

Why industrial manufacturing data need special considerations



Roland Sonnenschein
Hesotech GmbH
automatisieren – visualisieren

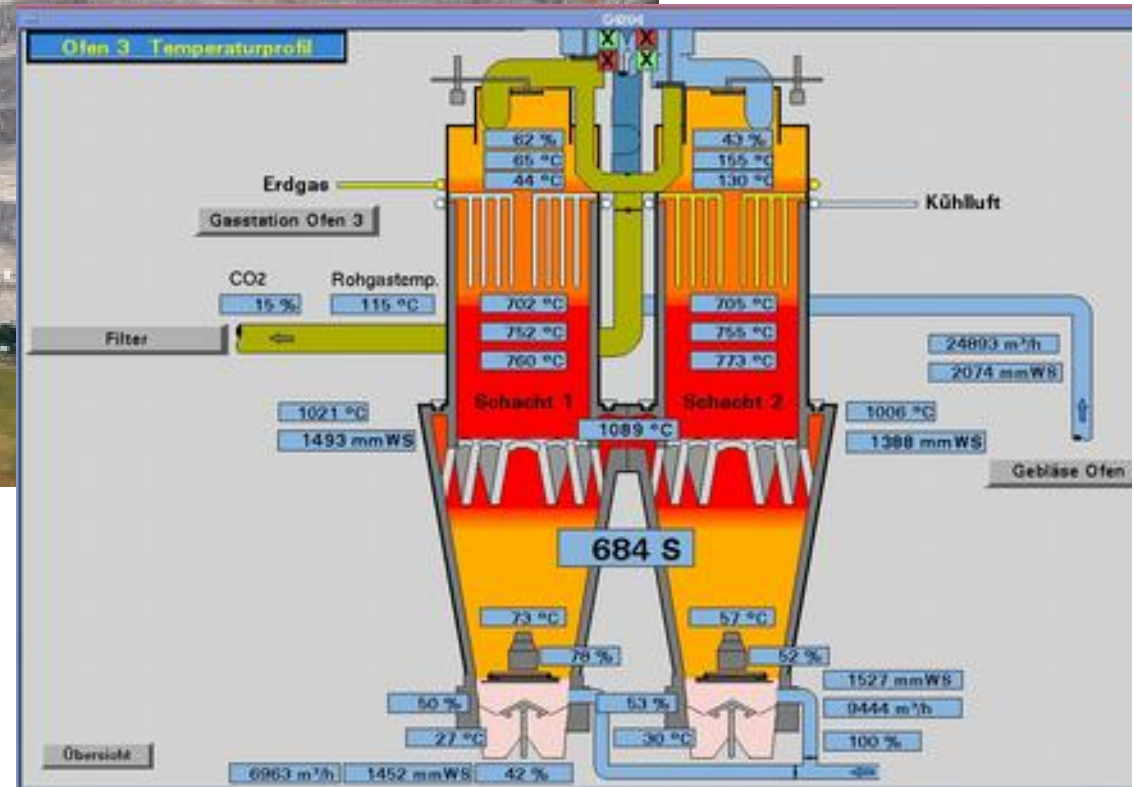
<http://www.hesotech.de>

- Industrial manufacturing data: What's meant
 - What's the task
- How to handle measurements in the database
 - Demo

Industrial manufacturing: What is meant?

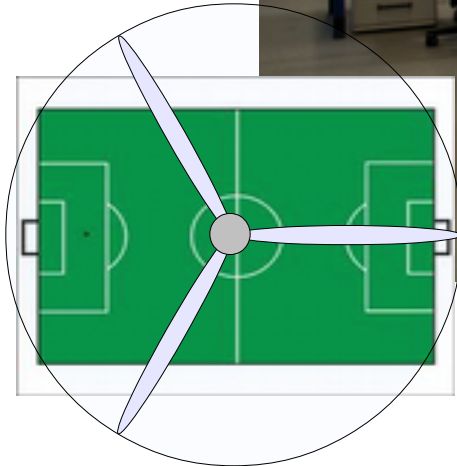
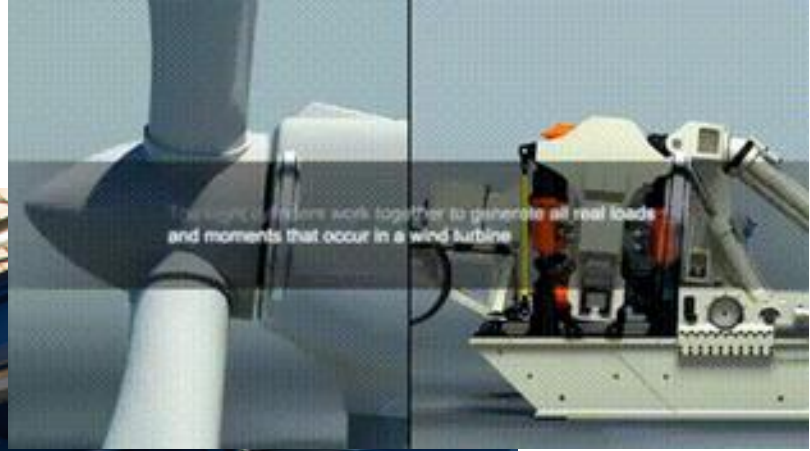


Industry: Mining / Lime production / Lime Kiln



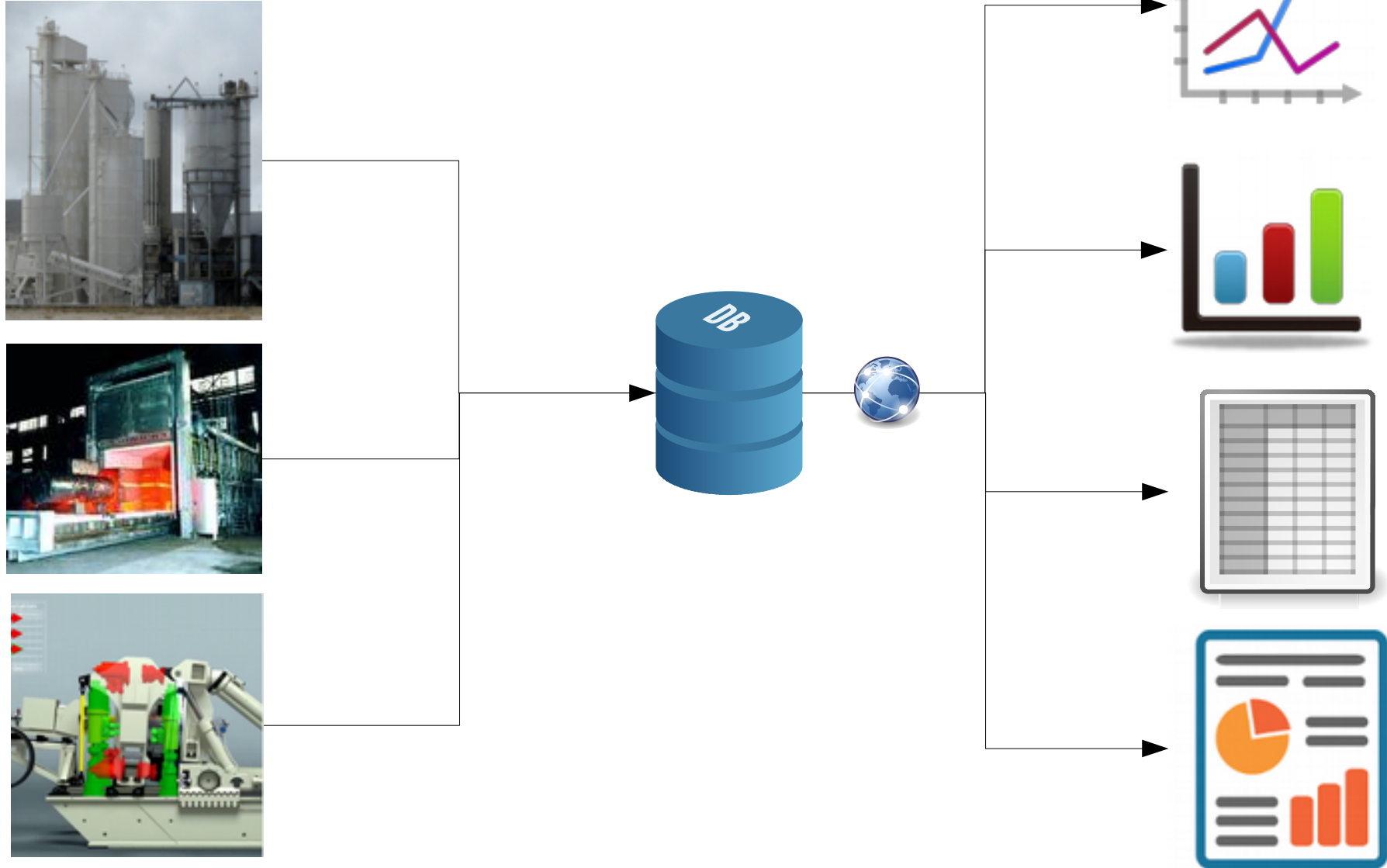


Industry: Testrig for very large bearings



Task: Handle stream of measurements

Bundle of sources



Industrial manufacturing data

- **Administration**
- **Measurements**

- **Administration**
- **Measurements**
- **Snapshot of Facts**



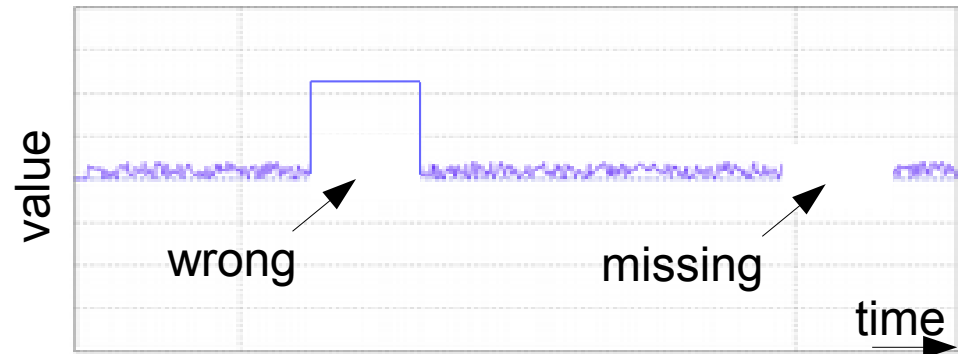
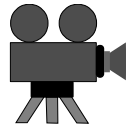
- Name of Batch
- Name of operator
- Article, serials, supplier
- Order, customer
- ...

- **Administration**
- **Snapshot of Facts**



- Name of Batch
- Name of operator
- Article, serials, supplier
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- ...

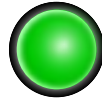
- **Measurements**
- **Variant with Surprises**



- Accuracy of sensor
- Resolution of A/D conversion
- Jitter / shift in time
- Faults
- Position of sensor / sampling
- New / removed sensors



Boolean



- Door open
- Oil-level ok

Integer



- Counter
- Enumeration
- Binaries
 - 16 Bits in 2 Bytes



Float



- Temperature
- flow
- pressure, force
- Results of Computervision

Binary data

- Images 
- Video 
- Acustics

Steel - Industry



Model of landslide



Measurements: Problems



- New and removed Sensors



- Variant and bad data

- Massive data



- Terabyte database

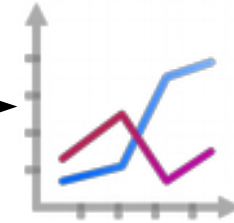
Storage



~~Retrieval~~



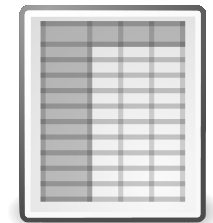
Bandwidth



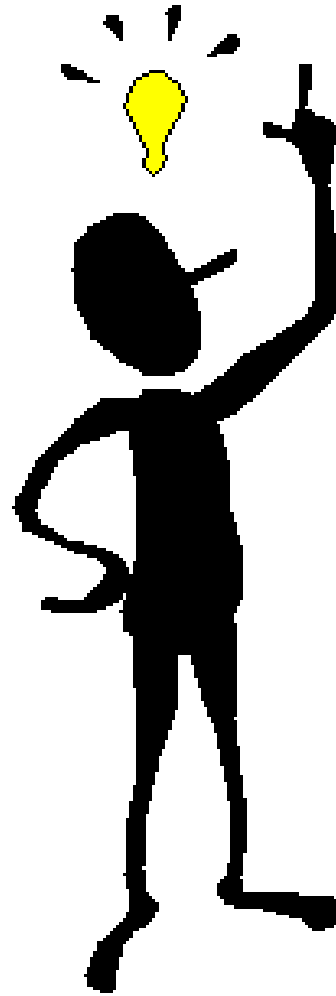
Response-time



GUI Config.



Understand the data, Consider physics !



Our solution



driver A

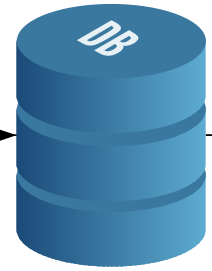
uniform storage of numerics **1**

herarchical storage structure **2**



driver B

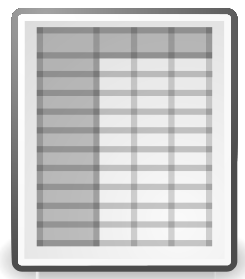
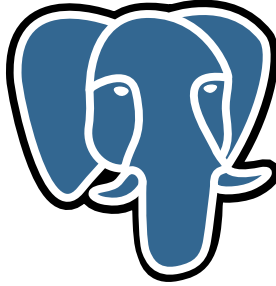
storage strategy **3**



retrieve strategy



driver C



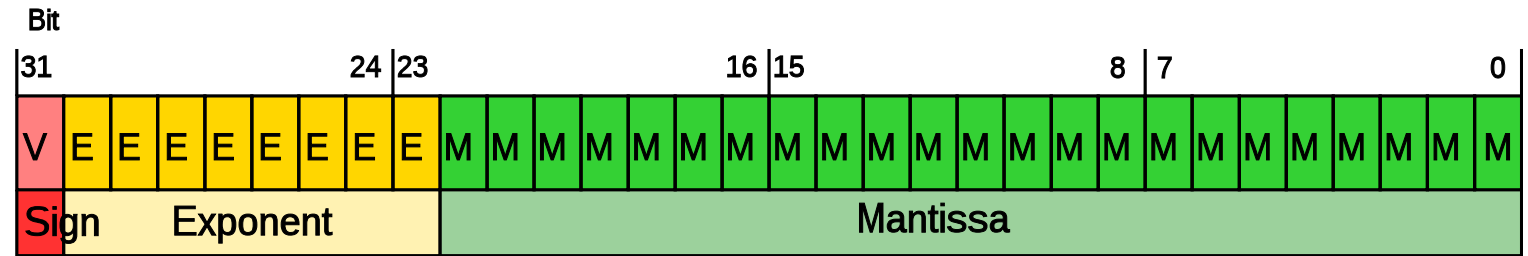


only
float4

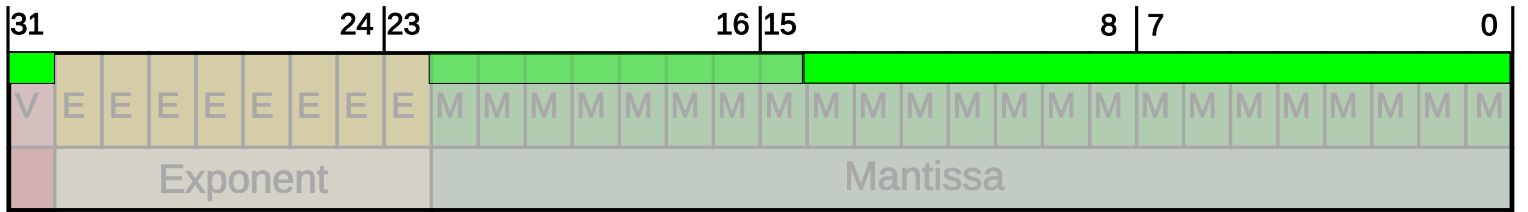
Uniform storage of numerics → all IEEE 754 floats

1

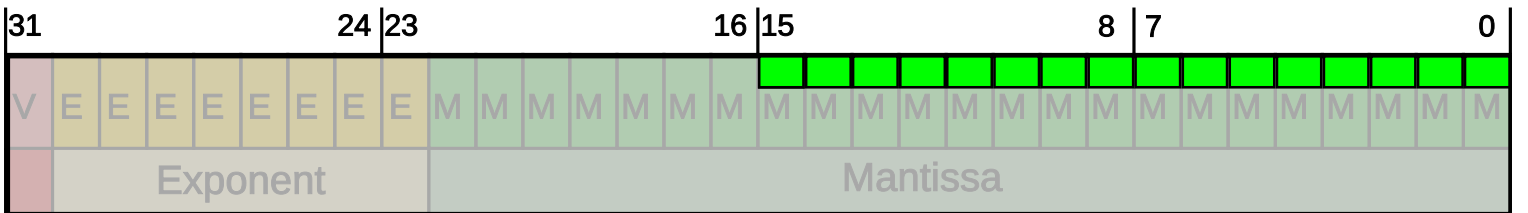
float4



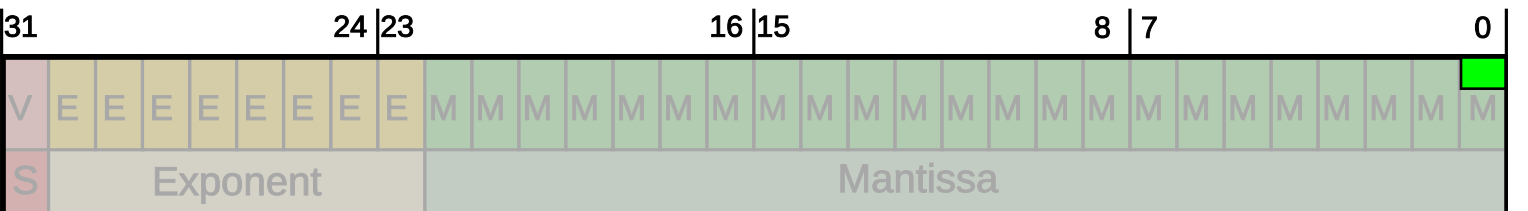
int2



binary



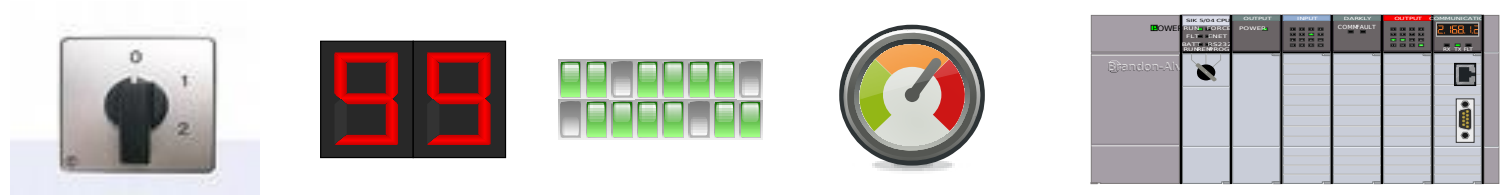
boolean





Packages of Measurements

`float4[][]`



Drivers



$0.1 \text{ Hz} < f < 100 \text{ kHz}$

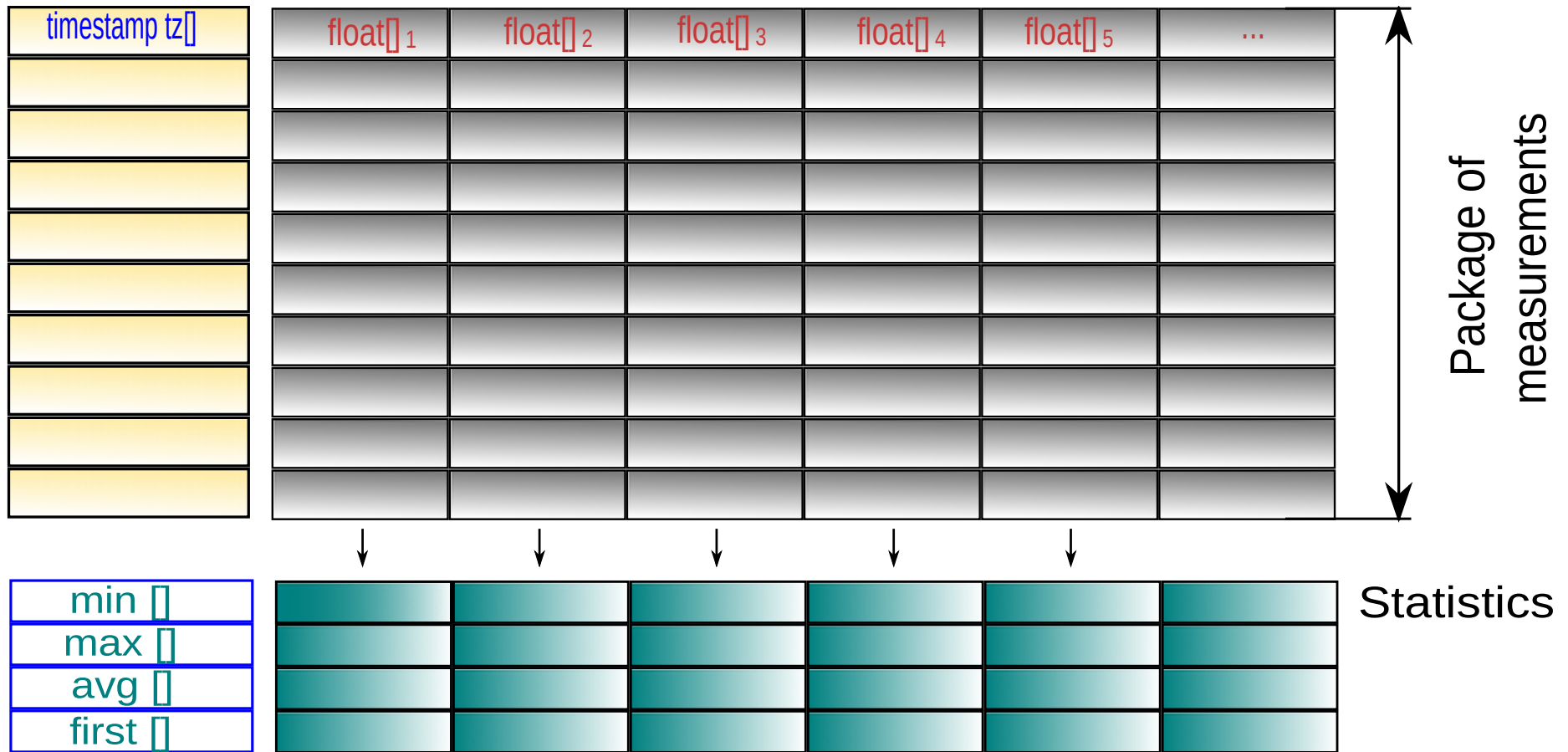
time

timestamp tz	float ₁	float ₂	float ₃	float ₄	float ₅	...



Hierarchical Storage: Packaging

2



- Statistics of package
- TS package ← First TimeStamp of this package
- dwll ← Interval to next package
- ChnSetId ← Reference to XML-File: ArrayIndex <-> Channel
- valid ← Valid-Flag
- serial ← Primary Key



- Hierarchical storage considering the various timescales of interest.
- Reduction of harddisk space
- Reduction of the number of transactions by factor of 1000 and more.
- Much less cost for internal indexing
- Very often, Min, Max, Avg and StdDev is sufficient for telling the story of a batch
- No need of schema changes on adding or removing measurements



Configuration of Measurement Task By XML-Document

ChnSetId

Measurement configuration is XML document

```
<Channel Name="Kla.Lichtsteuercode" Caption="Lichtsteuercode" DataType="System.UInt
<Channel Name="Kla.Sollwert Temperatur" Caption="Sollwert Temperatur" DataType="Sys
<Channel Name="Kla.Sollwert Feuchte" Caption="Sollwert Feuchte" DataType="System.In
<Channel Name="Kla.Istwert Temperatur" Caption="Istwert Temperatur" DataType="Syste
<Channel Name="Kla.Istwert Feuchte" Caption="Istwert Feuchte" DataType="System.Int1
<Channel Name="Kla.Istwert Abtautemperatur" Caption="Istwert Abtautemperatur" DataT
<Channel Name="Kla.Istwert Lichtstärke" Caption="Istwert Lichtstärke" DataType="Sys
```

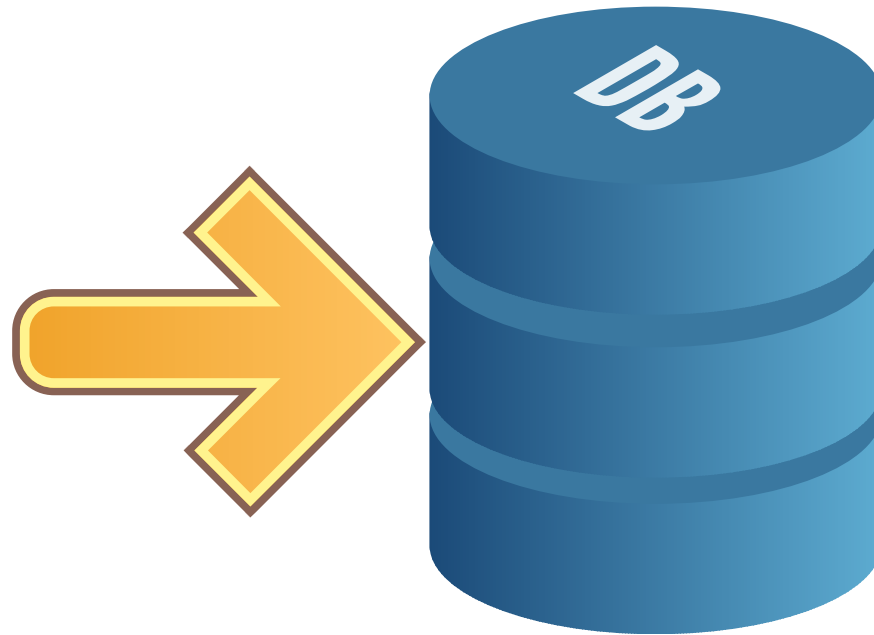
New Config → Add, Remove, Change row in pg_channelsets

pg_channelsets		
<u>chnsetid</u>	<u>serial</u>	<pk>
tablename	varchar(40)	
valid_from	timestamp with time zone	
valid_to	timestamp with time zone	
config	xml	

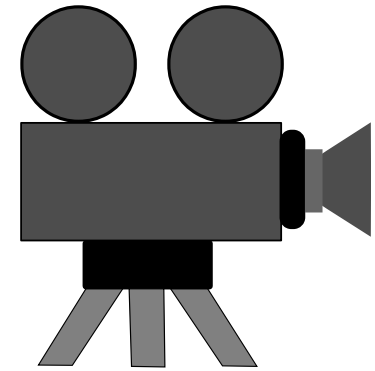
hischnset		
<u>entry</u>	<u>bigserial</u>	<pk>
status	INT4	
chnsetid	INT4	
dt_package	TIMESTAMP WITH TIME ZONE	
dwell	INTERVAL	
cnt_mv	INT4	
min_mv	FLOAT4[]	
max_mv	FLOAT4[]	
avg_mv	FLOAT4[]	
cur_mv	FLOAT4[]	
dt_list	bytea	
mv_array	bytea	

Order of channels in config.xml
=
Order in float[] table hischnset





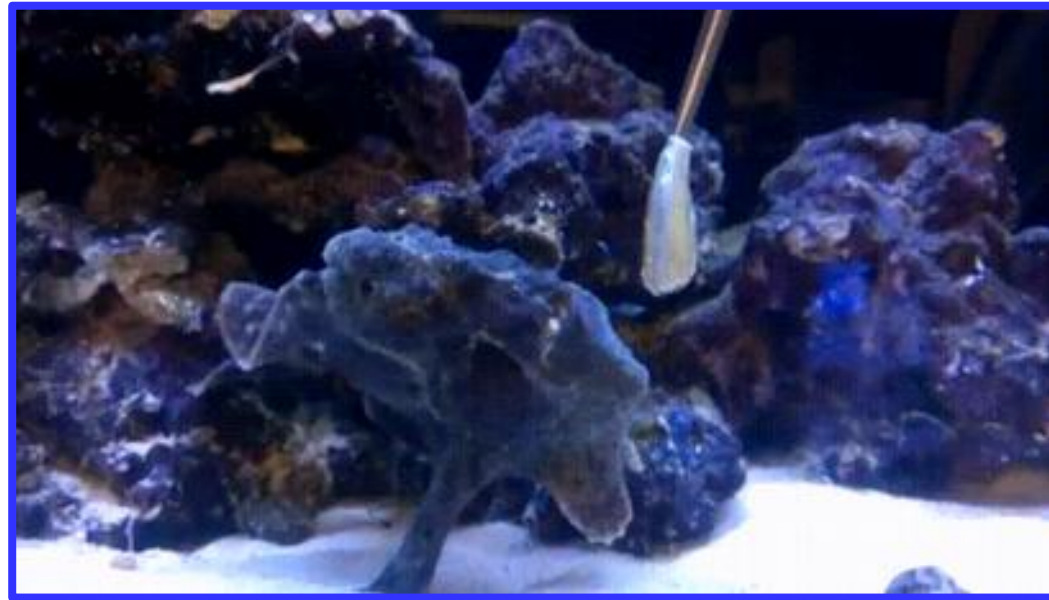
- Storybook
 - Instructions of production
- Levels of summary
- Exiting and boring phases
- Slow and fast motion
- Prerecording



All fine !

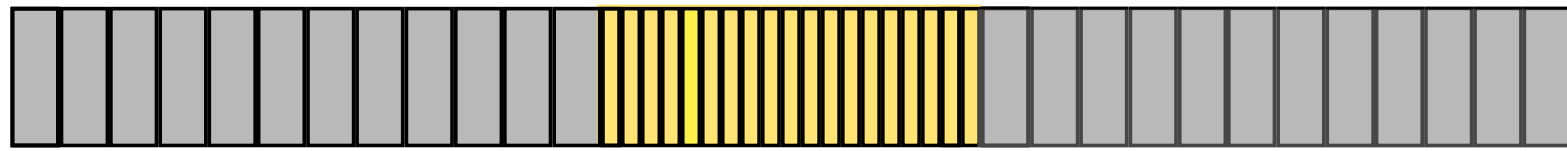
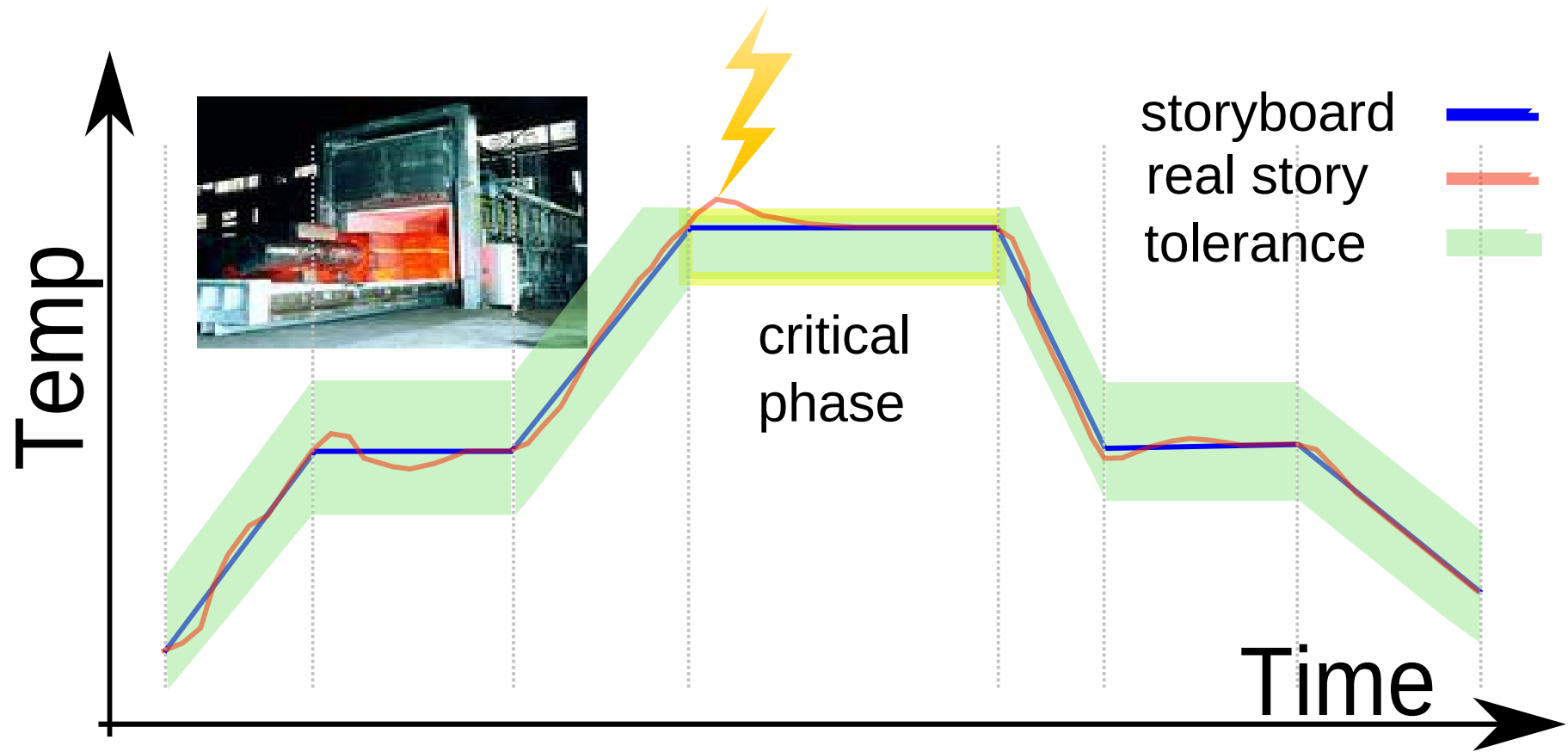


Phases of interest



Storage strategy: Only the relevant data

3

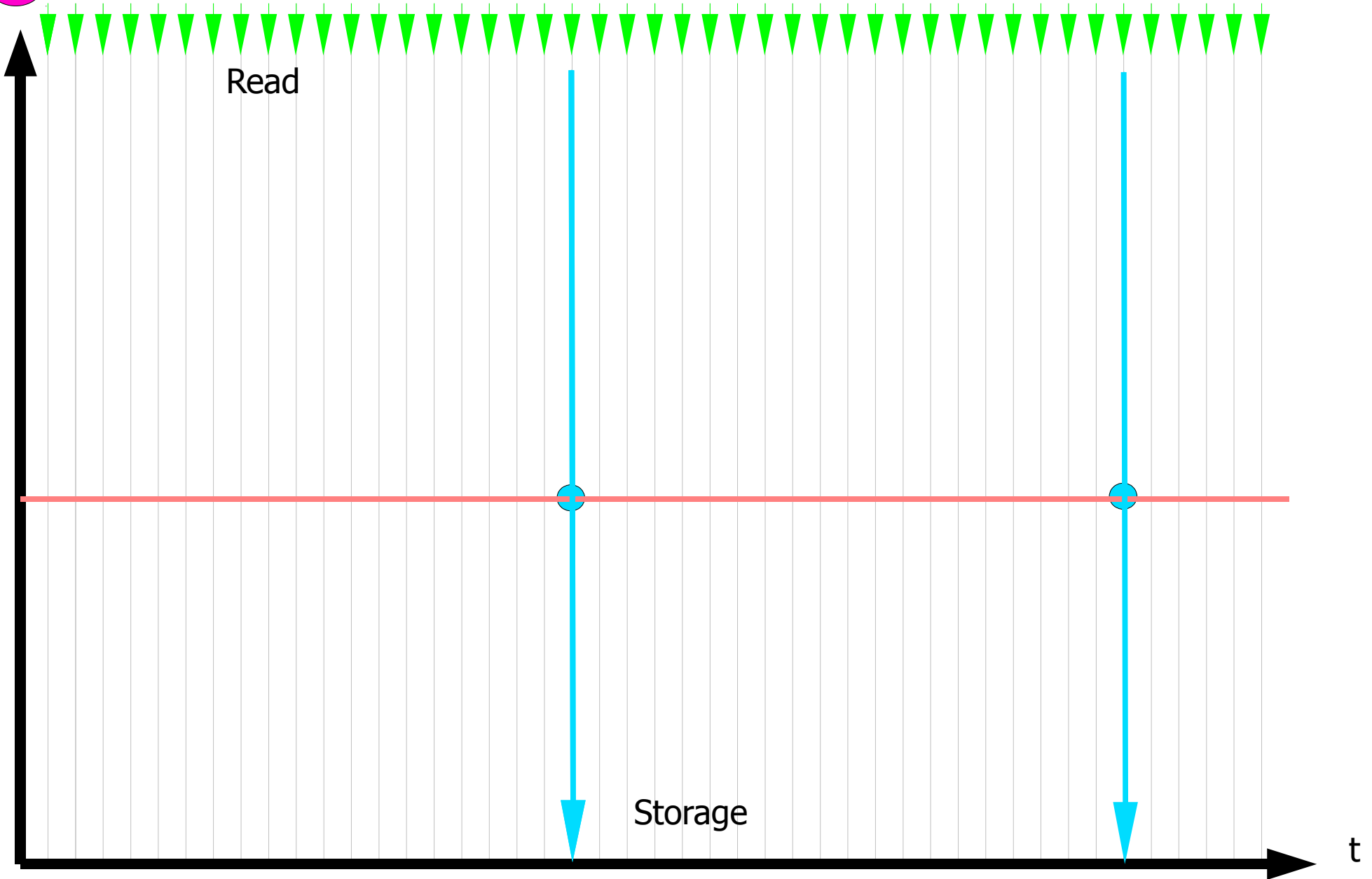


frequency of storage



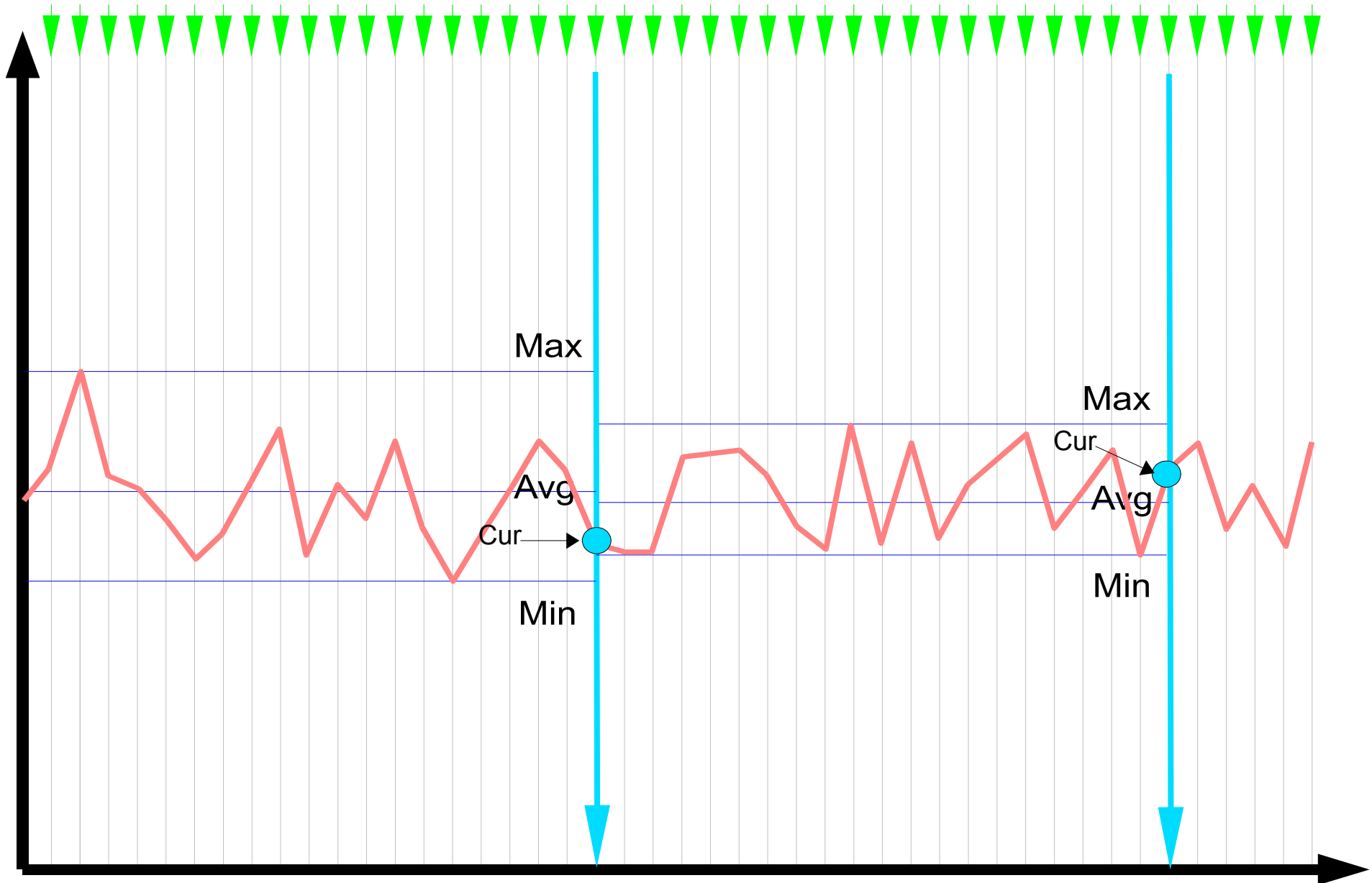
Storage Strategy: $\text{ReadRate} \geq \text{StorageRate}$

3



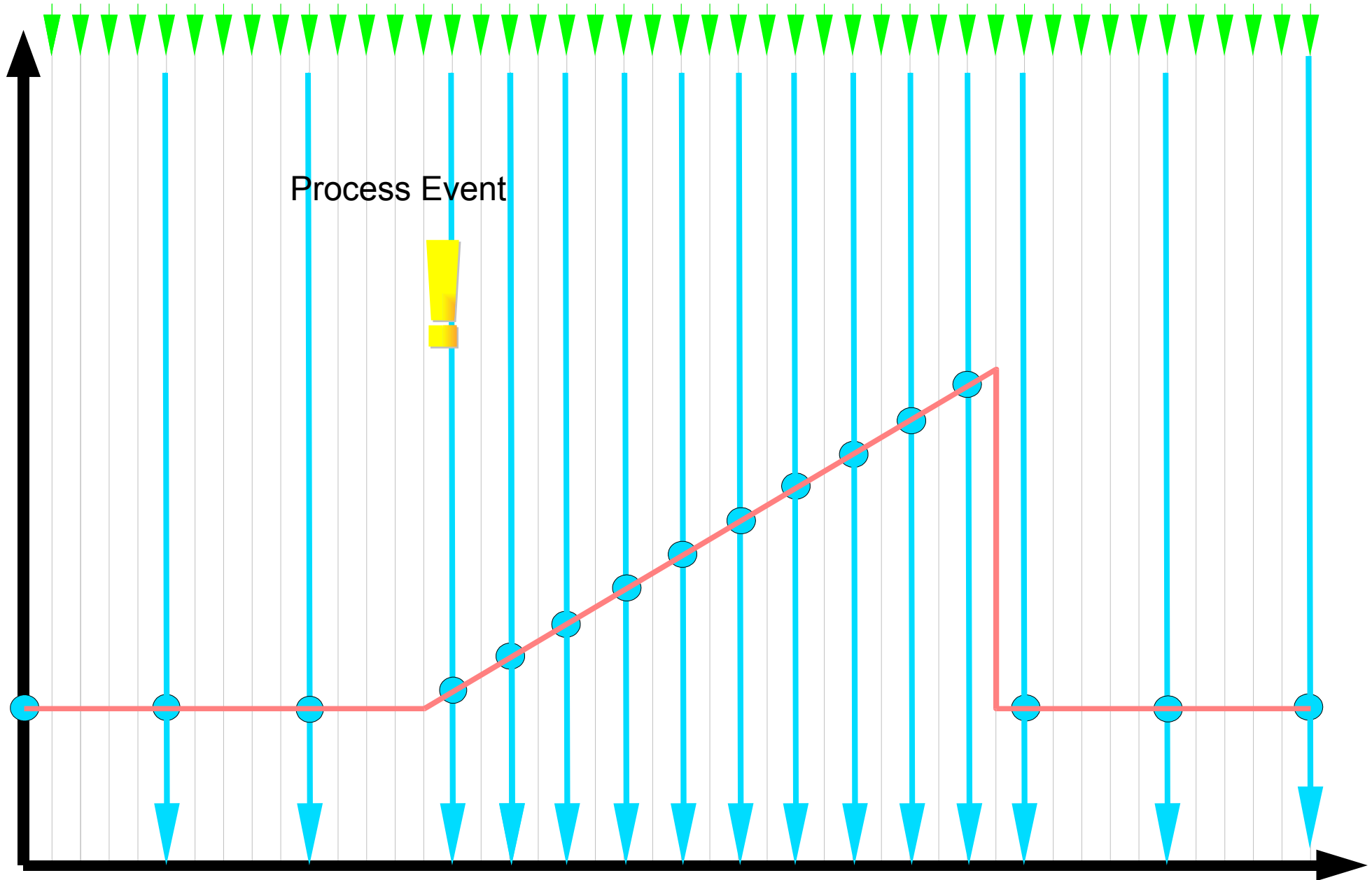
Storage Strategy: Storage of Statistical Data

3



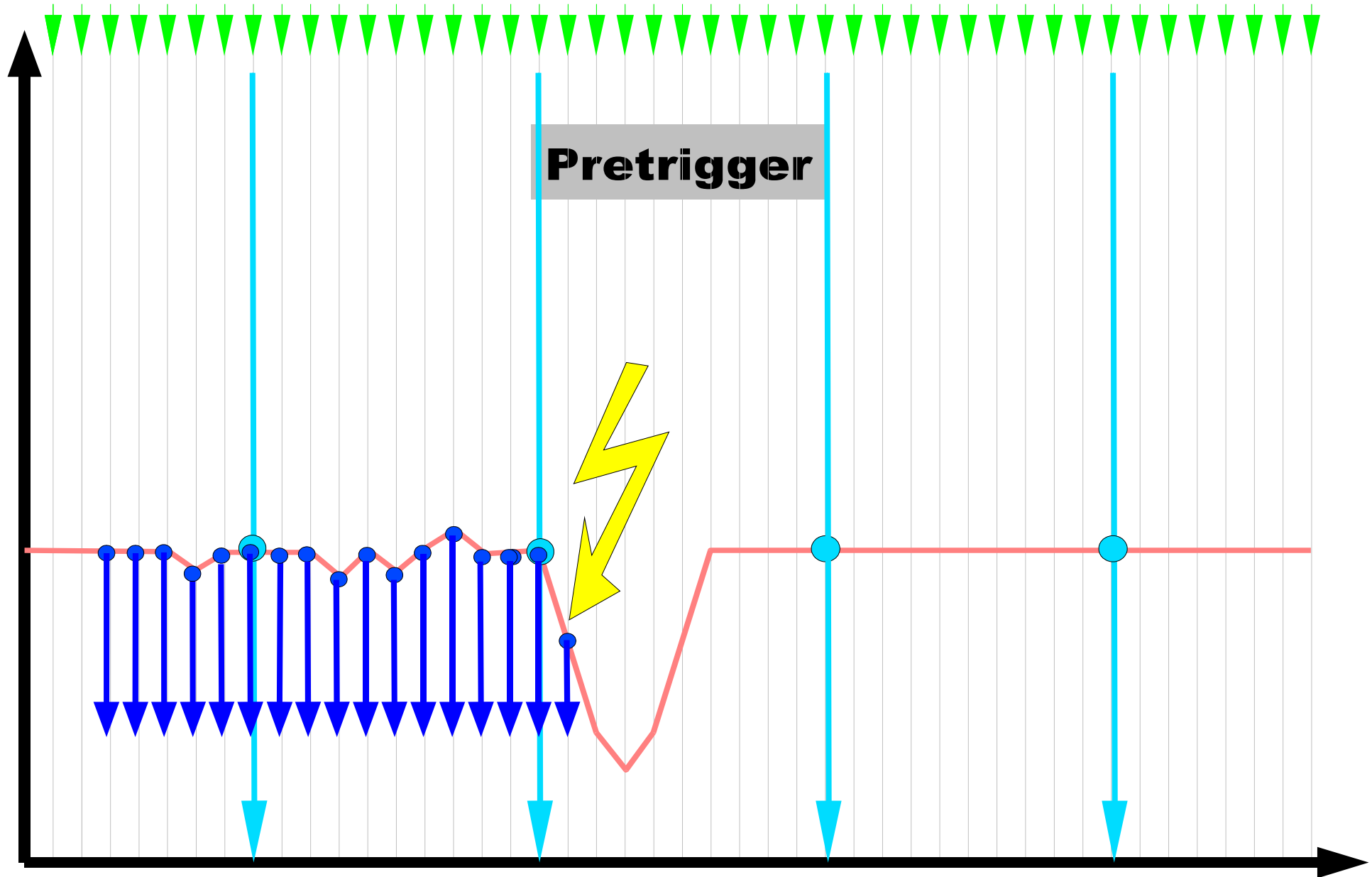
Storage Strategy: Controlled by the Process

3

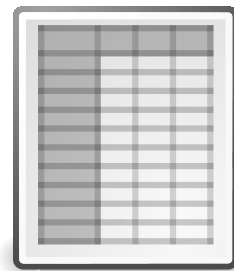
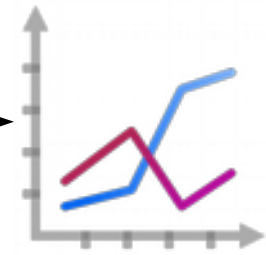


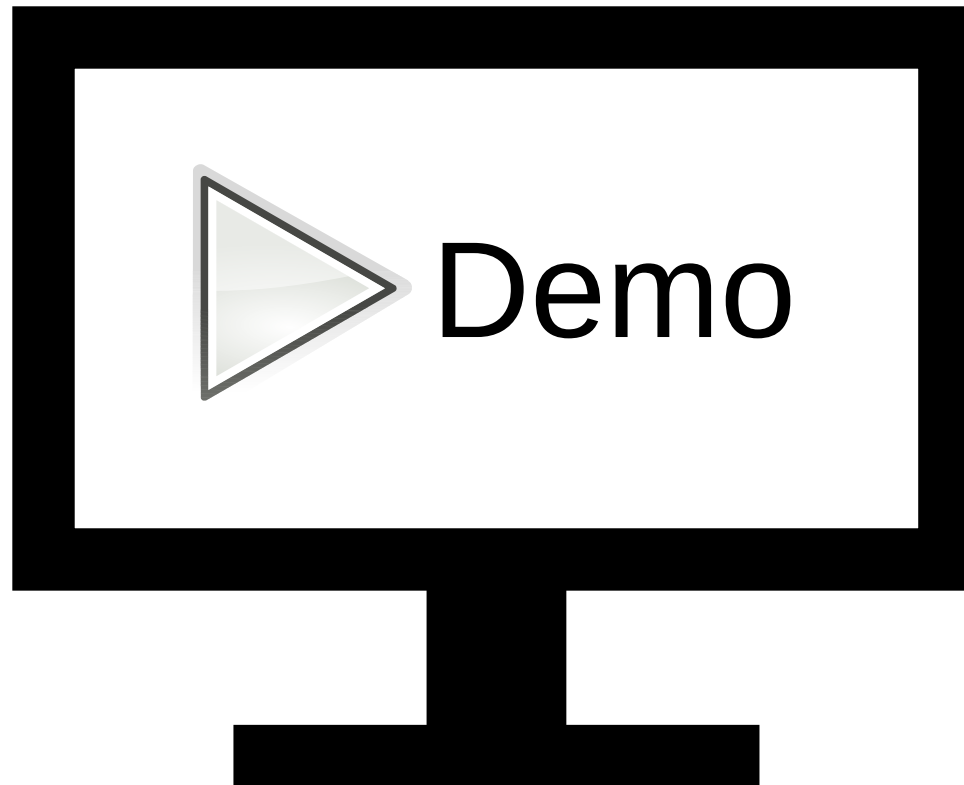
Storage Strategy: Pretriggerdata after event

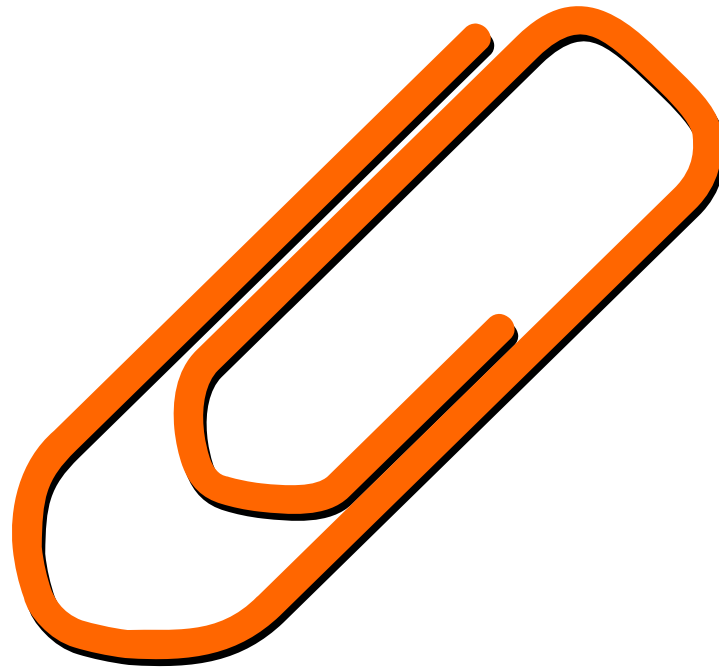
3



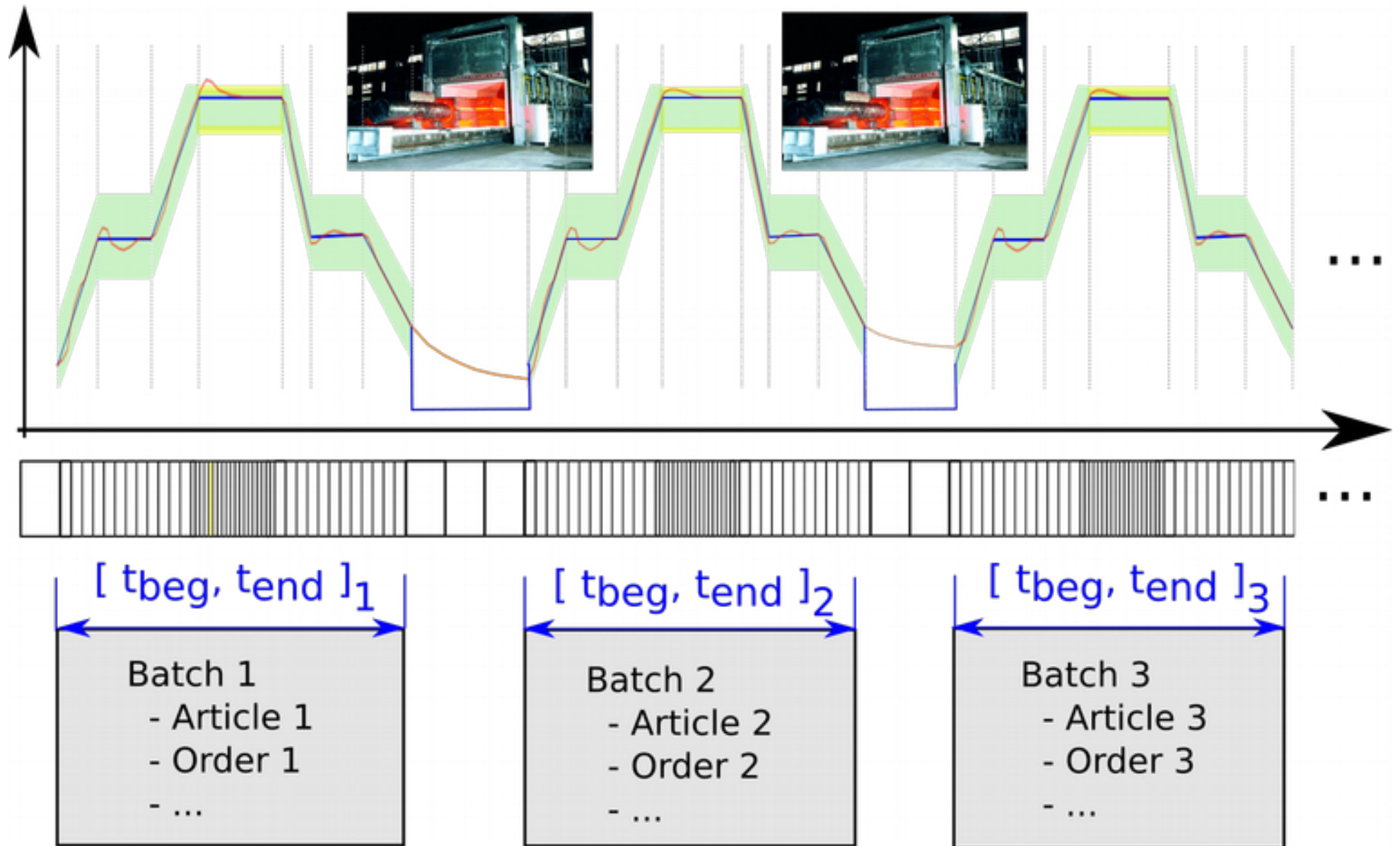
Demo with facility-simulator







Administrative data: Related to time-ranges



Спасибо за ВНИМАНИЕ

Spasibo sa wni ma ni je

