

# **WPI: Application and Environment Requirements**

**WPI Lead: Kresten Krab Thorup, Trifork  
Bruxelles, December 12, 2014**

# Rationale

- Capture experience from industrial partners
- Basho, Rovio and Trifork had CRDT-relevant experience before joining the project
  - Partitions and slow links are a fact of life in large systems.
  - Experience with CRDTs or CRDT-like “ad hoc” solutions
- D1.1: Natural Language Requirements [M6]
- D1.2: Formal Language Requirements [M18]

# Use Cases

## Rovio

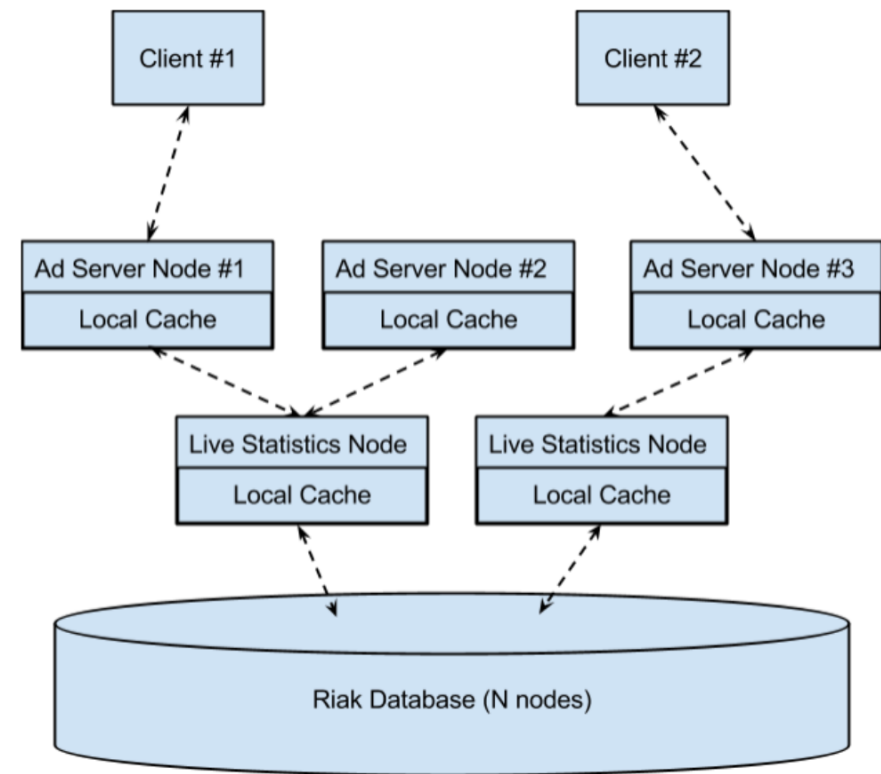
- **Ad Counter**
- **Leader Board**
- **Wallet**

## Trifork

- **FMK: Storage of Medical Records**
- **Business-to-business**
- **Festival App**

# Ad Counter

- Conflict Situations
- Invariants
- Transactions
- Divergence
- Partitioning
- Operations Requirements
- Security Requirements



# Leader Board

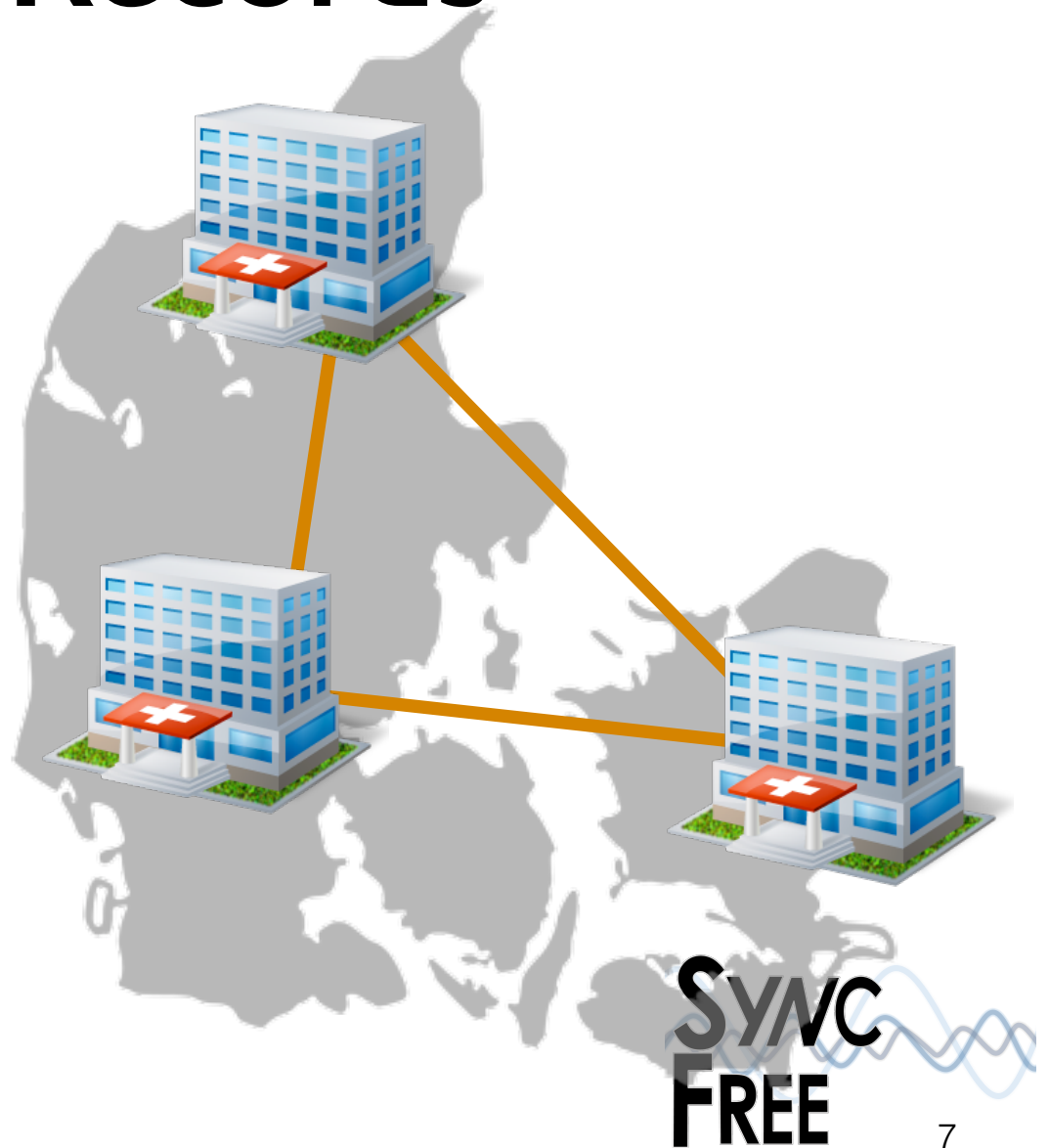
- **Send score**
- **Get ranking**
- **Get matching players**
- **Get leaderboard**

# Wallet

- **Buy in-app virtual currency for real money**
- **In-app micro payments**
- **Storage of purchased items**
- **Archive old transactions**
- **over-spending account?**

# FMK: Storage of Medical Records

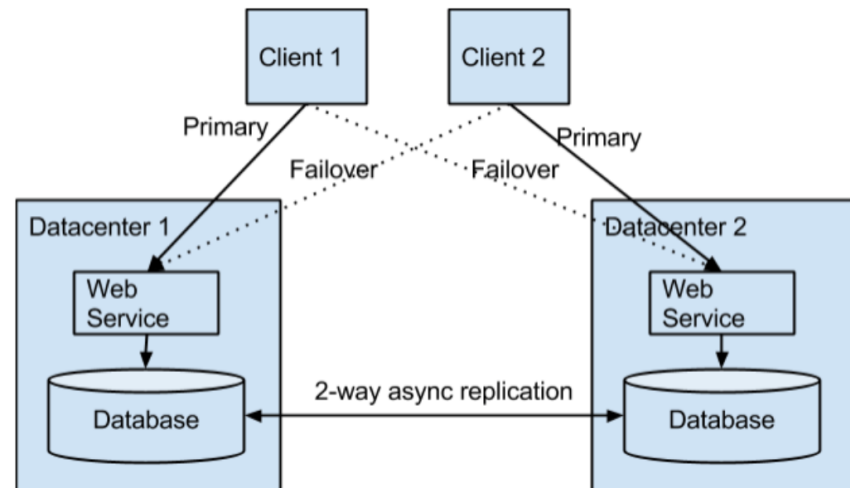
- For a person
  - List of current drug treatments
  - With prescriptions and related events



# An Ad-hoc CRDT

## PersonRecord (simplified)

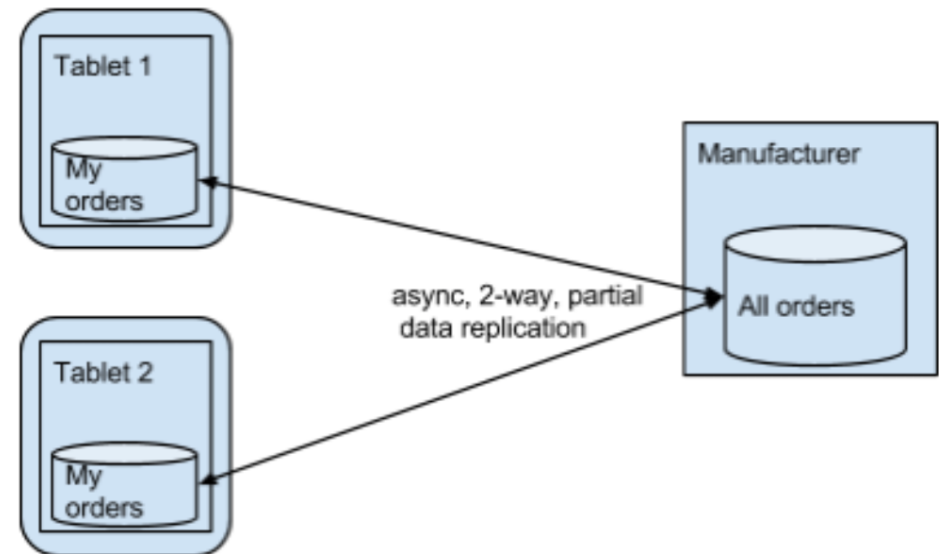
- basic data (name, id, address, ...)
- prescriptions [set]
  - prescription [stateful]
- prescription events [add-only]





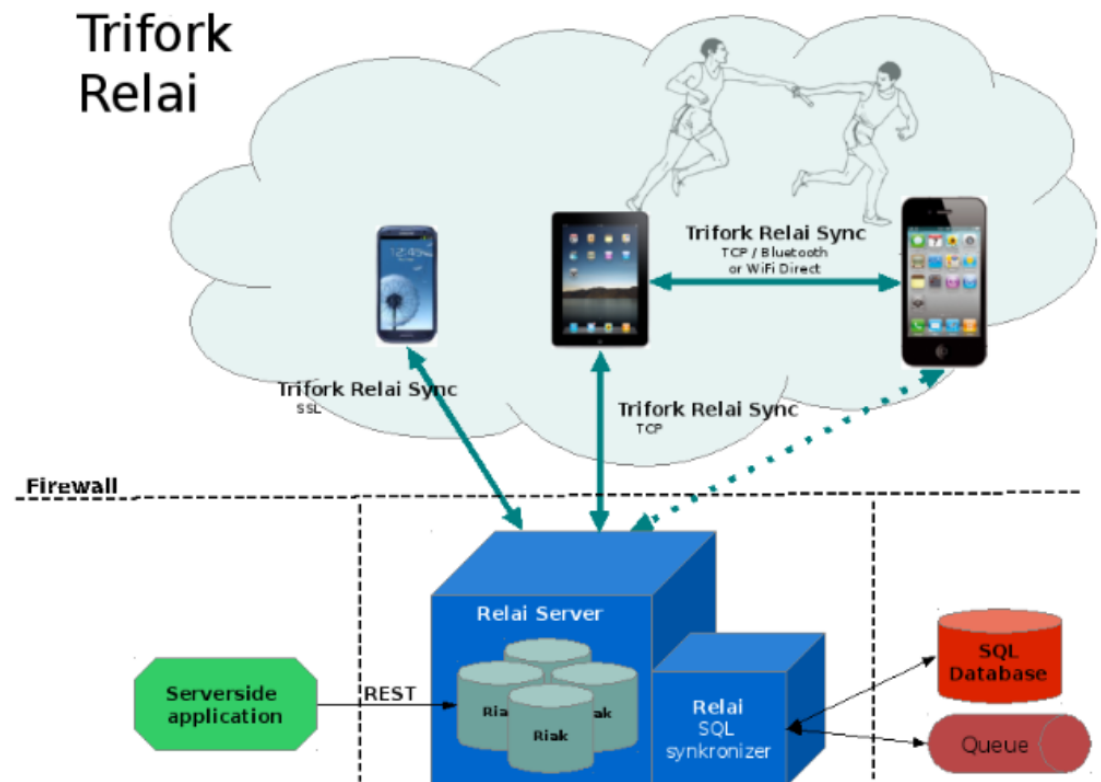
# Business-to-Business

- Offline-capable ordering for franchise business
- Nature of data
  - Client → Server
  - Server → Client
  - Server ↔ Client



# Festival App

- **Mesh-network CRDT syncing**
- **Data is informational:  
Low consistency requirements**



**SYNC  
FREE**

# Outlook — Formal Requirements

- **DI.2 / Work in progress on formal requirements.**
- **Capturing constraints in mathematical notation.**
- **WP4: Moving on with formalizing this using TLA+**

# Examples — Formal Requirements

Name	Description	Type
$AD$	It is the set of all advertisement-campaigns. $a$ identify one of the ads, $a \in AD$ , where $ AD $ is the number of ads.	$\mathbb{Z}_+$

Name/Description	Type
$T_a, T_a^{start}, T_a^{end}$	$\mathbb{R}_+$
$T_a$ is the duration of the campaign for ad $a$ . $T_a^{start}$ represents the beginning of the campaign and $T_a^{end}$ the end, with $T_a = T_a^{start} - T_a^{end}$ .	

$maxTotalViews(a)$	$\mathbb{Z}_+$
It is the maximum total number of times the ad $a$ should be shown.	

$maxTotalViewsPerDC(a, d)$	$\mathbb{Z}_+$
It is the total number of times the ad $a$ should be shown by DC $d$ .	

$maxViewsPerDevice(a)$	$\mathbb{Z}_+$
It represents the maximum number of times the ad $a$ should be presented on a device.	

$viewsPerDevice(a, dv)$	$\mathbb{Z}_+$
It is the number of times the ad $a$ has been shown on the device $g$ . $h(t)_{ag}$ is the same than $h_{ag}$ .	

$verifiedViews(a, n, q)$	$\mathbb{Z}_+$
It is the verified number of times an ad $a$ has been shown by node $q$ as the node $n$ report it, $n, q \in \{1, \dots,  Nodes \}$ .	

# Examples — Formal Requirements

$$\mathit{maxTotalViews}(a) = \sum_{d \in DC} \mathit{maxTotalViewsPerDC}(a, d)$$

$$\mathit{maxViewsPerDevice}(a) \geq \mathit{viewsPerDevice}(a, dv)$$

$$\mathit{maxTotalViews}(a) = \sum_{dv \in DV} \mathit{viewsPerDevice}(a, dv) + \Delta_a \forall t \geq T_a^{end}$$

# Outlook — General Operational Requirements

## Controlling storage consumption at scale

- Partial replication (replicating part objects)
- Geo-replication (replication data to where it is used)

# Relations with other WPs

- **WPI → WP2: Provides platform guidance**
- **WPI → WP3: Programming model**
- **WPI → WP4: Formal verification**

# Questions