Stress testing liquidity needs in Finnish retail securities settlement system

Preliminary results

23.8.2006, BoF simulation seminar

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Presentation structure

- Goal of this study
- System under study and stress testing scenarios
- Modelling securities settlement in BoF-PSS2
- Some results
- Conclusions

Project objectives

- Analysis and quantification of risks in retail securities settlement system (SSS)
  - Systemic risk, liquidity risk, contagion possibilities
- Increase our understanding in
  - the Finnish market infrastructure
  - the Finnish market practices
- Development of BoF-PSS2
- Making way for more interesting studies
  - Nordic CSD, CCP-clearing, T2S etc.

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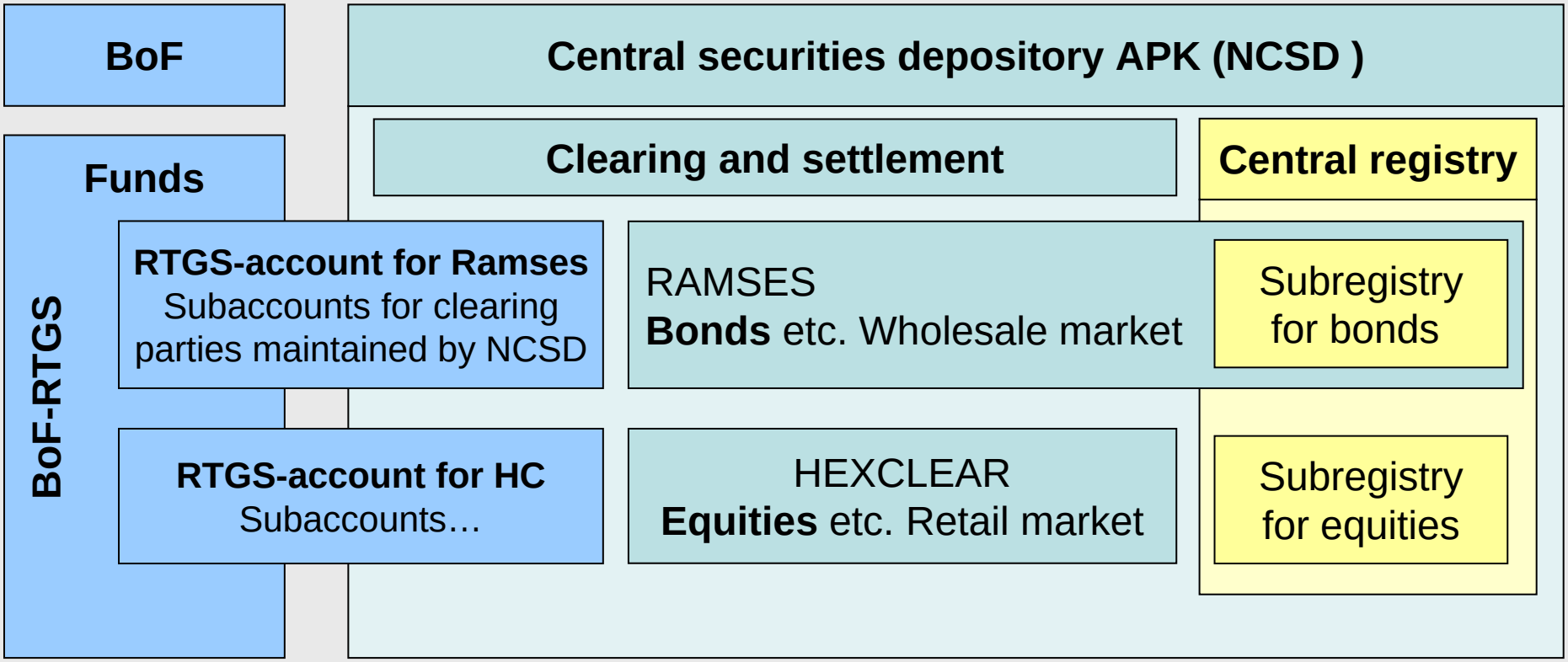
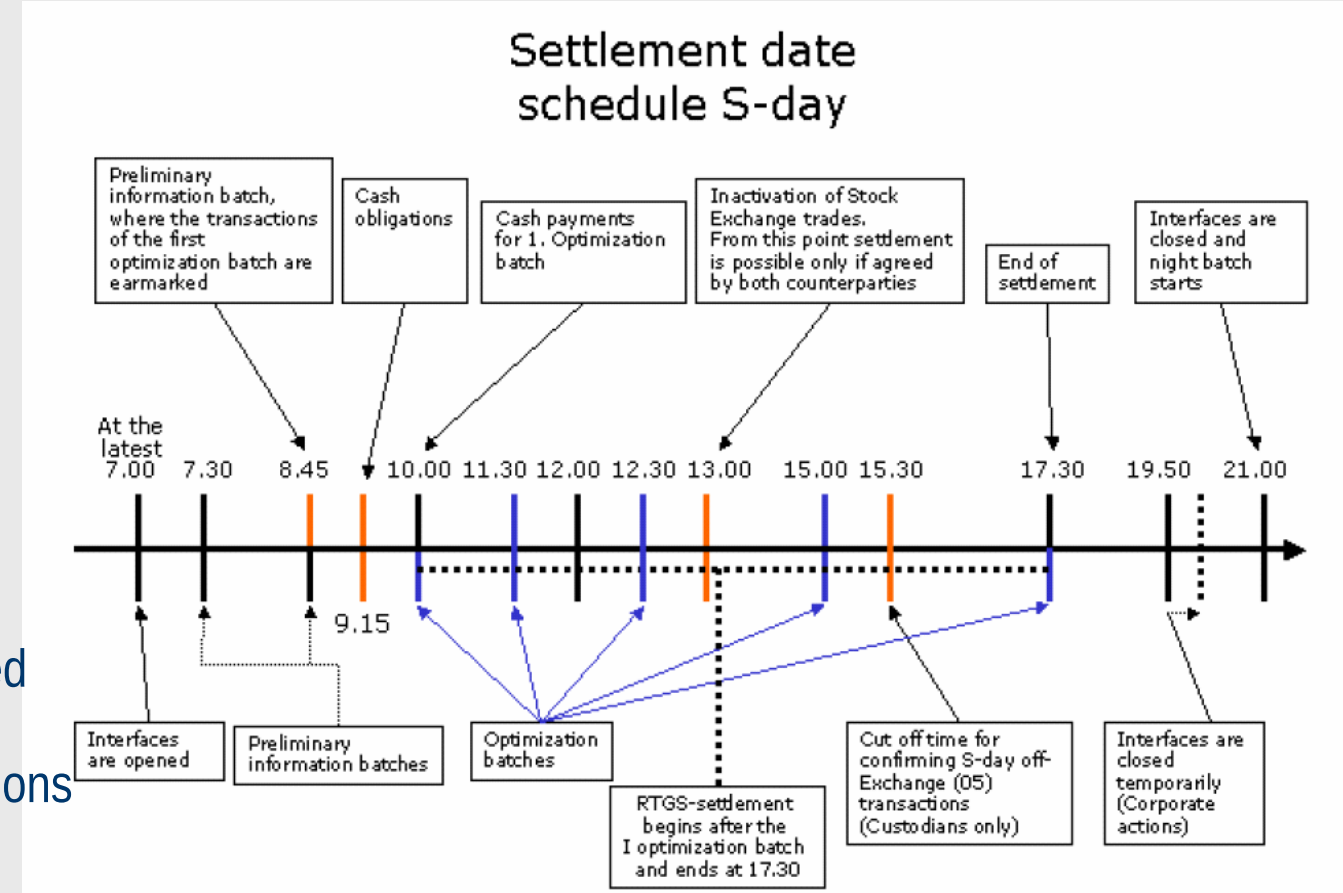
The Finnish post trade infrastructure



Monthly figures: (March 2006)	trade volumes	trade values	Market capitalization
In RAMSES	~ 1276	~ 13 b euro	~65 b euro
In HexClear	~ 865 000	~68 b euro	~235 b euro

HexClear settlement process structure

- Players of of the game
  - CSD
  - Account operators
  - Clearing parties
  - Brokers
  - Final investors
  - Central Bank
- Information flows of settlement process:
  - Exchange trade feed
  - OTC-trades & settlement transactions
  - Trade enrichments
  - Cash obligations
  - Registry reservations



Source: APK, HexClear documentation

The scenarios: What if...

- Operational failure strikes system participant(s)
  - Individual broker, clearing party, account operator, CSD (or CB)...
- There are communication problems
  - between CSD and clearing parties (abroad ?)
  - between CB and CSD
- Settlement algorithm failure
  - optimization is delayed or cancelled
- Some asset type excluded from settlement due to registry problems

- **Plausible?**
  - Minor scale examples of each category exist
- **Relevant?**
  - Maybe, lets find out…

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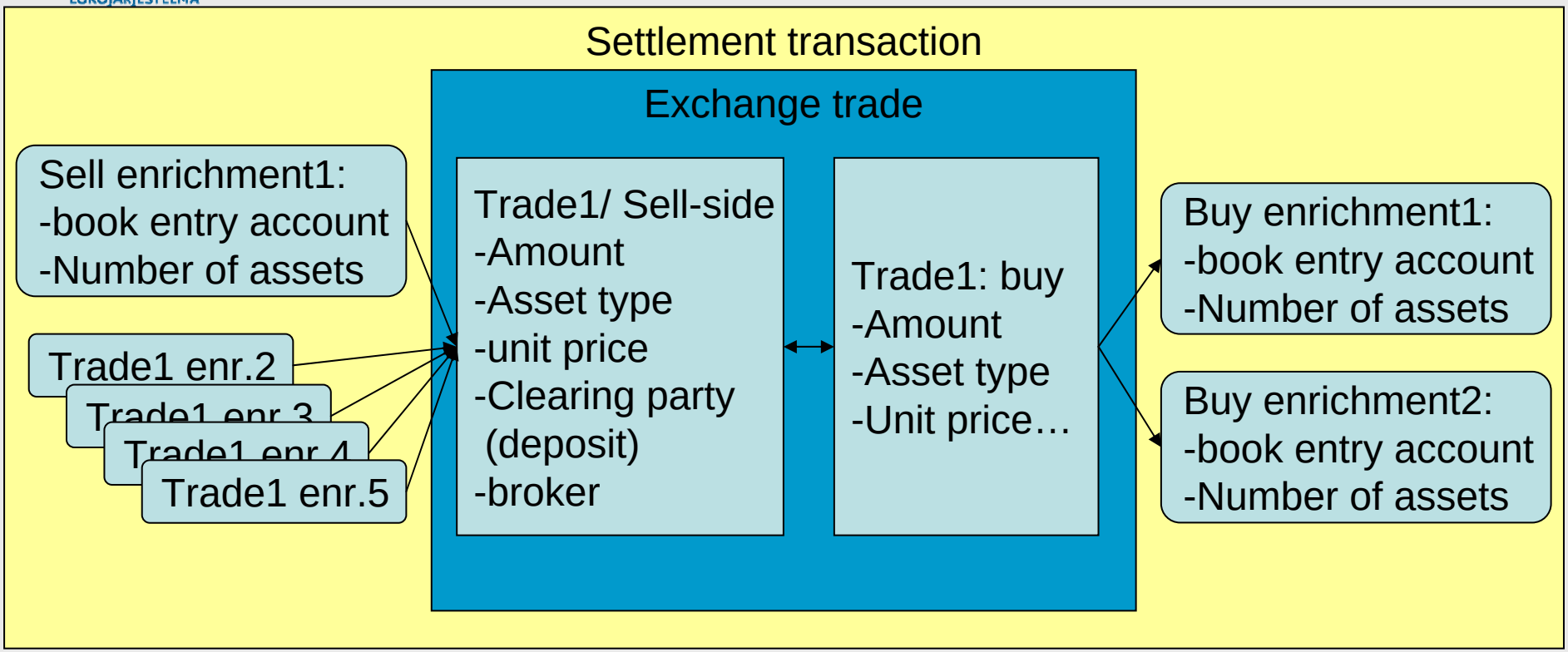
Modelling securities settlement in BoF-PSS2

- I’ts just as with payment systems except
- Different asset types are described with book entry currencies
  - Number of accounts increases
- Delivery versus Payment (DVP)
  - More accounts in each transaction
- Corporate actions, derivatives...

$\Rightarrow$ Increased complexity in clearing proces, same algorithms do not work anymore.

Settlement transaction structure example



- Simulated transactions = trade enrichments i.e. booking to individual account
- One trade can have arbitrary number of bookings

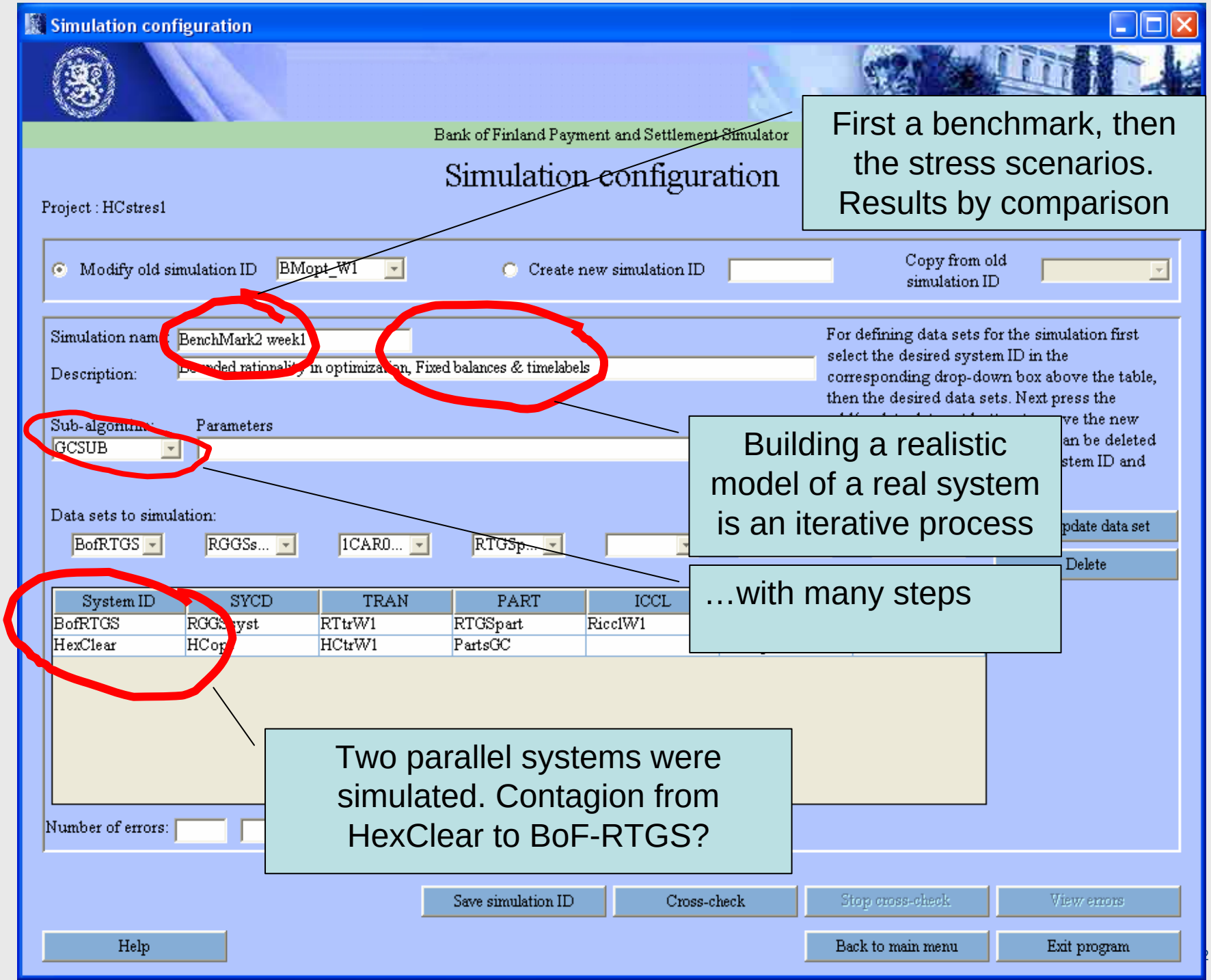
⇒New group code algorithms implemented through the line

- -Optimization: Batch type gridlock resolution, subset with max value (PNS)
- -Greedy search alternating with asset and fund settlement

Data we used

- Book entry account balances
  - All accounts and all asset types (only active accounts simulated)
- Settlement transactions
  - all trades, corporate actions, settlement transfers, account transfers… i.e. everything affecting be-account balances
- RTGS intraday credit limits, BoF-RTGS transactions

- Some numbers: ~93 000 accounts, 2 million trans (per month)
- Data mainly from APK, their help and co-operation crucial


Simulation configuration
Bank of Finland Payment and Settlement Simulator
Simulation configuration
Project : HCstres1
Modify old simulation ID
BMopt_W1
Create new simulation ID
Copy from old simulation ID
Simulation nam
BenchMark2 week1
Description:
n optimiza n, Fixed balances & timelabels
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
Sub-algorithm:
Parameters
GCSUB
Data sets to simulation:
BofRTGS
RGGSs...
1CAR0...
RTGSp...
pdate data set
Delete
System ID
SYCD
TRAN
PART
ICCL
BofRTGS
RGGS yst
RTtrW1
RTGSpart
RicclW1
HexClear
HCop
HCtrW1
PartsGC
Number of errors:
Save simulation ID
Cross-check
Stop cross-check
View errors
Help
Back to main menu
Exit program
First a benchmark, then the stress scenarios. Results by comparison
Building a realistic model of a real system is an iterative process
…with many steps
Two parallel systems were simulated. Contagion from HexClear to BoF-RTGS?

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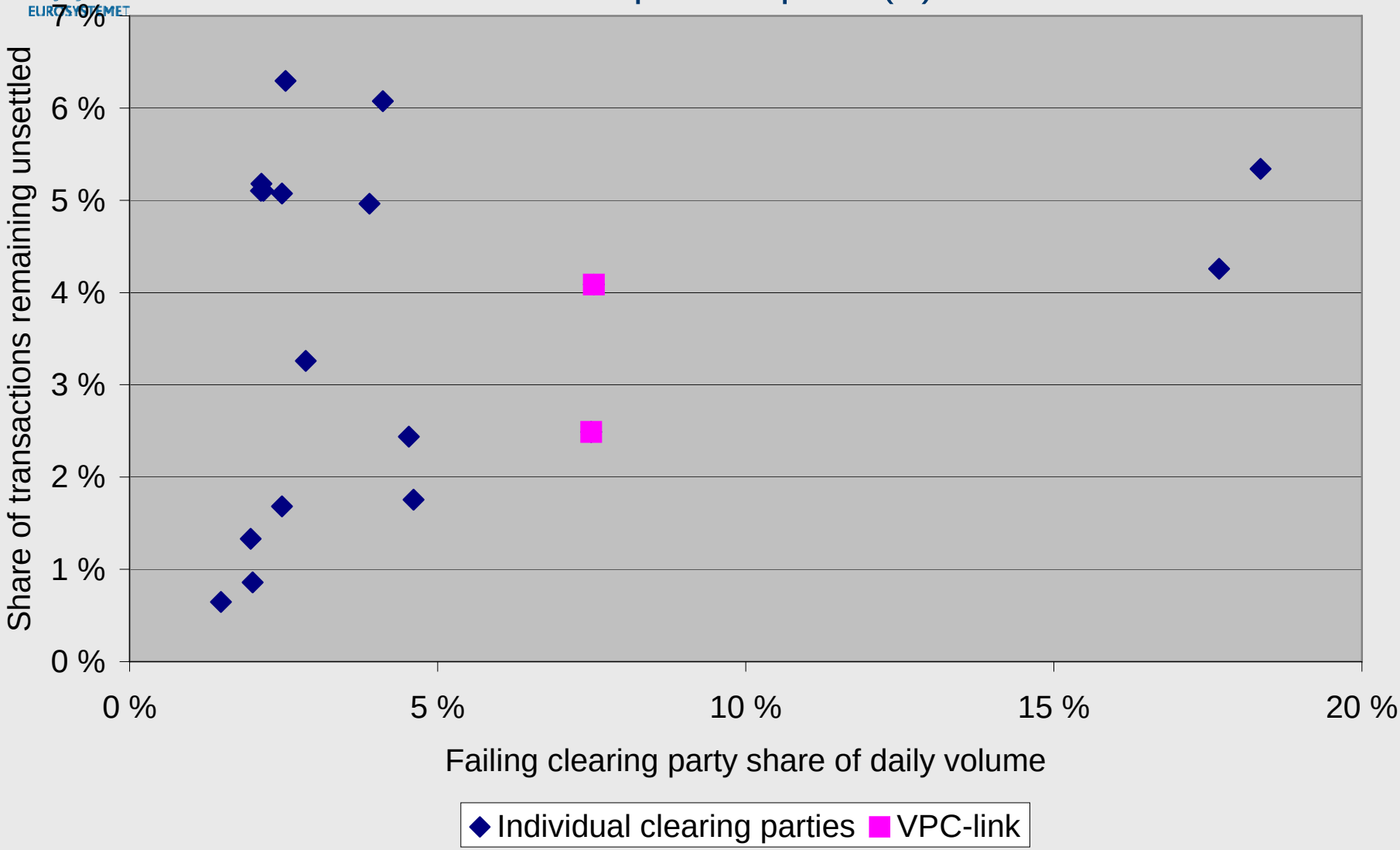
Scenario 1: operational failure of clearing participant

- One participant failing at a time
- Period: simply one calendar day to start with
- Actions which the failing part performed in the HexClear user interface are cancelled (input of trade enrichments etc)
- Some trades become unfeasible for settlement
- Chain reaction results (?) in settlement
- Sample consists of biggest clearing parties based on market share (volume)

- Scenario 2: all parties connecting to HexClear via VPC are excluded

Share of unsettled transactions in the next day after an operational failure of clearing participant(s)



Resulting liquidity shortages

- Differences in fund account balances in HexClear compared with benchmark after 2nd day
  - From -6,5 million euros up to +62 million euros
  - Cancelled money repatriations to BoF-RTGS mix the values (positive bias in balances of HexClear)
  - Still, the scale of liq. shortages is peanuts compared to e.g. intraday credit limits of the major participants

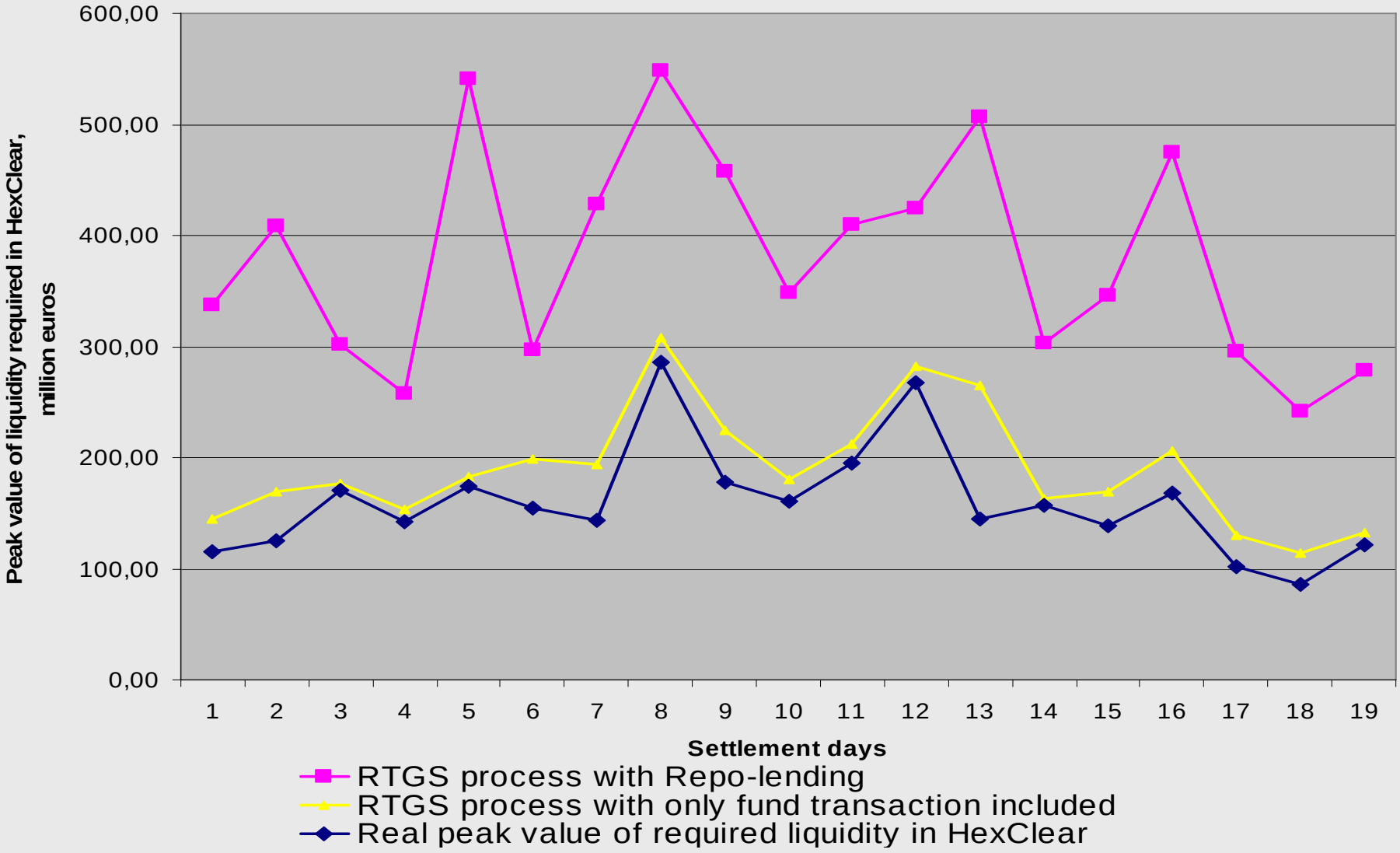
The liquidity need of equities settlement without optimization

- Assume that the normal, more efficient settlement process with gridlock resolution is unavailable in equities settlement. How much more liquidity is needed in plain RTGS process to ensure smooth settlement without any delays?
  - Maximum value of **momentary agregated liquidity need** over the whole system is considered
- Scenarios
  1. Only the cash transfers of the settlement process and the liquidity requirement they create is measured.

     $\Rightarrow$ In the average 21% increase in the liquidity nead, peak value +83%
  2. Lack of securities is included by converting the securities to cash with their average market value. In reality a very efficient and liquid Repo-marked would be needed for this.

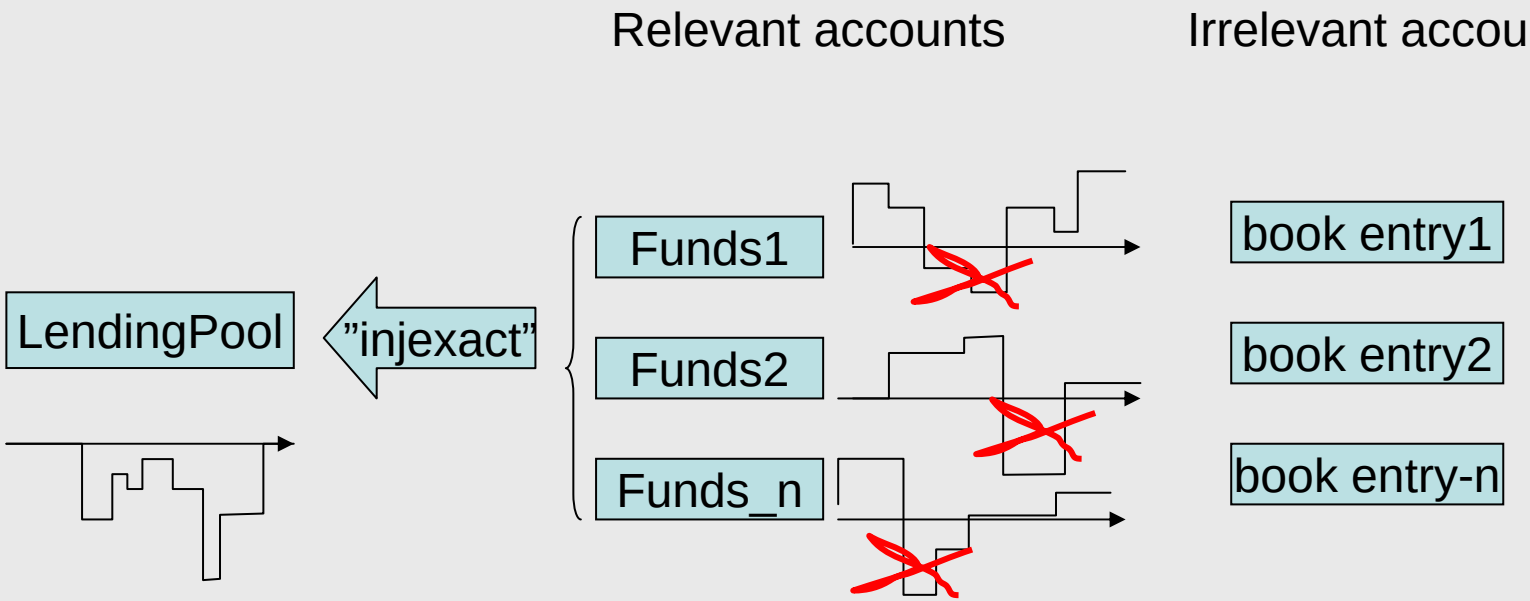
     $\Rightarrow$ In the average 146% increase in liquidity need, peak value +251%

The liquidity need in equities settlement when primary settlement algorithm is unavailable



The story behind the scenes

- Challenge: ”Maximum value of momentary agregated liquidity need over the whole system…”



•Solution: A new algorithm was developped for exact liquidity lending and loan returns. Source for liquidity injections can be defined on account level.

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Conclusions

- Stress testing and simulations **teaches a lot** of the system you study
- You may also find quantifiable results, but it takes some time and hard work. Especially in retail systems (with massive data) and when new processing logics are implemented in simulations.
- HexClear optimization saves liquidity compared to RTGS process

- Optimization *seems* to mitigate efficiently the impacts of failure situations
  - liquidity shortges after failures are moderate
  - Share of unsettled does not grow together with size of failing participant

BUT much more simulations will be needed for reliable observations