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A typical simulation process

▸ Define input data
  – Participants/accounts, transactions, system data
▸ Execute simulations
  – Different data sets, algorithms, liquidity, etc.
▸ Analyse results
  – Compare current with potential system structures/policies and check 'what if' special circumstances are realised
▸ Iterate

Large simulations are time-consuming

▸ Good data preparation

▸ Clear simulation plan

▸ Systematic analysing/reporting concept

▸ Remember backups

Main menu is door to sub-functions

Project

Help
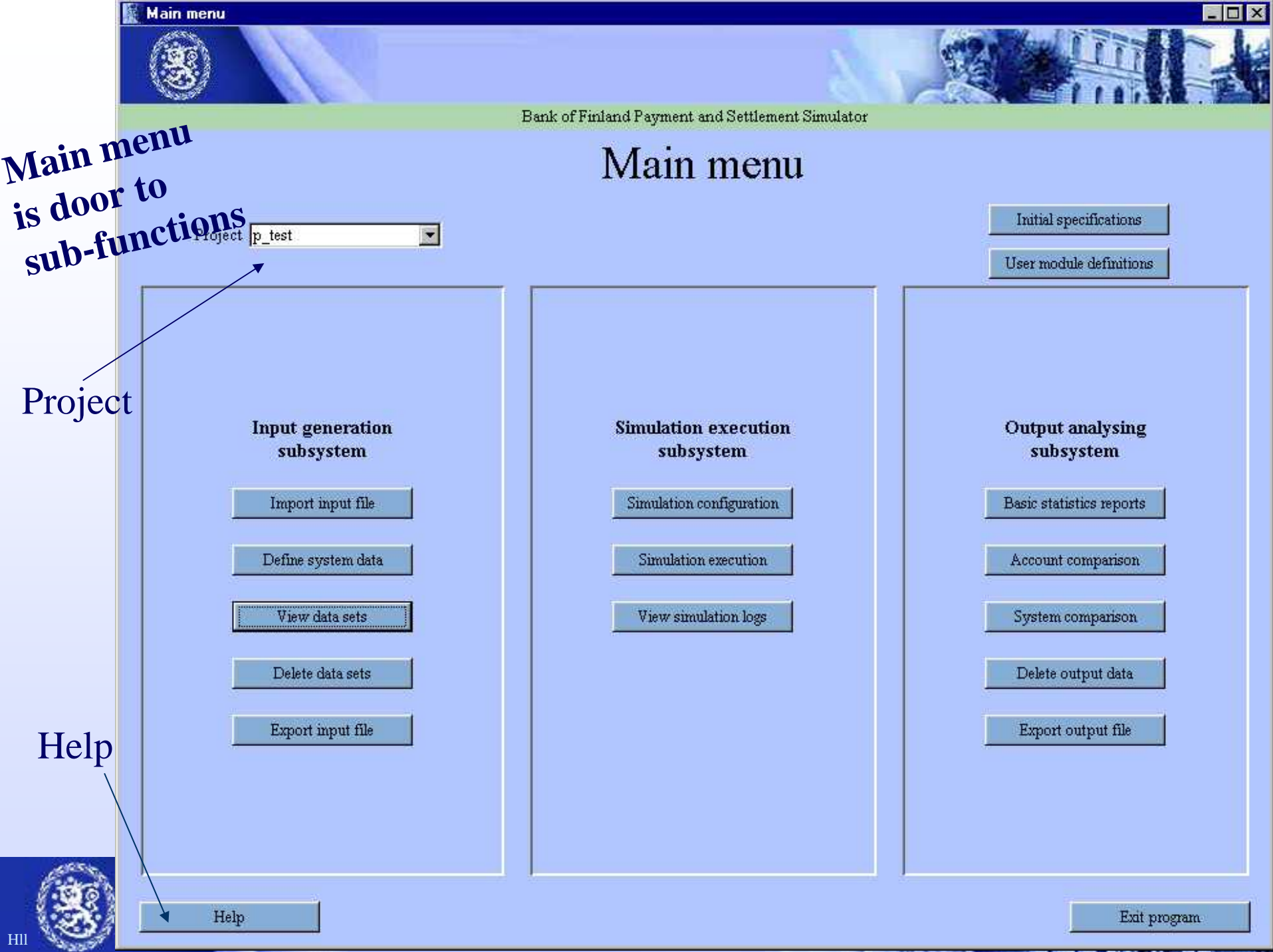
Project feature

▸ Project definitions can be used to distinguish simulation projects, e.g. RTGS simulations from security settlement simulations

▸ Projects typically have a separate input and output database (if not, a common input and/or output database can be defined)

▸ Projects established using the 'initial specifications' button

Online help

Print

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Presentation structure

The input generation subsystem facilitates data preparation

Input generation subsystem

| Import input file | ← | Import of participant/account, transaction, initial balances and intraday credit changes |

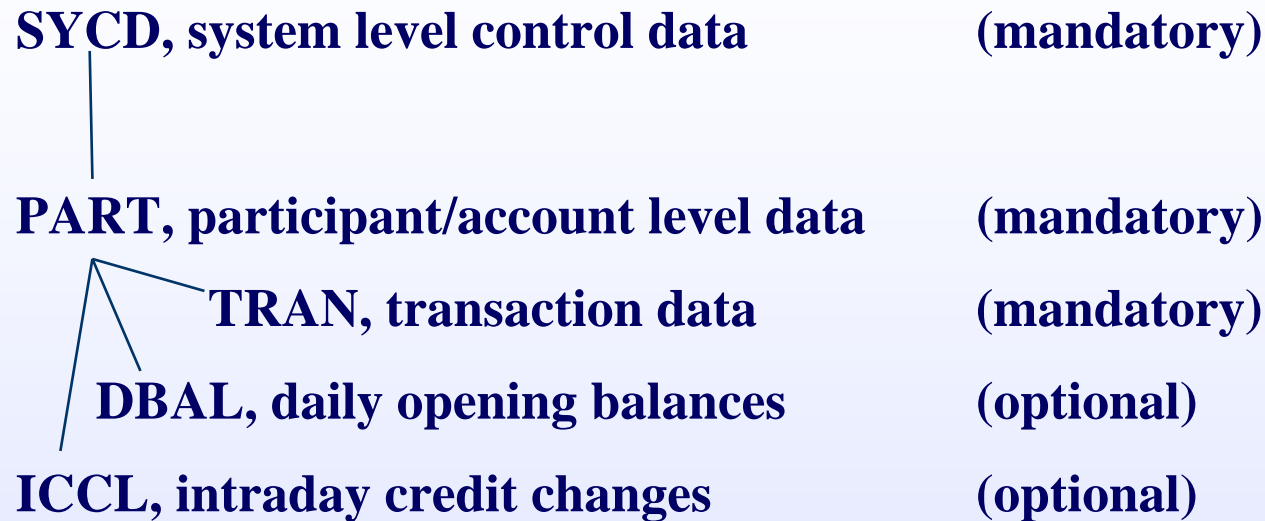| Define system data | ← | Payment/settlement system definition data |

| View data sets | ← | View data in input database |

| Delete data sets | ← | Delete data from input database |

| Export input file | ← | Export data from the input database, e.g. for editing purposes |

Input database data table structure

SYCD, system level control data   **(mandatory)**

PART, participant/account level data   **(mandatory)**

TRAN, transaction data   **(mandatory)**

DBAL, daily opening balances   (optional)

ICCL, intraday credit changes   (optional)

All data for the PART, TRAN, DBAL AND ICCL data tables are imported via CSV-files (comma separated values). SYCD system level data is defined via a separate screen.

Importing data from CSV file

Defaults

Data types
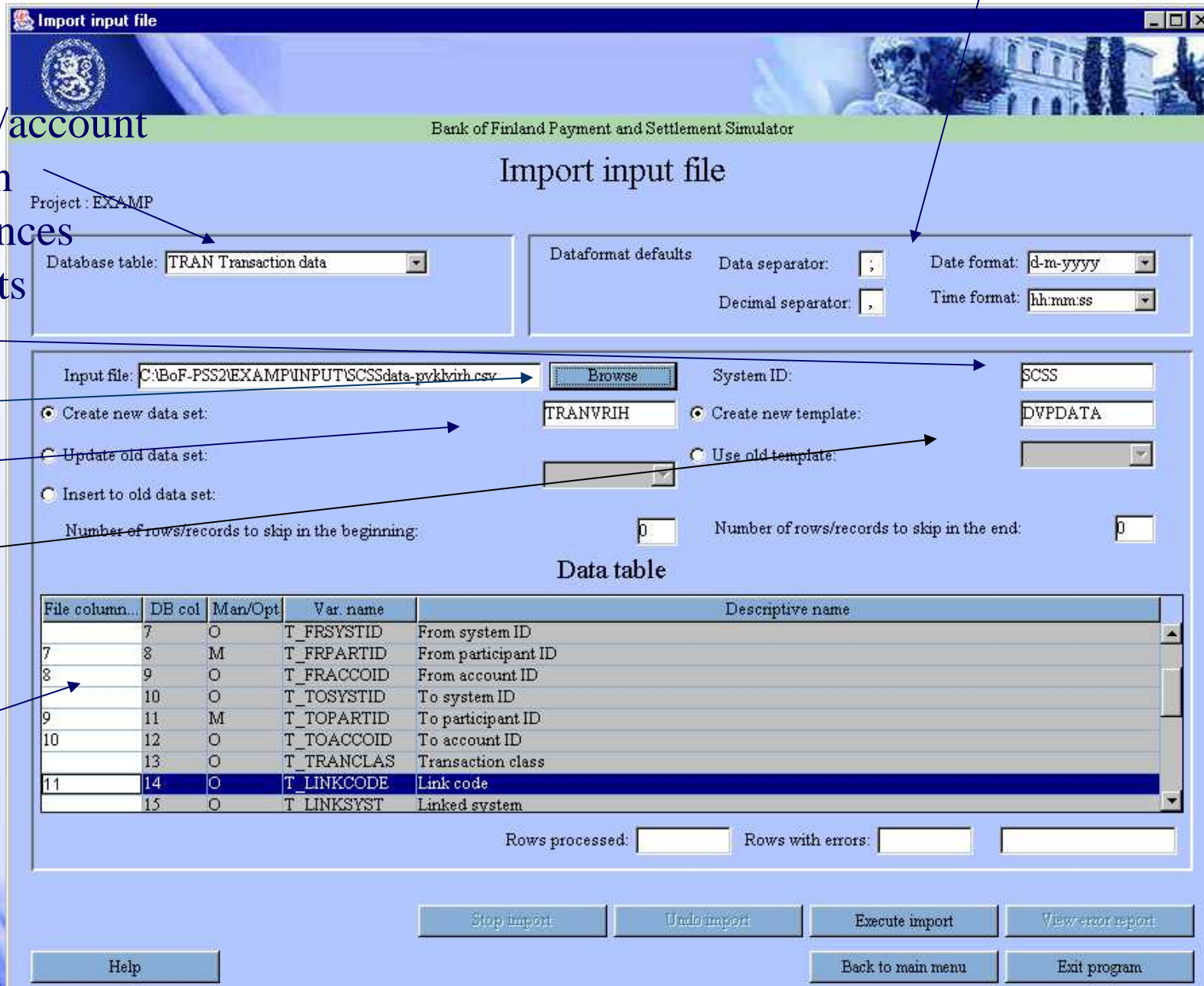- Participant/account
- Transaction
- Initial balances
- Credit limits

System ID

Input file

Data set

Template name

Template column numbers

CSV (=comma separated values) input data types

- ▶ PART participant and account data
  - – Participant and account IDs and data can be defined on participant and account levels
- ▶ TRAN transaction data
  - – Date/time, from participant/account, to participant/account, to/from system, value, transaction ID (alpha ascending!)
- ▶ DBAL daily initial balances
  - – Day and value
- ▶ ICCL intraday credit limit changes
  - – Day, time and new value
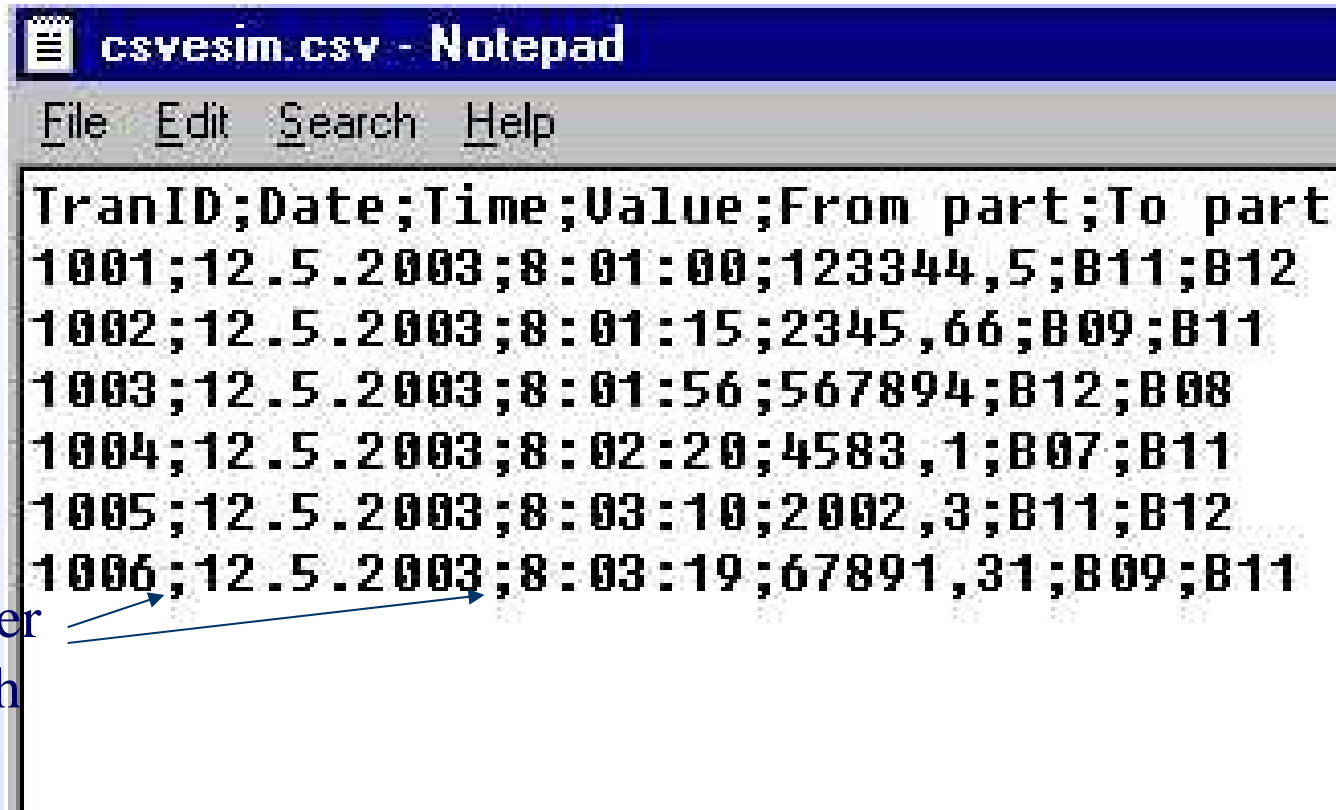
PART and TRAN are mandatory, while DBAL and ICCL are optional.
System ID must be coherent with input data!
CSV files can be generated by Excel (saved as CSV type).

Typical CSV-file

```
csvesim.csv - Notepad
File  Edit  Search  Help
TranID;Date;Time;Value;From part;To part
1001;12.5.2003;8:01:00;123344,5;B11;B12
1002;12.5.2003;8:01:15;2345,66;B09;B11
1003;12.5.2003;8:01:56;567894;B12;B08
1004;12.5.2003;8:02:20;4583,1;B07;B11
1005;12.5.2003;8:03:10;2002,3;B11;B12
1006;12.5.2003;8:03:19;67891,31;B09;B11
```

A title line that can be skipped is helpful

Data delimiter between each data field

CSV-files can be easily created with Excel, Access, MySQL etc.
The 'true' content can be easily checked with Notepad.

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Template to CSV-file relationship

Two introductory explanation rows to be skipped

File column in input template tells the data order in the input CSV-file

Data sets

▶ Data set IDs allow storage of parallel data tables in data base

▶ Simulations may use different data sets for varying the input data, e.g. more or less intraday credit, normal or exceptional transaction flows

Data set IDs   CRVAL1   CRVAL2   CRVALn

Data tables
ICCL table	ICCL table	. . .	ICCL table

Use a clear naming convention
for different data sets
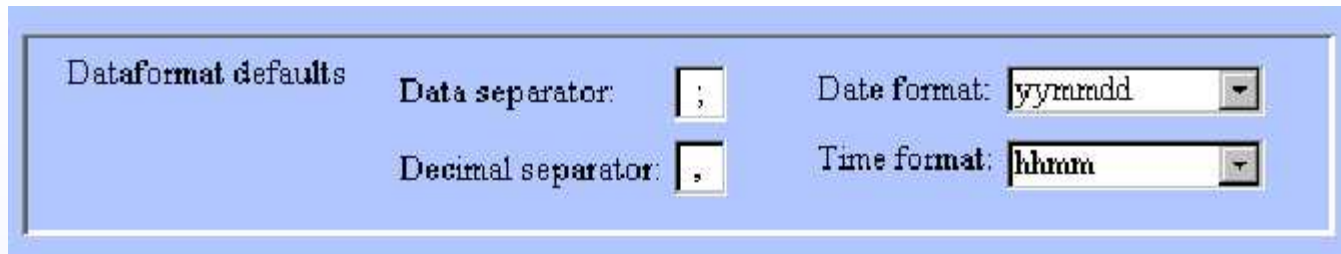
Import templates

- Import templates facilitates data/file format conversions
- Templates define relations between the input CSV columns and data base table fields
- The column (=data field order) in the CSV file should be stated for each data field to be imported
- Fields can be any order; there may be extra fields in the CSV file that will not be imported
- Each data table has some mandatory fields that must be present
- Templates are named and can be reused
- Changes to old templates will be updated

Use a clear naming convention
for different data sets

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Default data formats

Dataformat defaults   Data separator: `;`   Date format: `yymmdd`

Decimal separator: `,`   Time format: `hhmm`

▶ Data and decimal separators can be freely chosen, but must be different.

▶ A number of predefined date and time formats are available. Time accuracy to 1/1000 second.

▶ Imports allow all kinds of date and time delimiters

▶ Exports generate dashes with dates and colons with time formats (when delimiters specified).

▶ New defaults remain in force until they are changed.

▶ When using Excel or other tools, check that the data format defaults are identical

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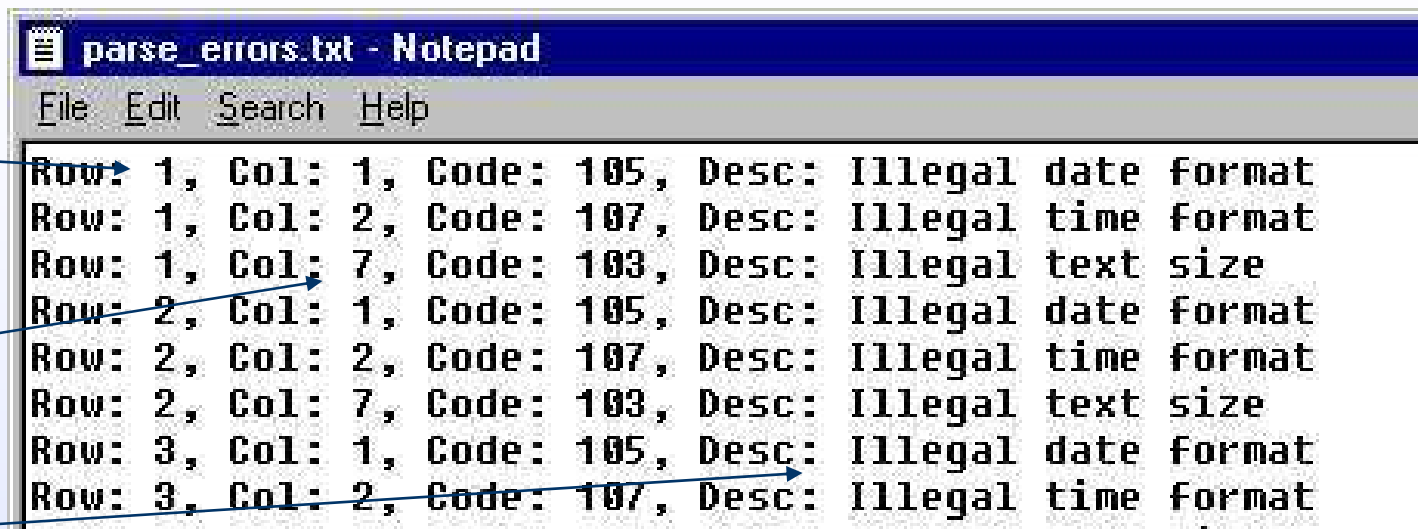
Import input error list

Line in CSV-file with error

Column/field with error

Error type

```
parse_errors.txt - Notepad
File   Edit   Search   Help

Row: 1, Col: 1, Code: 105, Desc: Illegal date format
Row: 1, Col: 2, Code: 107, Desc: Illegal time format
Row: 1, Col: 7, Code: 103, Desc: Illegal text size
Row: 2, Col: 1, Code: 105, Desc: Illegal date format
Row: 2, Col: 2, Code: 107, Desc: Illegal time format
Row: 2, Col: 7, Code: 103, Desc: Illegal text size
Row: 3, Col: 1, Code: 105, Desc: Illegal date format
Row: 3, Col: 2, Code: 107, Desc: Illegal time format
```

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System ID

Data set ID

System type

Algorithm selection

Define system data

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System control data specification/modification

Project : EXAMP

System ID: RTGS-A

⦿ Modify old system data set sys1   ○ Create new system data set [   ] Copy from old system data set [   ]

System full name: [   ]   Opens (hhmm 24h): 0700   System description: [   ]

System type: RTGS   Closes: 1900

System acronym: [   ]

Transfer of balances
☐ Transfer balances to next day

Intraday credit availability
○ Credits according to limit table or
○ No credits available or
⦿ Credit available without limits

Handling of unsettled transactions
⦿ Transfer unsettled transactions to next day/settlement occasion or
○ Delete unsettled transactions or
○ Force end-of-day settlement of unsettled transactions

Potential algorithms: select one and add it to the attached algorithms by pressing the 'Add algorithm' button. ENT and END algorithms are mandatory.

SPMVALU1 SPL value,Positive amount with two decimals   [Add algorithm]

Attached algorithms: Changes of order by dragging/dropping. Deletion by striking keyboard 'delete' button for active algorithms.

Algorithm	Alg. type	Double click row to insert parameter values
ENBASIC1	ENT	
ENDRTGS1	END	

[Save system data set]

[Help]   [Back to main menu]   [Exit program]

System control data

▶ System ID must be coherent with input data!

▶ Data set IDs to be used with parallel data sets

▶ System types available:
- RTGS (real time gross settlement),
- CNS (continuous net settlement) and
- DNS (deferred net settlement)

▶ Algorithms for defining the processing conventions need to be specified for each system

▶ Mandatory algorithms:
- ENT (entry) and
- END (end-of-day)

▶ Optional algorithms:
- SPL (split)   INJ (injection),
- QUE (queue release)   SET (settlement)
- BOS (bilateral offsetting)   PNS (partial net settlement)
- MNS (complete multilateral settlement)

Main algorithms

- **SUB** (submission) algorithm determines when a transaction is submitted for processing, i.e. chooses next transaction to be processed
- **ENT** (entry) algorithm is first processing phase for a transaction. Generally transferred to bookings when liquidity available; queued/discarded if there is a lack of liquidity
- **SET** (settlement) algorithm processes queued transactions, e.g. invoking gridlock- resolution algorithms
- **END** (end-of-day) algorithm clears up end-of-day situations

Sub-algorithms

- Can be invoked by ENT, SET and END algorithms
- **QUE** (queue release) algorithms release transactions from waiting queues in a defined order
- **SPL** (splitting) algorithms split large transactions into small, easy-to-process transactions
- **INJ** (injection) algorithms transfer liquidity from/to accounts to/from other systems
- **BOS** (bilateral offsetting) nets queued transactions between two counterparties in a given order
- **PNS** (partial net settlement) algorithms seek multilateral payment batches that can be netted
- **MNS** (complete multilateral settlement) netting of all transactions in queues

Expanding the algorithm list

▶ Current algorithm list includes most common settlement algorithms and conventions

▶ General and parameter-driven algorithms facilitate user adaptation

▶ Users can also develop own algorithms with user module interface

▶ Modular design of algorithms and interfaces facilitates easy expansion

Comments and proposals on algorithm development are always welcome.

View data sets

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View data sets

Project : p_test

Data type: TRAN Transaction data   System ID: S-RTGS   Data set ID: tran0814

Transaction ID	Introduction date	Introduction time	Transaction value	From system ID	From participant ID	From account ID	To sy:
101	2003-05-12	07:01:00	4880384,39	S-RTGS	1		S-RTGS
102	2003-05-12	07:01:00	685826,60	S-RTGS	1		S-RTGS
103	2003-05-12	07:01:00	2639630,73	S-RTGS	1		S-RTGS
104	2003-05-12	07:01:00	46064,41	S-RTGS	1		S-RTGS
105	2003-05-12	07:01:00	633795,99	S-RTGS	1		S-RTGS
106	2003-05-12	07:01:00	79702,04	S-RTGS	1		S-RTGS
107	2003-05-12	07:01:00	2786,33	S-RTGS	1		S-RTGS
108	2003-05-12	07:01:00	8000,03	S-RTGS	1		S-RTGS
109	2003-05-12	07:01:00	153492,54	S-RTGS	5		S-RTGS
110	2003-05-12	07:01:00	83989,24	S-RTGS	5		S-RTGS
111	2003-05-12	07:01:00	779471,41	S-RTGS	5		S-RTGS
112	2003-05-12	07:01:00	6678,92	S-RTGS	5		S-RTGS
113	2003-05-12	07:01:00	49921,70	S-RTGS	5		S-RTGS
114	2003-05-12	07:01:00	17337,06	S-RTGS	5		S-RTGS
115	2003-05-12	07:01:00	300182,44	S-RTGS	5		S-RTGS
116	2003-05-12	07:01:00	18950,49	S-RTGS	5		S-RTGS
117	2003-05-12	07:01:00	1634545,51	S-RTGS	6		S-RTGS
118	2003-05-12	07:01:00	408639,34	S-RTGS	6		S-RTGS
119	2003-05-12	07:01:00	1856551,99	S-RTGS	6		S-RTGS
120	2003-05-12	07:01:00	184378,62	S-RTGS	6		S-RTGS
121	2003-05-12	07:01:00	16723,85	S-RTGS	6		S-RTGS
122	2003-05-12	07:01:00	12084,40	S-RTGS	6		S-RTGS
123	2003-05-12	07:01:00	57860,37	S-RTGS	6		S-RTGS
124	2003-05-12	07:01:00	4920425,27	S-RTGS	14		S-RTGS
125	2003-05-12	07:01:00	1826540,68	S-RTGS	14		S-RTGS

Help   Back to main menu   Exit program

Useful for checking moderate size data tables

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Delete data sets ▯□×

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Delete data sets

Project : p_test

Data type: [TRAN Transaction data ▼]   System ID: [2P ▼]

2Ptran2
2tran
tran3

To delete data sets, press Ctrl and click the data sets active with the left mouse button. Press the Delete data sets button below.

Provides view
of available
data sets

Extra data
sets can be
deleted

[Delete data sets]

[Help]   [Back to main menu]   [Exit program]

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Input data can be exported for modification and re-imported

Export input file

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Export input file

Project:

Data set ID:
Database table: PART participant data

Dataformat defaults
Data separator:
Decimal separator:
Date format: yyyymmdd
Time format: hhmmss.sss

Output file:
☐ Create names of columns
○ Create new template:
○ Use old template:

Export template

Output file column numbers

Selection criteria

File column...	DB col	Man/Opt	Var. name	Descriptive name	Selection Criteria
	2	M	P_SYSTEMID	System ID	
	3	M	P_PARTICID	Participant ID	
	4	M	P_ACCOUNID	Account ID	
	5	O	P_FULLNAME	Full name	
	6	O	P_SHORTACR	Short acronym	
	7	O	P_ACCONAME	Account name	
	8	O	P_SETINSYS	Settles in system	
	9	O	P_SETONPAR	Settles on participant	
	10	O	P_SETONACC	Settles on account	
	11	O	P_LIQFRSYS	Liquidity injection from system	
	12	O	P_LIQFRPAR	Liquidity injection from participant	
	13	O	P_LIQFRACC	Liquidity injection from account	
	14	O	P_LIQINJVA	Participant/account specific liquidity injection value	

Rows processed:

Execute export   Stop export

Help

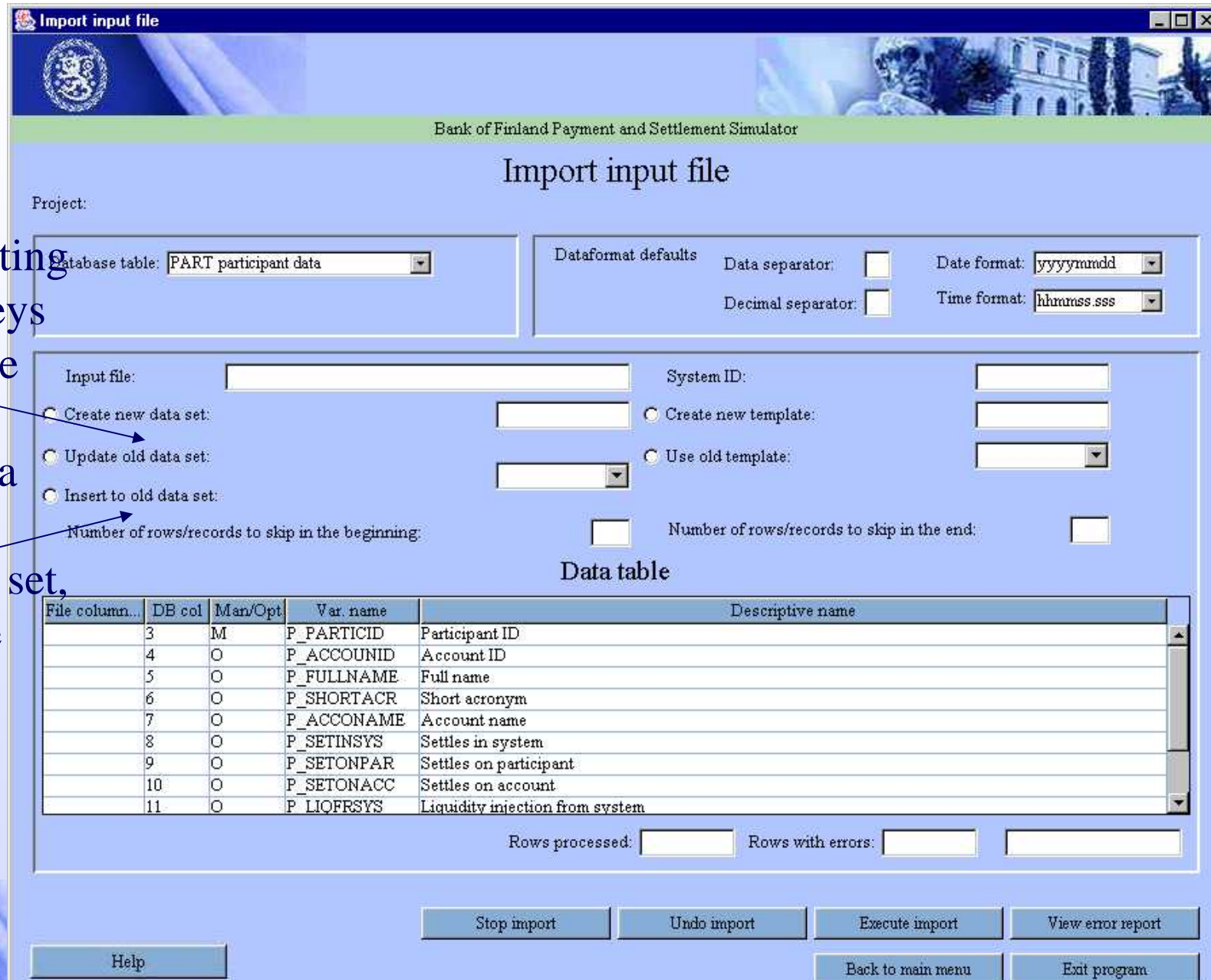Back to main menu   Exit program

Export and re-import of input data

- Selection criteria can be used to extract given parts of a data set
  - Several criteria for different fields operate in .AND. mode
  - Several criteria for same field operate in .OR. mode)
- Data can be re-imported using UPDATE or INSERT mode on an existing data set
- When Excel is used for editing, the following should be observed:
  - Limit of about 65,000 rows
  - Extra rows may be added to the CSV file in the form of empty ,,,, rows if these has been activated in Excel
  - Excel may change delimiters, decimals and special signs/characters
  - Large values may loose accuracy

Import data from CSV file in INSERT or UPDATE mode

Updates existing data rows, keys must coincide

Add new data rows to an existing data set, keys must be different

Presentation structure

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The execution subsystem launches and monitors simulations

Simulation execution
subsystem

Simulation configuration

Simulation execution

View simulation logs

Definition of simulation: which systems and which data

Launching simulations and defining output data

View logs of previous simulations

Simulation ID (good naming convention)

Name and description are optional

Choose systems and data sets for systems

Cross-check data

Simulation configuration

Bank of Finland Payment and Settlement Simulator

Simulation configuration

Project : SMALL

○ Modify old simulation ID [koe1 ▼]   ● Create new simulation ID [simul1]   Copy from old simulation ID [▼]

Simulation name: [   ]

Description: [   ]

For defining data sets for the simulation first select the desired system ID in the corresponding drop-down box above the table, then the desired data sets. Next press the add/update data set button to move the new data to the data table. A system can be deleted from the table by selecting the system ID and pressing the Delete button.

Sub-algorithm: Parameters
[SUFIFOPR ▼]   [   ]

Data sets to simulation:
[RTGS-S ▼] [SYST1 ▼] [TRAN1 ▼] [PART1 ▼] [ICCL1 ▼] [▼]   [Add/update data set]
                                                                    [Delete]

System ID	System data set	Transaction data set	Participant data set	Credit limit data set	Balance data set
RTGS-S	SYST1	TRAN1	PART1	ICCL1	

Number of errors: [   ] [   ]

[Save simulation ID] [Cross-check] [Stop cross-check] [View errors]

[Help]   [Back to main menu] [Exit program]

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Possible system combinations

- One independent system

- Domestic system structure with eg RTGS, DNS and securities settlement system

- International multi-RTGS system in single currency (eg TARGET)

- International RTGS or CNS multi-currency system with PVP processing

- DVP processing in securities settlement systems with internal or external (RTGS) money leg settlement

The simulator provides flexible possibilities for simulations with multi-system structures

Features for DVP/PVP and system relationships

▸ Transactions can be made between systems just by defining FROM-SYSTEM and TO-SYSTEM in the transactions

▸ DVP and PVP is automatically invoked by defining LINKCODE and LINKSYST in the transactions

▸ Injection and end-of-day algorithms can transfer liquidity/make bookings between main and ancillary systems

The simulator provides flexible possibilities for simulations with multi-system structures

Cross-checking for data coherency

▸ Simulation configuration implies definition of which systems will run and with which data sets

▸ Cross-checking implies checking for data coherency eg so all participants/accounts are available as demanded by transaction records and all systems are available as demanded by inter-system transactions

▸ Import functions only have checked data values, no cross-table checks

▸ Incoherent data (sets) will not execute

Simulations can be made in batches with one or more simulation ID

Select from pre-configured simulations

Determine output tables to be stored in output database

Simulation execution

Bank of Finland Payment and Settlement Simulator

Simulation execution

Project : SMALL

○ Modify old simulation batch ID   ● Create new simulation batch ID   Copy from old simulation batch ID

Select a simulation ID and add it to the table by pressing the add simulation ID button. A simulation can be deleted from the batch by selecting the simulation ID and by pressing thereafter the Delete button.

Simulation ID   Simulation name

SIMUL1   Add simulation ID   Delete

Simulation id	Simulation name	System level stat. SYLS	Account stat. ACST	Transact. event stat TEST	Netting event stat. NEST	Account violation stat. AVST	Booking event stat. BEST	Unsettl. transact. stat. UNST	Submitt. transact. stat. SUST	Queued transact. stat. QUST	Comment transact. stat. CTST	Comment intraday credit stat. CCST
SIMUL1		✔	✔	✔	☐	☐	☐	✔	☐	☐	☐	☐

Save batch   Start   Stop   View error report

Help   Back to main menu   Exit program

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View simulation logs

Project : p_test

Simulation ID	Simulation name ▽	Date/time	Duration	SYLS	ACST	TEST	NEST	AVST	BEST
2Pjono		14-07-2003/11:21:35	00:00:00	☑	☑	☑	☐	☐	☐
2Painall		14-07-2003/01:45:11	00:00:00	☑	☑	☑	☐	☐	☐
2Pbalnc		14-07-2003/02:03:53	00:00:00	☑	☑	☑	☐	☐	☐
2Pque1		15-07-2003/12:21:09	00:00:00	☑	☑	☑	☐	☐	☐
2Pque3		15-07-2003/01:12:05	00:00:00	☑	☑	☐	☐	☐	☐
2Pjono2	toinen yrittämä	14-07-2003/11:24:24	00:00:00	☑	☑	☑	☐	☐	☐

List of previous
simulations and
available
output data tables

Help		Back to main menu	Exit program

Presentation structure

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The output analysing subsystem provides basic output reports and export facilities

Output analysing subsystem

Basic statistics reports

Account comparison

System comparison

Delete output data

Export output file

Basic statistics report

Account level comparisons of simulations

System level comparisons of simulations

Deleting unnecessary output data

Exporting output files for further analyses (all data from output database to CSV files)

Hll

Output database data table structure

SIMULATION, SYSTEM AND ACOCUNT LEVEL

BARI, simulation batch run data

SIRI, simulation run data

SYLS, system level statistics

ACST, account level statistics

TRANSACTIONS LEVEL

TEST, Transaction event statistics,

NEST, Netting event statistics,

AVST, account violation statistics

BEST, booking event statistics,

UNST, unsettled transactions statistics

SUST, submitted transactions statistics

QUST, queued transactions statistics

CTST, comment transactions statistics

CCST, comment intraday credit statistics

All data from the data table can be exported into CSV-files and thereby viewed eg using Excel

Bank of Finland Payment and Settlement Simulator

Reports on system and account level and as data or time series

Each report is written to CSV files and viewed in Excel

Basic statistics reports

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Basic statistics reports

Project : EXAMP

Simulation ID   Simulation name

eka   eka kokeilu   Output file: C:/BoF-PSS2/EXAMP/OUTPUT_REPORTS/Systemstatistics_eka.csv

Choose one of the report options

◉ System statistics report

○ Account statistics report   System ID:

○ System time series report   System ID: Reporting interval per   minutes

○ Account time series report   System ID: Reporting interval per   minutes

Participant ID   Account ID
Account ID:

Save in csv-file   Save and open csv-file

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Account level report example

Microsoft Excel - Accountstatistics_FIRSTSMApilk.csv

	A	B	C	E	F	H	J
1	Account statistics						
2							
3	Simulation	Simulation	Simulation processing	Simulation processing time:			
4	System:RTGS-A						
5							
6	Participant	Beginning-	End-of-day balance	Minimum balance	Maximum balance	Value settled	Number settled
7	1	0	-9 920 125,53	-62 487 362,45	8 976 190,52	75 589 147,66	52
8	2	0	-8 257 211,55	-46 332 642,55	42 660 636,69	103 916 633,12	47
9	3	0	231,61	-98 472 668,39	231,61	144 105 054,21	102
10	4	0	140,00	0,00	140,00	0,00	0
11	5	0	-54 702 407,40	-54 702 407,40	123 774 347,88	201 506 601,70	25
12	6	0	156 073 179,53	-31 529 770,02	215 304 644,95	98 130 151,61	31
13	7	0	0,00	0,00	0,00	0,00	0
14	8	0	389 741 145,11	0,00	389 741 145,11	0,00	0
15	9	0	-389 741 145,07	-1 459 456 768,50	0,00	2 576 765 840,54	70

*All reports are produced as CSV-files,
which can be opened with Excel,
reporting is 'rough' and needs editing.*

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Comparison views are saved for re-use

Additional columns

Account comparison analyser

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Account comparison analyser

Project : harrykuv

- ○ Modify old comparison view
- ● Create new comparison view
- Copy from old comparison view

Choose simulations to be compared (becomes columns in report)

Output file: C:/BoF-PSS2/harrykuv/OUTPUT/

Difference from the first selected simulation
☐ Show percentage
☐ Show absolute

Select from the drop-down list the simulation ID and add it to the comparison by pressing the add to comparison button. When all simulations are selected, select a system ID from the system ID drop-down list.

Choose system

Add to comparison

Delete

Select from the drop-down list the account statistics field to report and add it to the comparison by pressing the add to comparison button.

Choose data fields (becomes rows in report for each account)

System ID

Add to comparison

Delete

Save in csv-file   Save in csv-file and open

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Delete output data

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Project : p_test

To delete output data tables, click them active and then press the Delete output data button.

Remove entire simulati...	Simulation ...	Simulation name	System level st... SYLS	Account stat. ACST	Transact. event stat. TEST	Netting event stat. NEST	Account violation stat. AVST	Booking event stat. BEST	Unsettl. transact. stat. UNST	Submitt. transact. stat. SUST	Queued transact. stat. QUST	Comment transact. stat. CTST	Comment intraday credit st... CCST
☐	2Pjono		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	2Pjono2	toinen yrittämä	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	2Painall		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	2Pbalnc		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	2Pque1		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
☐	2Pque3		☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

Remove all or some
output data for a given
simulation.

To save space,
it is a good idea to
delete unnecessary
output data.

Delete output data

Help

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Exit program

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Specify/change data formats

Export output file

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Export output file

Project:

Choose simulation
Choose output table

Simulation ID: [ ]

Database table: SYLS System level statistics [ ]

Dataformat defaults   Data separator: [ ]   Date format: yyyymmdd [ ]

Decimal separator: [ ]   Time format: hhmmss.sss [ ]

Output file

Output file: [ ]

☐ Create names of columns

○ Create new template: [ ]

○ Use old template: [ ]

Choose or define output template

File column...	DB col	Var. name	Descriptive name	Selection Criteria
	1	N_SIMRUNID	Simulation run ID	
	2	N_SYSTEMID	System ID	
	3	N_ALGORIID	Algorithm ID	
	4	N_NETTDATE	Resolution date	
	5	N_NETTTIME	Resolution time	
	6	N_NETTINID	Netting ID	
	7	N_TRANSVAL	Transaction value	
	8	N_TRANSVOL	Transaction volume	
	9	N_SETTLVAL	Settled value	
	10	N_SETTLVOL	Settled volume	
	11	N_TOTALVAL	Total value	
	12	N_TOTALVOL	Total volume	

Rows processed: [ ]   [ ]

Execute export   Stop export

Help   Back to main menu   Exit program

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Example of output export CSV-file opened with Excel

Microsoft Excel - Test1

	A	B	C	D	E	F	G	H	K	L	M	N
1	FIRSTSMA	FIRST SMALL										
2	System ID	Transactio	Data set ID	Introductio	Introductio	Transaction val	From p	To pi	Settlement time	Settlement	Sending account's balance	
3	RTGS-A	100	TRAN1	12.5.2003	22:10:00	4880384,39	13	1	22:10:00	1	-4880384,39	
4	RTGS-A	101	TRAN1	12.5.2003	22:10:00	685826,6	12	1	22:10:00	1	-685826,6	
5	RTGS-A	102	TRAN1	12.5.2003	22:10:00	2639630,73	11	1	22:10:00	1	-2639630,73	
6	RTGS-A	103	TRAN1	12.5.2003	22:10:00	46064,41	10	1	22:10:00	1	-46064,41	
7	RTGS-A	104	TRAN1	12.5.2003	22:10:00	633795,99	2	1	22:10:00	1	-633795,99	
8	RTGS-A	105	TRAN1	12.5.2003	22:10:00	79702,04	14	1	22:10:00	1	-79702,04	
9	RTGS-A	106	TRAN1	12.5.2003	22:10:00	2786,33	6	1	22:10:00	1	-2786,33	
10	RTGS-A	107	TRAN1	12.5.2003	22:10:00	8000,03	5	1	22:10:00	1	-8000,03	
11	RTGS-A	108	TRAN1	12.5.2003	22:10:00	153492,54	13	5	22:10:00	1	-5033876,93	
12	RTGS-A	109	TRAN1	12.5.2003	22:10:00	83989,24	12	5	22:10:00	1	-769815,84	
13	RTGS-A	110	TRAN1	12.5.2003	22:10:00	779471,41	11	5	22:10:00	1	-3419102,14	
14	RTGS-A	111	TRAN1	12.5.2003	22:10:00	6678,92	10	5	22:10:00	1	-52743,33	
15	RTGS-A	112	TRAN1	12.5.2003	22:10:00	49921,7	2	5	22:10:00	1	-683717,69	
16	RTGS-A	113	TRAN1	12.5.2003	22:10:00	17337,06	14	5	22:10:00	1	-97039,1	
17	RTGS-A	114	TRAN1	12.5.2003	22:10:00	300182,44	6	5	22:10:00	1	-302968,77	
18	RTGS-A	115	TRAN1	12.5.2003	22:10:00	18950,49	1	5	22:10:00	1	8957240,03	
19	RTGS-A	116	TRAN1	12.5.2003	22:10:00	1634545,51	13	6	22:10:00	1	-6668422,44	

All data fields and rows of a given data table recognised by the simulation ID can be exported

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Presentation structure

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Version and licensee info

Project name

Database directories (use defaults if not common databases are needed)

Other directories

Initial specifications _ □ ✕

Bank of Finland Payment and Settlement Simulator

Initial specifications

Version: 0.7.1 / 28.4.2003
Licensee: Bank of Finland
Research Dept

○ Create new project: ▢ ○ Modify old project ▢ ▾

Databases

The simulator will create a new input and output database for each project in the indicated default directory. The user can change directory and also specify an already existing input and output database when desired. However, there can only be one input and output database assigned to the same project at one time.

Input database: ▢
Output database: ▢

Default directories

The simulator will use indicated default directories for the different file types. Each project is assumed to have its own default directories. The user can change the defaults and also use common directories.

Default directory for input files: ▢

Default directory for error list: ▢

Default directory for output files: ▢

Default directory for output reports: ▢

Save project modification

Help

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User module
name

Location

Type

Parameters

Checking rules

User module definitions — □ ✕

Bank of Finland Payment and Settlement Simulator

User module definition

Project : harrykuv

User module name: [_____]

User module file: [_____] [Browse]

User module type: [SUB ▼]

Parameters   Check rules

[→____]   [Positive numeric ▼]   [Add parameter]

                                     [Delete parameter]

[Save definition]

[Help]   [Back to main menu]   [Exit program]

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User modules for advanced users

▶ Facilitates introduction of user algorithms

▶ Java-based

▶ Standardised simulator interfaces

▶ Ready-made functions to retrieve data from databases and runtime main memory

▶ Examples/templates of user module designs

▶ User modules should conform to algorithm categories

A library of shared user-developed modules could also be distributed eventually

Use of Excel

- Excel is used for viewing CSV-files
- Excel can be used for editing input CSV-files
- Excel can be used for making reports out of CSV-files
- Current Excel versions have a limitation of 65.000 rows
- Excel is often producing extra empty rows/columns (,,,,,)
- Check that delimiters (decimal and data separators) and presentation formats (date and time) are identical with simulator specifications
- Large values may be distorted (less accuracy)
- The actual content of CSV files stored by Excel can be checked with eg Notepad

Use of MySQL

▶ MySQL provides advanced functions for database management (see www.mysql.com)

▶ Augments advanced user capabilities when simulator functions are insufficient

▶ Some special administration features omitted in the simulator and MySQL required when e.g. deleting projects, templates, comparison views, user module definitions and batch-run IDs

▶ Detailed database description available

Presentation structure

1. Background

2. Input generation sub-system

3. Simulation execution sub-system

4. Output analysing sub-system

5. Special functions

6. Requirements and user support

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Hardware and software requirements

▶ PC Intel Pentium 4 class processor with min. 256 MB main memory (512 MB or more is recommended for large simulations)

▶ Microsoft Windows NT/2000 or Microsoft Windows XP operating systems with Office/Excel installed (Linux is probably possible with some limitations)

▶ MySQL database system with Java connector (can be loaded down from Internet without charge)

A typical simulation site would be a stand alone micro and in the network environment parallel usage of MySQL requires special attention

Ordering and delivery

▶ The simulator is available free of charge to researchers, but carries no BoF warranties

▶ Fax ordering,

▶ Download from the Internet

▶ Automated installation

▶ Published research results should be reported

▶ Users free to make additions (user modules and analysis tools)

Ordering form and guide available at www.bof.fi/sc/bof-pss

Documentation

▸ Product information sheet

▸ Combined presentation and tutorial (PowerPoint)

▸ "Simulating Interbank Payment and Settlement Mechanisms" (discussion paper)

▸ Licensing terms and conditions

▸ User guide

▸ Installation guide

▸ Database description

▸ User module development guide

▸ Simulation examples

▸ Seminar and workshop proceedings

Documents available at www.bof.fi/sc/bof-pss

Bank of Finland Payment and Settlement Simulator

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User support

- Most user support should be available from help features and documentation

- Bank of Finland provides limited user support (errors, in particular, should be reported)

- MSG Software Oy provides technical assistance and programming services in line with their normal service offerings

- Planned annual seminars and workshops for simulator user community to give opportunities to exchange experiences, views and ideas

- Comments welcome to help us enhance simulator offerings

Further developments

▶ First production version (1.0.0) available since 03/2003

▶ Next update (1.1.0) including cross-check bypass available 09/2003

▶ Bug correction version (1.1.1) probably available 11/2003

▶ Next larger update probably (2.0.0) available early 2005

*Development plans may still change because
the final decisions will be made after seminar discussions.*

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is available for
- **questions**
- **comments**
- **ideas**
- **etc**