Information Dissemination in Modern Banking Applications

Peter Peinl

Department of Computer Science
University of Applied Science Fulda
peter.peinl@informatik.fh-fulda.de

Marquardstraße 35
D-36039 Fulda

Overview

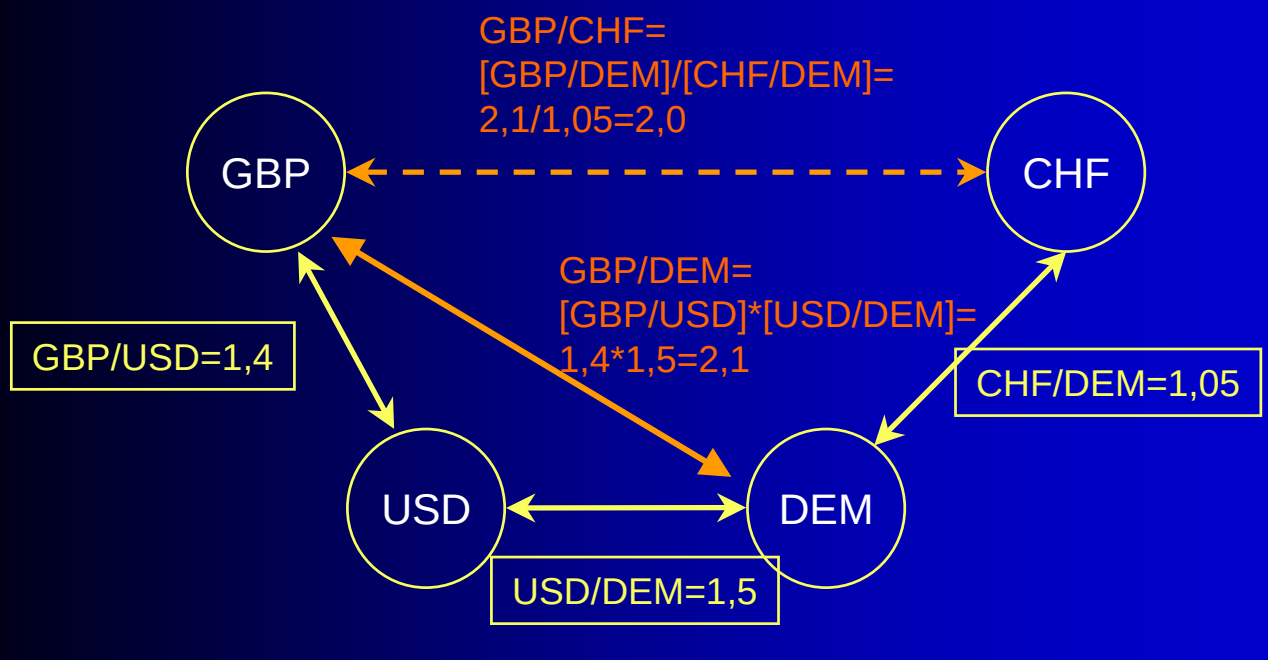
- Foreign exchange trading
- Application and systems requirements
- System architecture and implementation
- Distribution, replication and parallelism issues
- Conclusions

Business trends in the banking and finance industry

- Radical change of business world
  - Deregulation (goods, services, capital)
  - Market globalization
  - Decrease of margins of conventional products
- Properties of novel financial products
  - Rapid pace of innovation
  - Multitude of products: swaps, options, futures
  - Complex rules and high profit potential
- Business impact
  - Volume of open trades exceeds many times the total assets on the balance sheet
  - Indispensibility of effective risk assessment and control
  - Paramount for high profitability

Foreign Exchange (FX)

- Exchange of currencies and derivatives
  - Truly electronic market (inter-bank trading: 1.9 trillion USD per day)
  - Online/real-time characteristics
- Complex application rules (FX-calculus)
  - Spot, forward, options, value dates, ...
  - More exceptions than rules“



Electronic markets
- interbank trading -

- Global network of financial institutions
  - Entirely computerized trading
  - Worldwide, integrated networks
  - Newest available technology
- Ideal markets (economic theory)
  - Supply and demand determine price
  - High liquidity, many participants
  - Transparent, continuously quoted prices
  - Round-the-clock trading
- Market transparency achieved by
  - Commercial information providers for financial data (Reuters, Bloomberg, Telerate)
  - Interconnection of banking systems

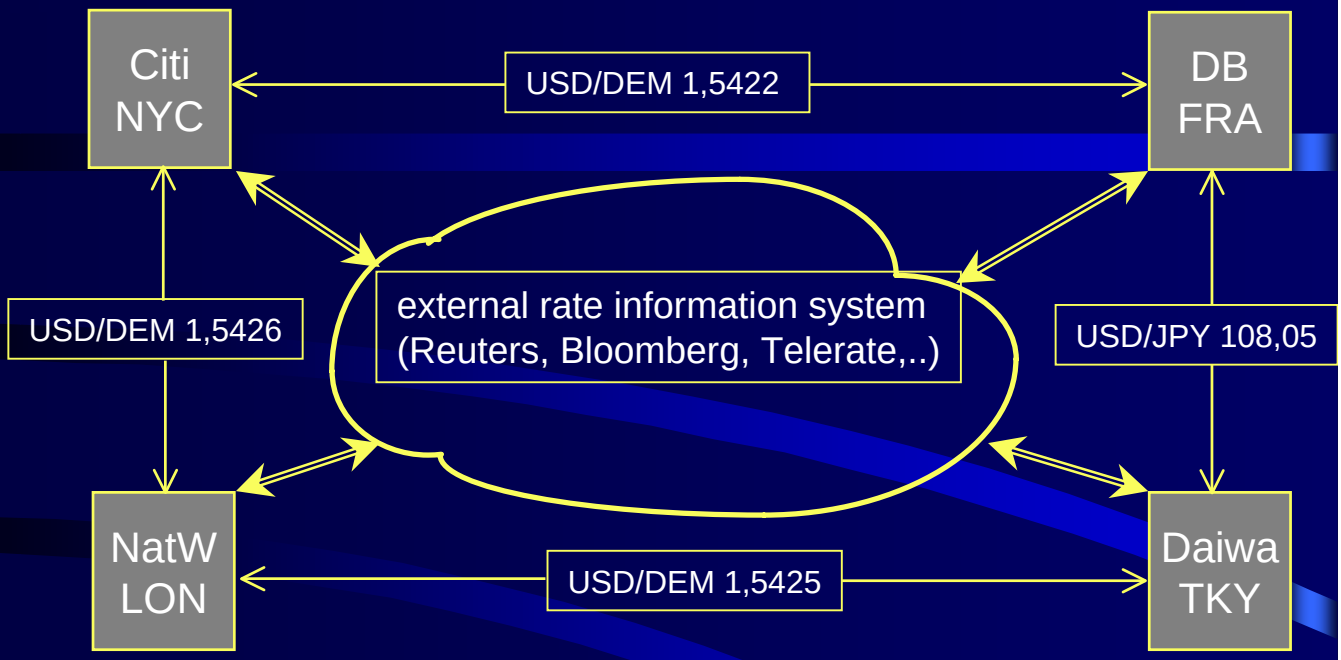
- Types of information systems

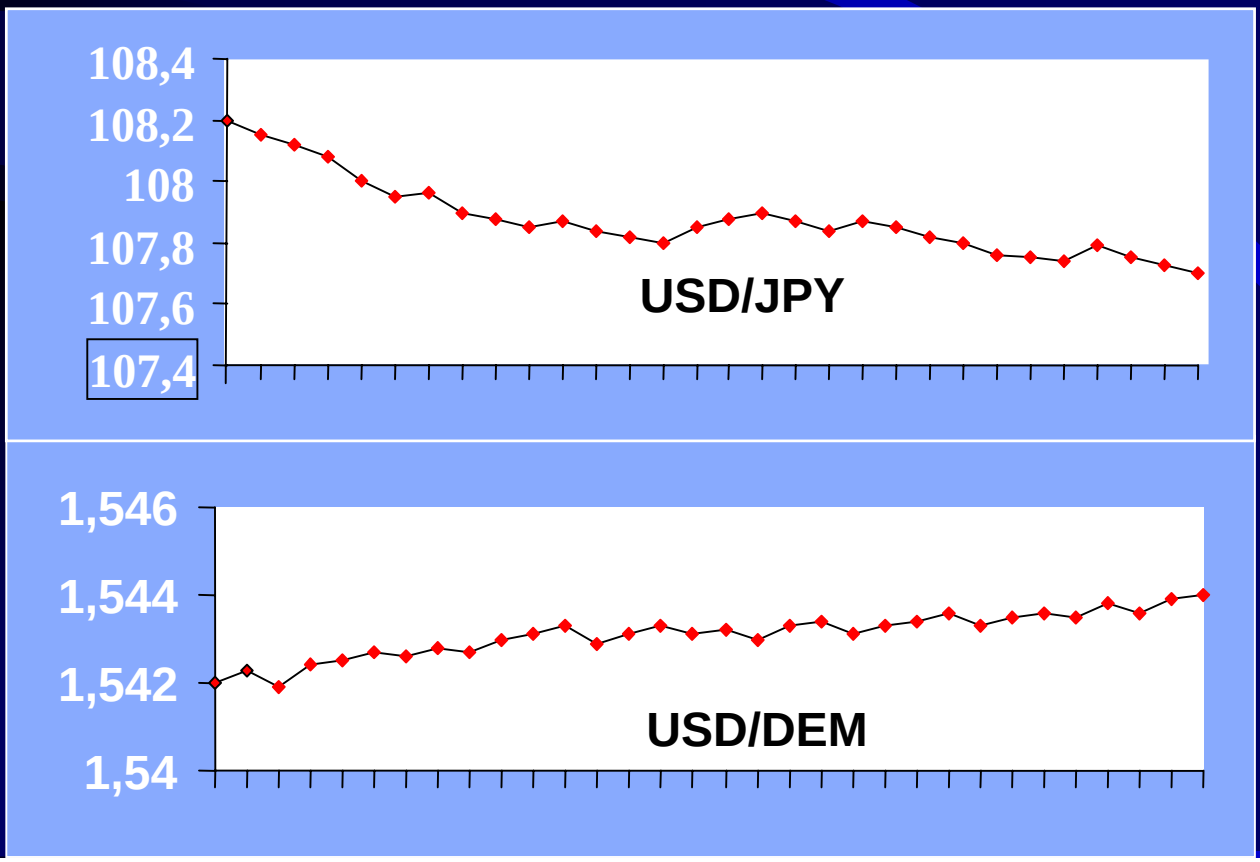
Rate/quote information systems

Trading systems

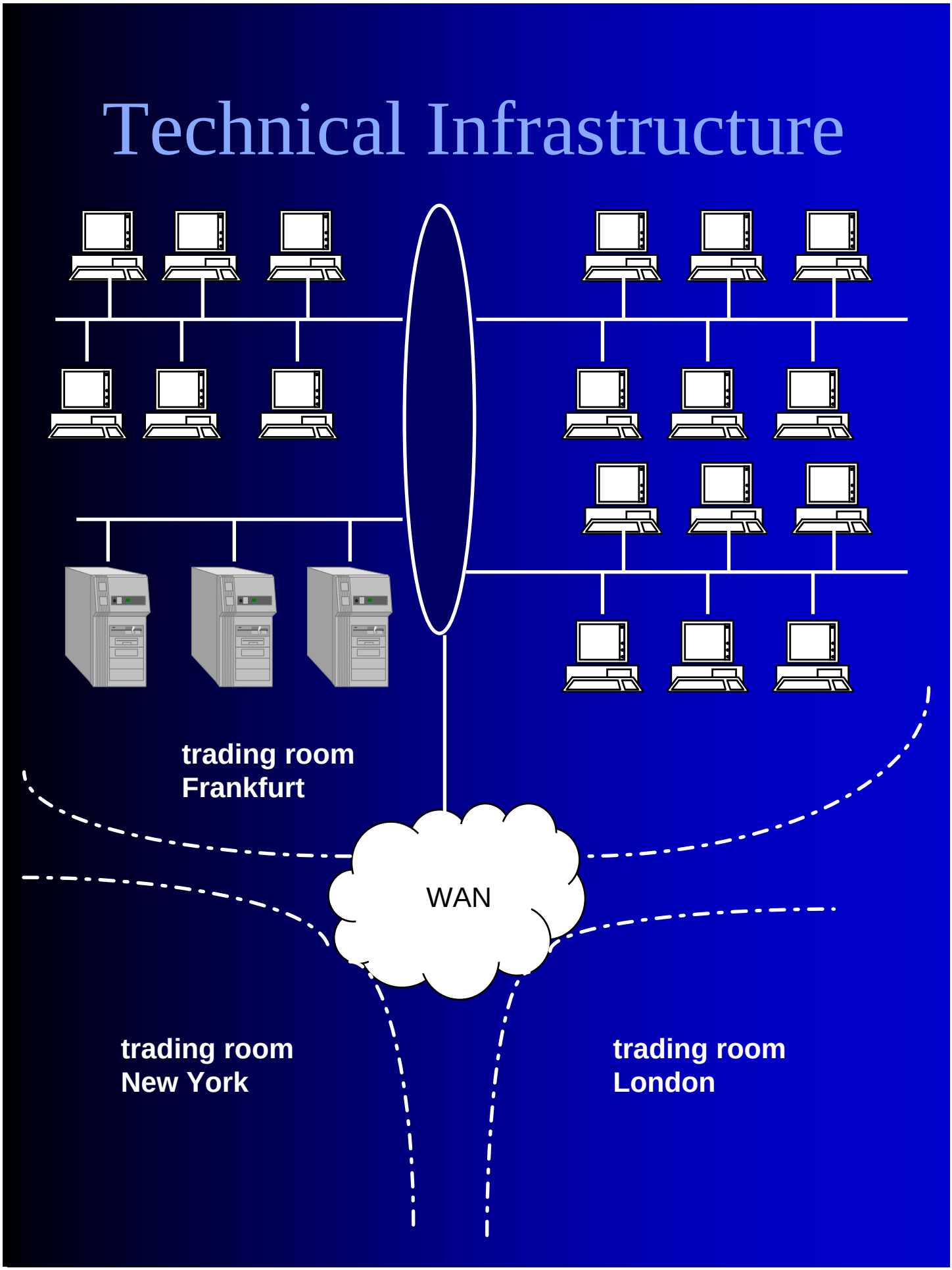
Settlement systems

External (rate) information and trading systems





Technical Infrastructure



Foreign exchange trading
- basic terms -

- Spot market
  - Provision of liquidity for import and export trades (goods and services)
  - Provision of liquidity for financial transactions
- Forward market
  - Financing exports or imports
  - Sell or but foreign currency in the future at a fixed predetermined price, no choice
- Options market
  - Hedging (insurance) against the risk of currency fluctuations (option price)
  - Choice to exercise the option or to let it lapse

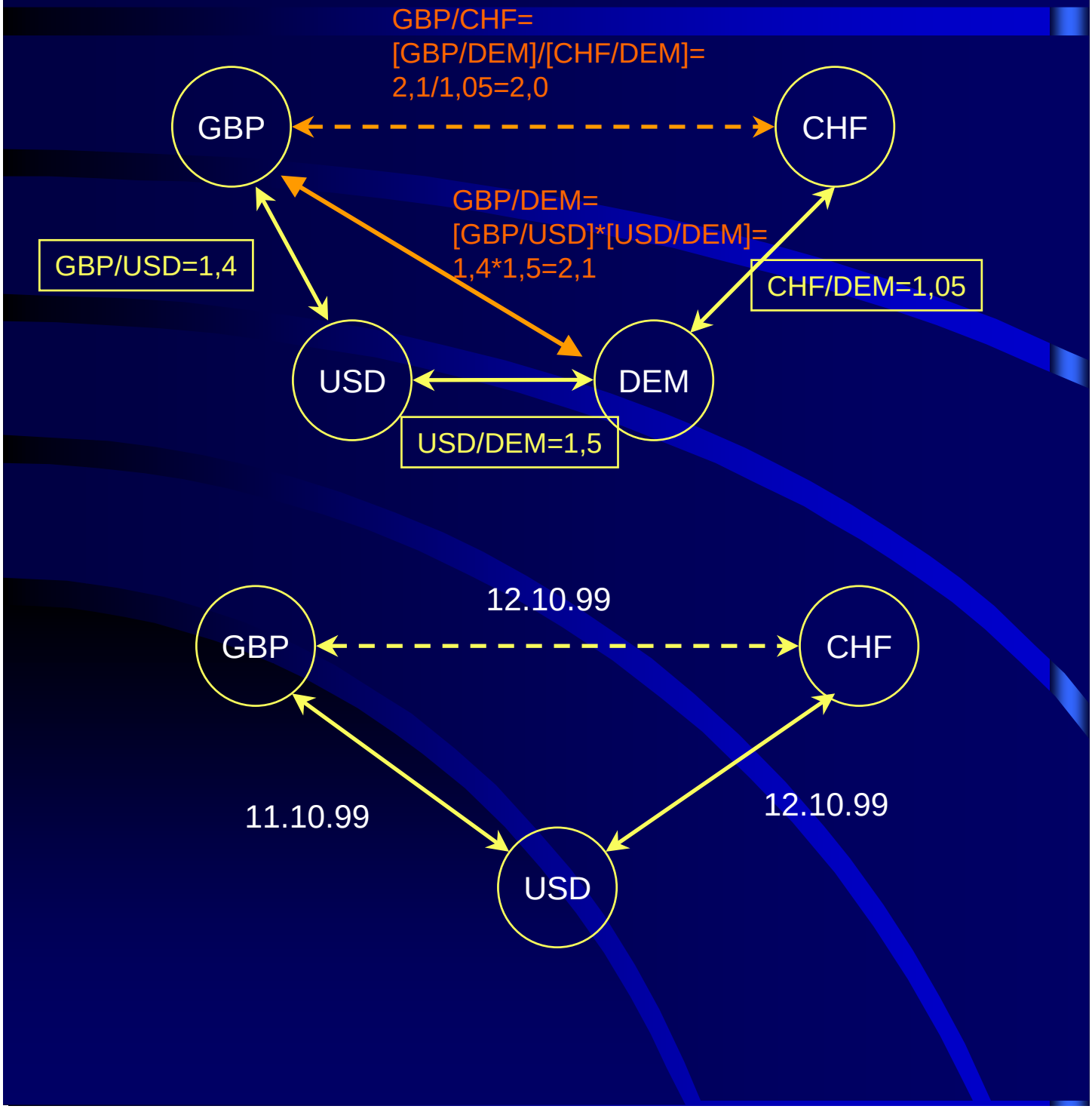
FX trading rules

- value dates -

- Types of date in an FX trade
  - Trading date: date of trade agreement
  - Value date: date of settlement of trade, i.e. the respective currency amounts have to be made available to the clearing accounts of the paties of the trade
  - Expiry date: ultimate date when option may be exercized
- Complex rules for value date calculation
  - Standard value dates (overnight, spot, 1 week, 1 month, etc.)
  - many exceptions

FX trading rules

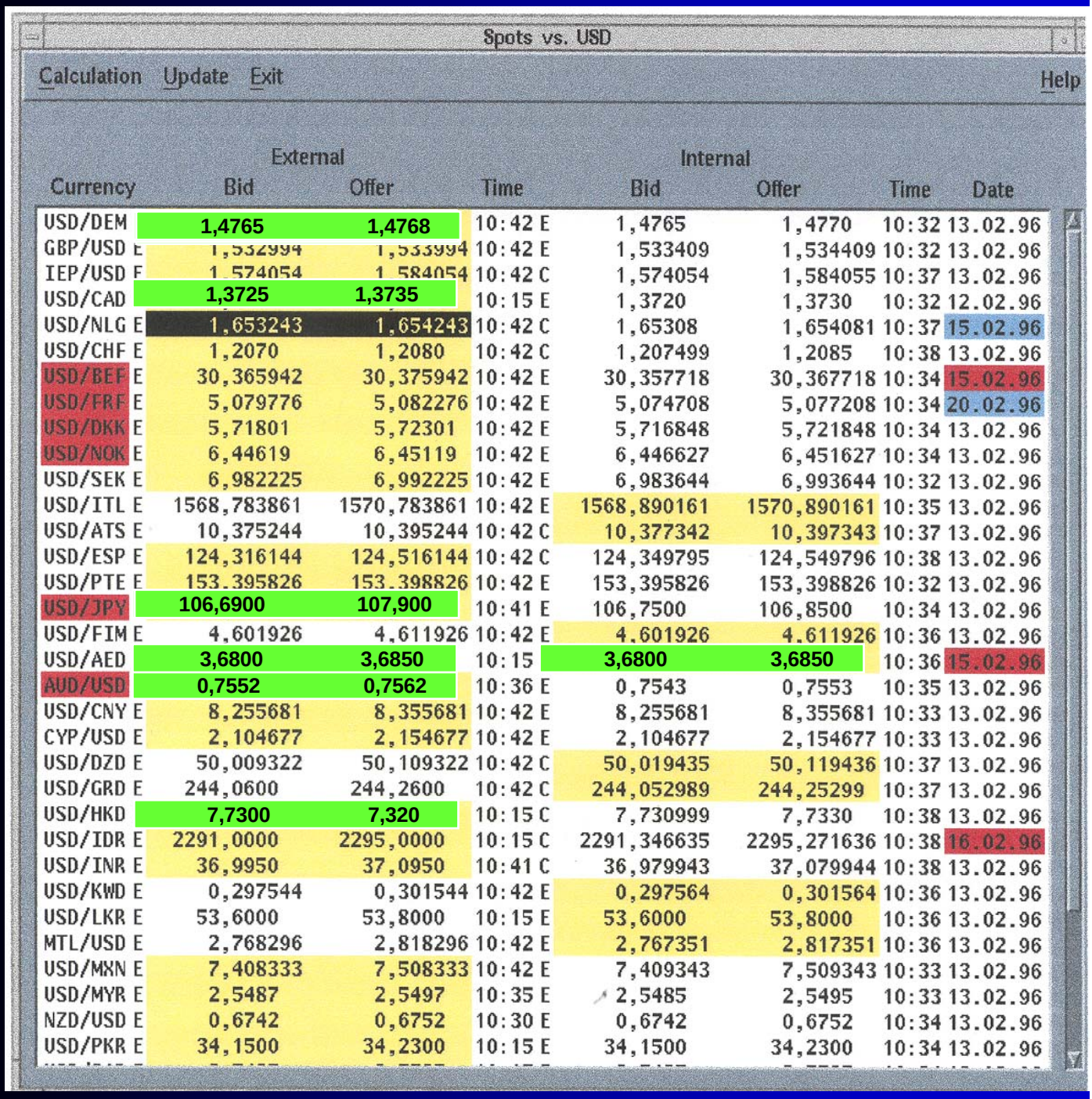
- example 3: cross rates -



Requirements

- Application to efficiently provide full FX-calculus functionality in a distributed, replicated, parallel environment
- System
  - Autonomy of trader
  - Centralised policy making
  - Shared up-to-date information
  - Recoverability, security, accounting
  - Different coupling modes between trading rooms

Trader interface example
- spot window -

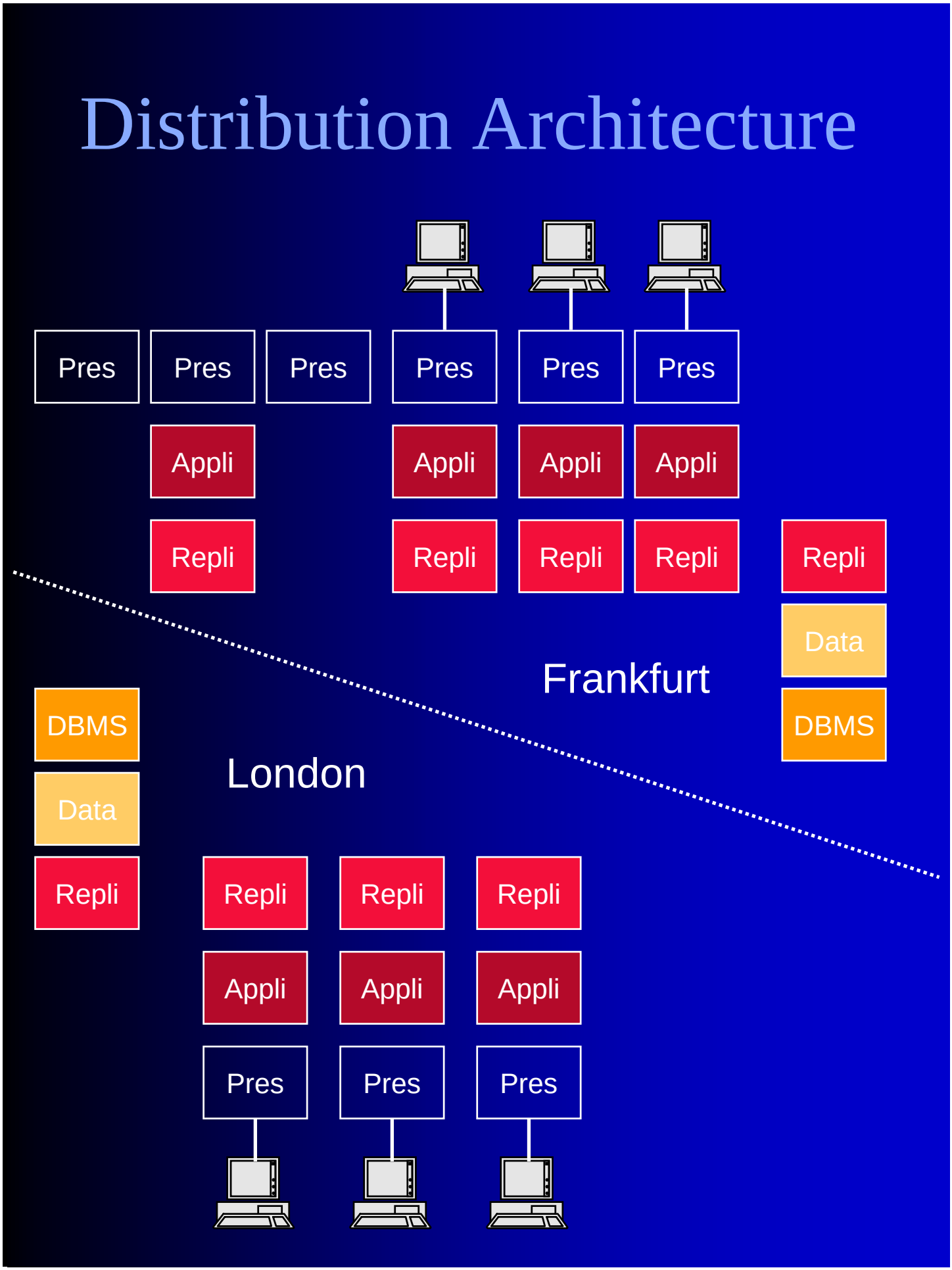


Spots vs. USD

Calculation Update Exit Help

Currency	External Bid	External Offer	Time	Internal Bid	Internal Offer	Time	Date
USD/DEM	1,4765	1,4768	10:42 E	1,4765	1,4770	10:32	13.02.96
GBP/USD E	1,532994	1,533994	10:42 E	1,533409	1,534409	10:32	13.02.96
IEP/USD E	1,574054	1,584054	10:42 C	1,574054	1,584055	10:37	13.02.96
USD/CAD	1,3725	1,3735	10:15 E	1,3720	1,3730	10:32	12.02.96
USD/NLG E	1,653243	1,654243	10:42 C	1,65308	1,654081	10:37	15.02.96
USD/CHF E	1,2070	1,2080	10:42 C	1,207499	1,2085	10:38	13.02.96
USD/BEF E	30,365942	30,375942	10:42 E	30,357718	30,367718	10:34	15.02.96
USD/FRF E	5,079776	5,082276	10:42 E	5,074708	5,077208	10:34	20.02.96
USD/DKK E	5,71801	5,72301	10:42 E	5,716848	5,721848	10:34	13.02.96
USD/NOK E	6,44619	6,45119	10:42 E	6,446627	6,451627	10:34	13.02.96
USD/SEK E	6,982225	6,992225	10:42 E	6,983644	6,993644	10:32	13.02.96
USD/ITL E	1568,783861	1570,783861	10:42 E	1568,890161	1570,890161	10:35	13.02.96
USD/ATS E	10,375244	10,395244	10:42 C	10,377342	10,397343	10:37	13.02.96
USD/ESP E	124,316144	124,516144	10:42 C	124,349795	124,549796	10:38	13.02.96
USD/PTE E	153,395826	153,398826	10:42 E	153,395826	153,398826	10:32	13.02.96
USD/JPY	106,6900	107,900	10:41 E	106,7500	106,8500	10:34	13.02.96
USD/FIM E	4,601926	4,611926	10:42 E	4,601926	4,611926	10:36	13.02.96
USD/AED	3,6800	3,6850	10:15	3,6800	3,6850	10:36	15.02.96
AUD/USD	0,7552	0,7562	10:36 E	0,7543	0,7553	10:35	13.02.96
USD/CNY E	8,255681	8,355681	10:42 E	8,255681	8,355681	10:33	13.02.96
CYP/USD E	2,104677	2,154677	10:42 E	2,104677	2,154677	10:33	13.02.96
USD/DZD E	50,009322	50,109322	10:42 C	50,019435	50,119436	10:37	13.02.96
USD/GRD E	244,0600	244,2600	10:42 C	244,052989	244,25299	10:37	13.02.96
USD/HKD	7,7300	7,320	10:15 C	7,730999	7,7330	10:38	13.02.96
USD/IDR E	2291,0000	2295,0000	10:15 C	2291,346635	2295,271636	10:38	16.02.96
USD/INR E	36,9950	37,0950	10:41 C	36,979943	37,079944	10:38	13.02.96
USD/KWD E	0,297544	0,301544	10:42 E	0,297564	0,301564	10:36	13.02.96
USD/LKR E	53,6000	53,8000	10:15 E	53,6000	53,8000	10:36	13.02.96
MTL/USD E	2,768296	2,818296	10:42 E	2,767351	2,817351	10:36	13.02.96
USD/MXN E	7,408333	7,508333	10:42 E	7,409343	7,509343	10:33	13.02.96
USD/MYR E	2,5487	2,5497	10:35 E	2,5485	2,5495	10:33	13.02.96
NZD/USD E	0,6742	0,6752	10:30 E	0,6742	0,6752	10:34	13.02.96
USD/PKR E	34,1500	34,2300	10:15 E	34,1500	34,2300	10:34	13.02.96

Distribution Architecture



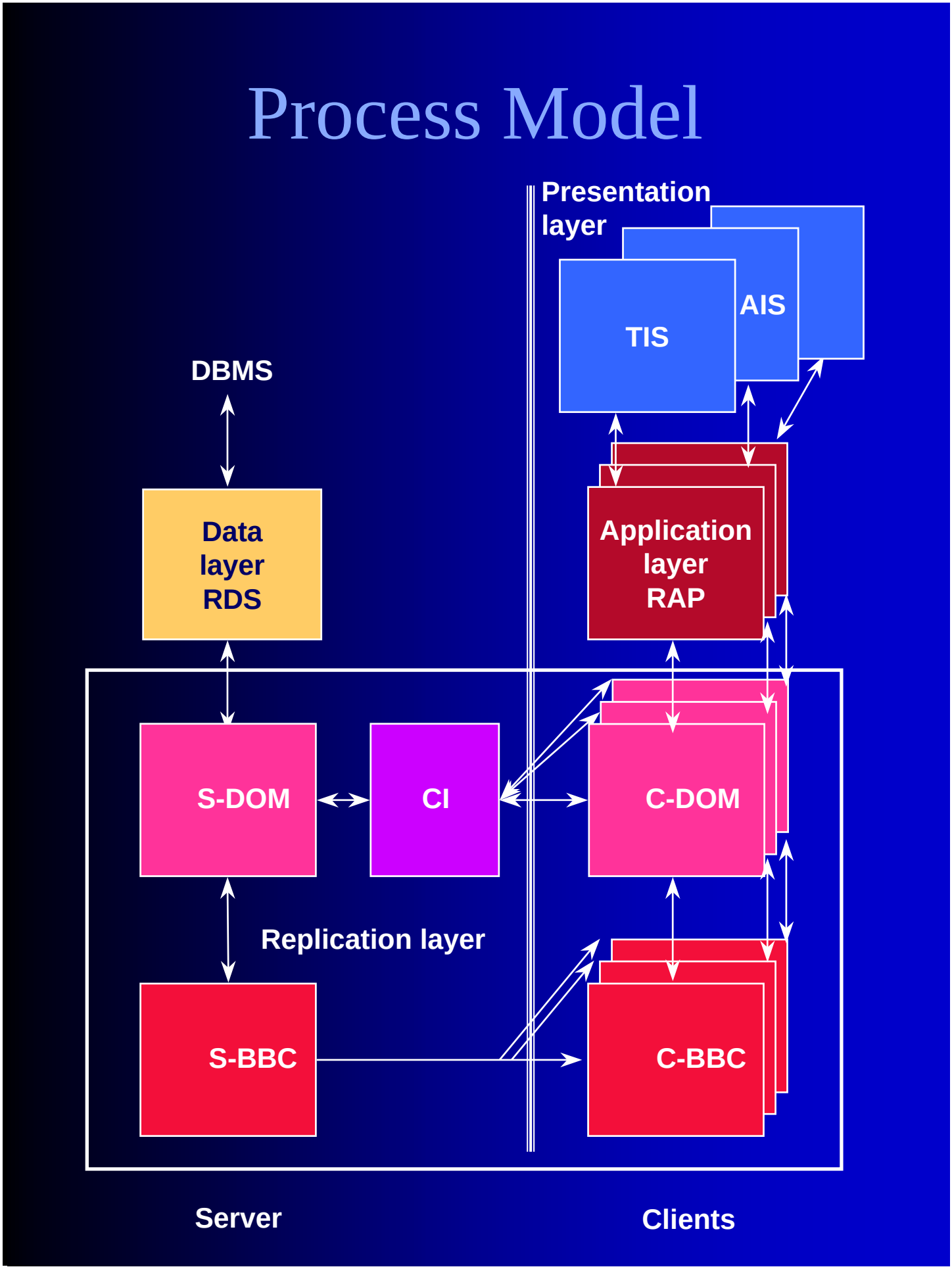
Functional Architecture

- Application layer
  - Implementation of business objects
  - Implementation of application-specific interface for presentation layer („publish-and-subscribe API“)
  - Implementation of the FX-calculus
  - Versioning of FX-objects („what-if scenarios“)
  - Implementation of event-driven dynamic recalculation mechanism

Functional Architecture

- Replication layer
  - Implementation of active system-wide replication of business objects
  - Context of trading room managed as shared global memory
  - Automatic restart and recovery
  - Guarantee of lossless transmission
- Data layer
  - Mapping between object-oriented and relational representation of business objects
  - Management and control of the world-wide replication of business objects between trading rooms

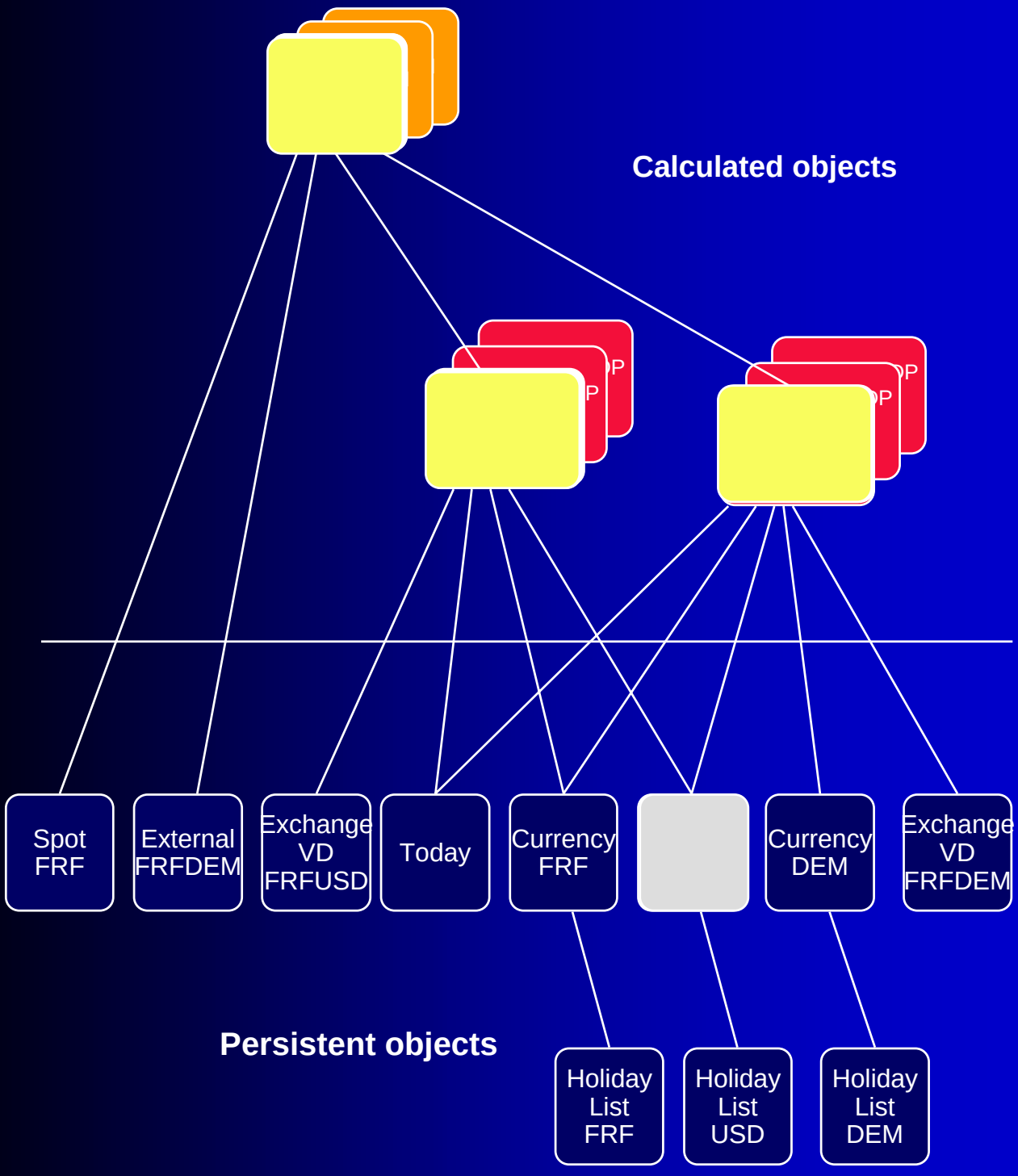
Process Model



Distributed Dynamic Recalculation Mechanism

- Objective
  - Capability to calculate every conceivable rate in online/real-time mode at every workstation
  - Modesty in the consumption of bandwidth
- Observation
  - Small percentage of total number of FX-objects actually required on an individual workstation
  - Calculation of all potential rates based on a relatively small number of basic objects possible
  - Information need of particular workstation is dynamic and cannot be planned
- Solution
  - Dynamic client-based recalculation mechanism

Dynamic Recalculation



Conclusions

- Status: operational
  - Several 100k LoC
  - Several 100 workstations
  - Several trading rooms
- Lessons learnt
  - Employment of off-the-shelf components is critical but often not possible
  - Employment of commercial DBMS-based replication mechanism was a good decision but not sufficient
  - Dynamic distributed calculation mechanism satisfies expectations