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TimeSync

D E N O G 1 5

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21 | 11 | 2023

AGENDA

INTRODUCTION

BASICS OF TIME SYNCHRONIZATION

COORDINATED UNIVERSAL TIME

RISKS

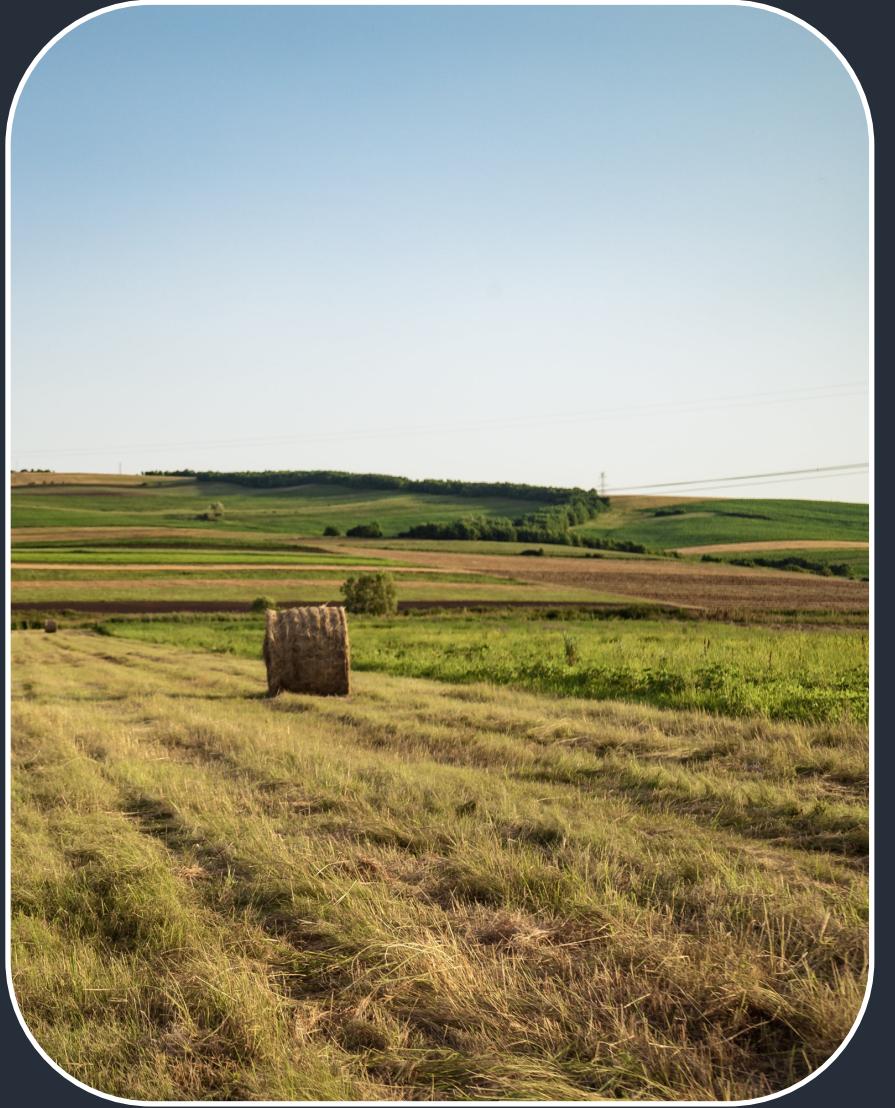
TIME SYNCHRONIZATION @ TELEKOM

USE CASES AND FUTURE REQUIREMENTS



Time has always determined processes

Introduction



Agriculture

Social life



Orchestra

Time is essential for our daily life

Introduction



Seconds

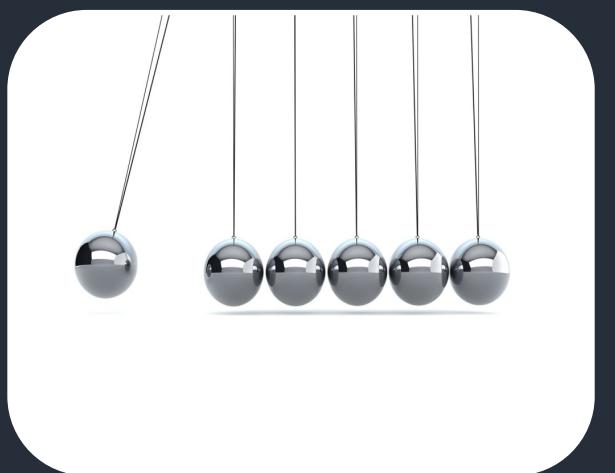
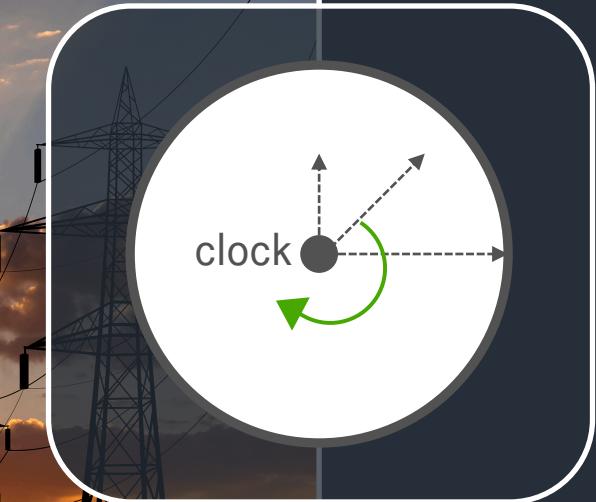
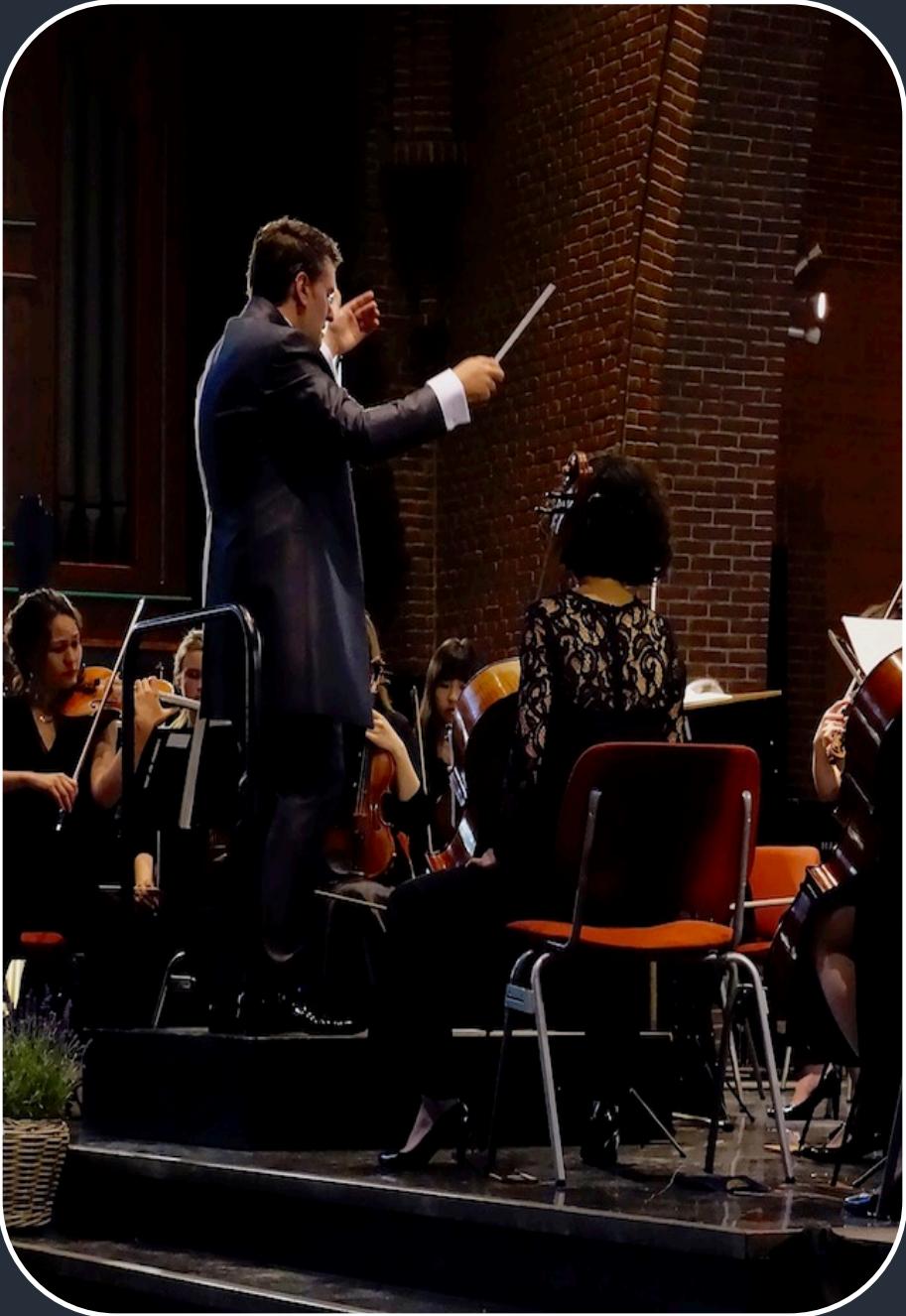
Milliseconds



Microseconds

Frequency synchronization

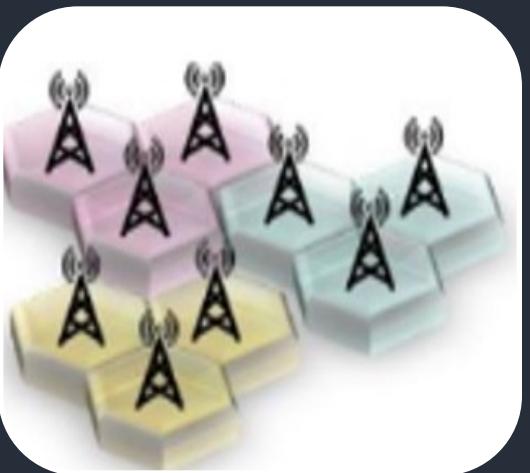
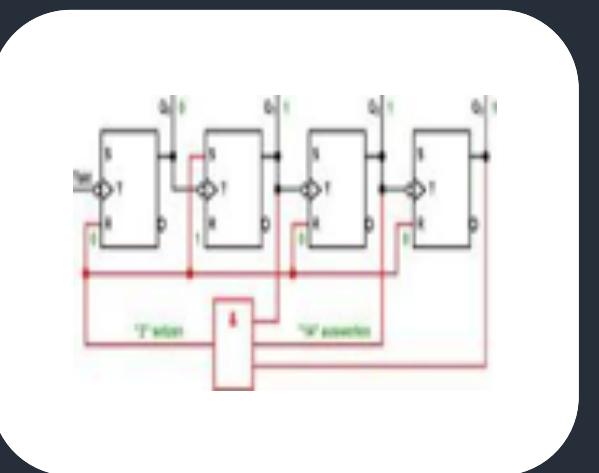
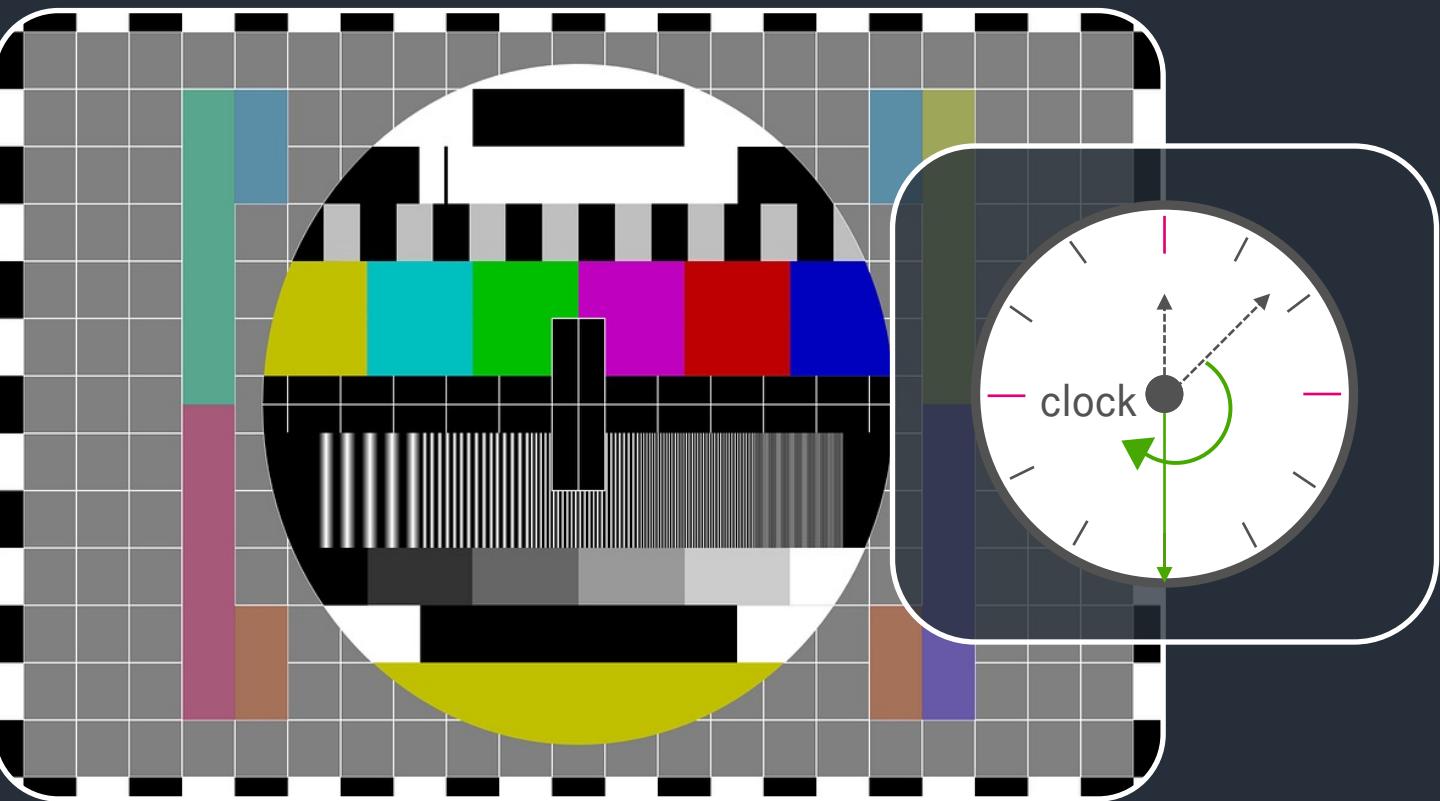
Basics



Time Sync

Phase synchronization

Basics



Time Sync

Time synchronization

Basics



Time Sync

Units of measurement in synchronization

Basics

prefix	definition	decimal	type of clock
1 fs	femtosecond	0,000 000 000 000 001 s	optical atomic clocks
1 ps	picosecond	0,000 000 000 001 s	atomic clock
1 ns	nanosecond	0,000 000 001 s	atomic clock
1 μ s	microsecond	0,000 001 s	quartz clock
1 ms	millisecond	0,001 s	quartz clock
1 s	second	1 s	mechanical clocks
1 min	minute	60 s	mechanical clocks
1 h	hour	3.600 s	nature clocks
1 d	day	86.400 s	calendar
1 w	week	604.800 s	seasons



Distribution

Basics

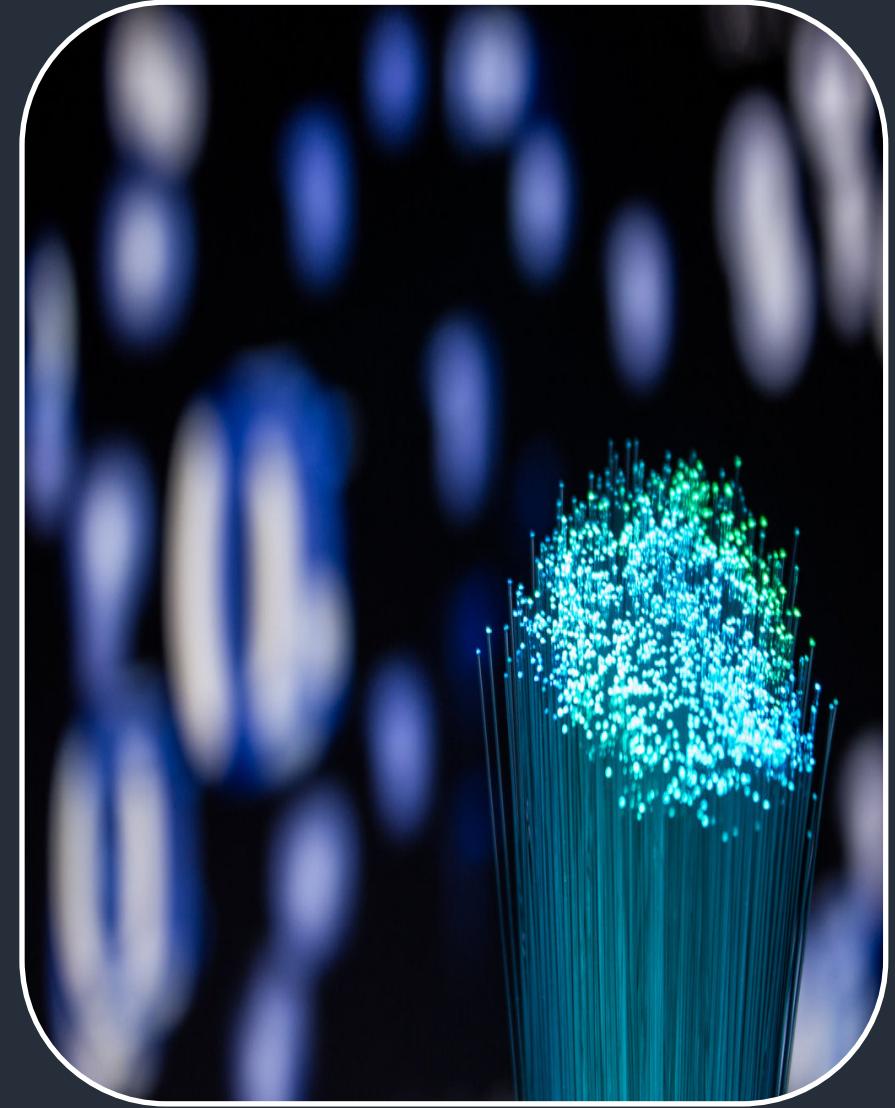


Satellites

Air



Fixed



Time Sync

Basics

Standards

Synchronous Ethernet | SyncE

- IEEE 802.3 | ITU-T G.8261/62
- Ethernet Physical Layer (L1)
- Pulse information
- Frequency accuracy
- Usage for
 - SDH & PDH
 - GSM & UMTS
 - LTE & 5G

Precision Time Protocol | PTP

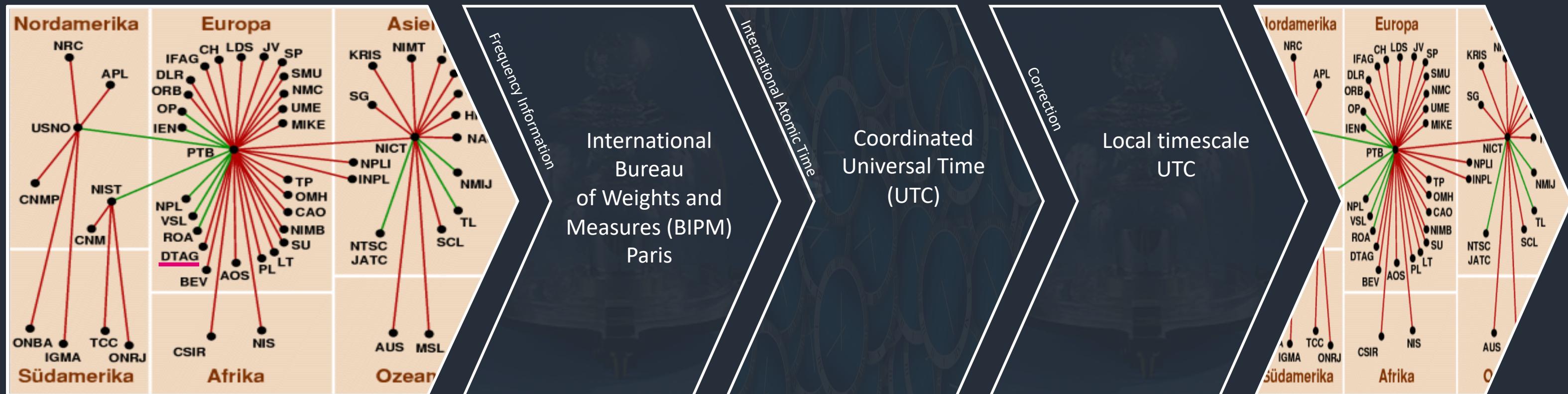
- IEEE 1588 | ITU-T G.8275.1/.2
- Data Link (L2) & Network Layer (L3)
- Pulse & Time-of-Date information
- Accuracy nanosecond range
- Usage for
 - LTE & 5G
 - Smart Grids
 - Industry 4.0, IoT
 - Time Sensitive Networks

Network Time Protocol | NTP

- RFC 5905 (v4)
- Transport Layer (L4)
- Pulse & Time-of-Date information
- Accuracy 10 ms up to 200 μ s
- NTS for more security
- Usage for
 - Operating systems like UNIX, Windows, Linux, macOS

Coordinated Universal Time

UTC



Leap Second
International Earth
Rotation Service &
Reference systems

Time Sync

Risks of satellite based timesync

Risks



Attacks on networks occur
perpetrated by hacker
and states



Space debris, weather and solar
storms can impact accuracy



Increasing risk of EMP attacks or
interference, radiation from
other electronic equipment



Software needs to be updated
frequently



Reflections and enclosed
spaces can disrupt GNSS
signals



Blocking (jamming) or distorting
(spoofing) of GNSS Signals is
possible

Risks of fixed based timesync

Risks



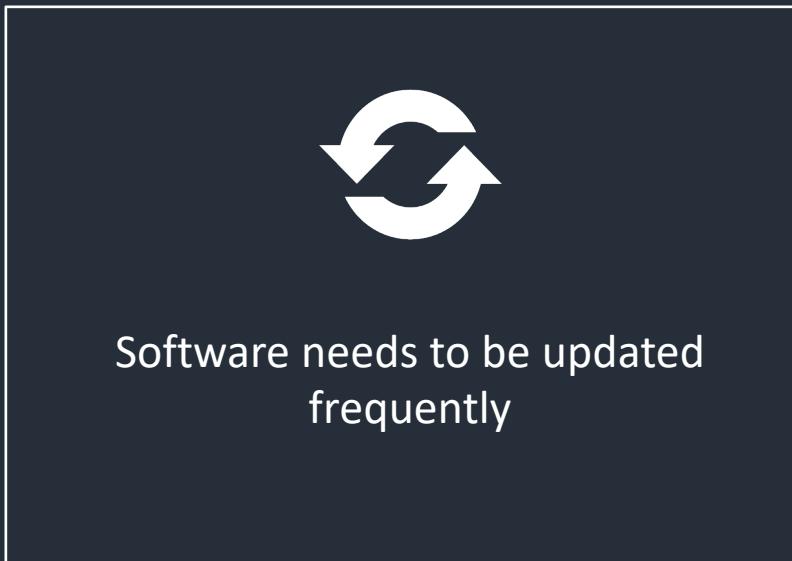
Attacks on networks occur
perpetrated by hacker and states



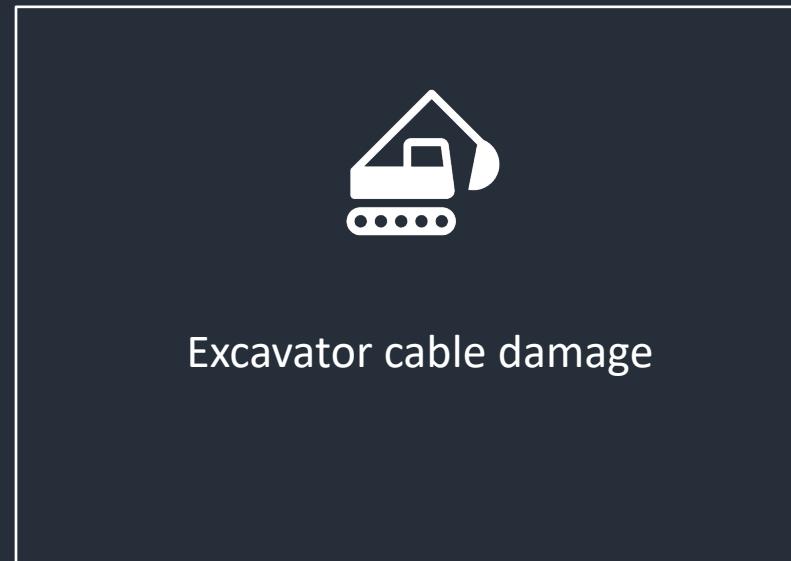
extreme weather situation
can impact the infrastructure



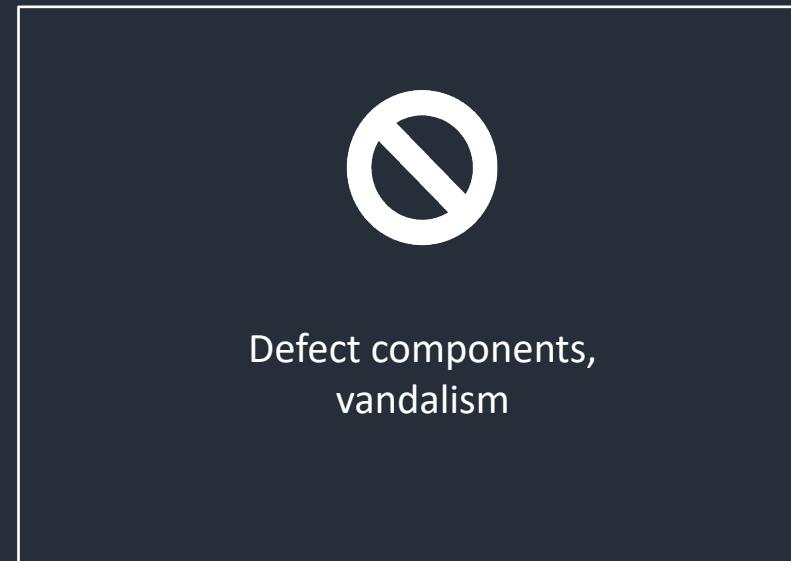
Small risk of EMP attacks



Software needs to be updated
frequently



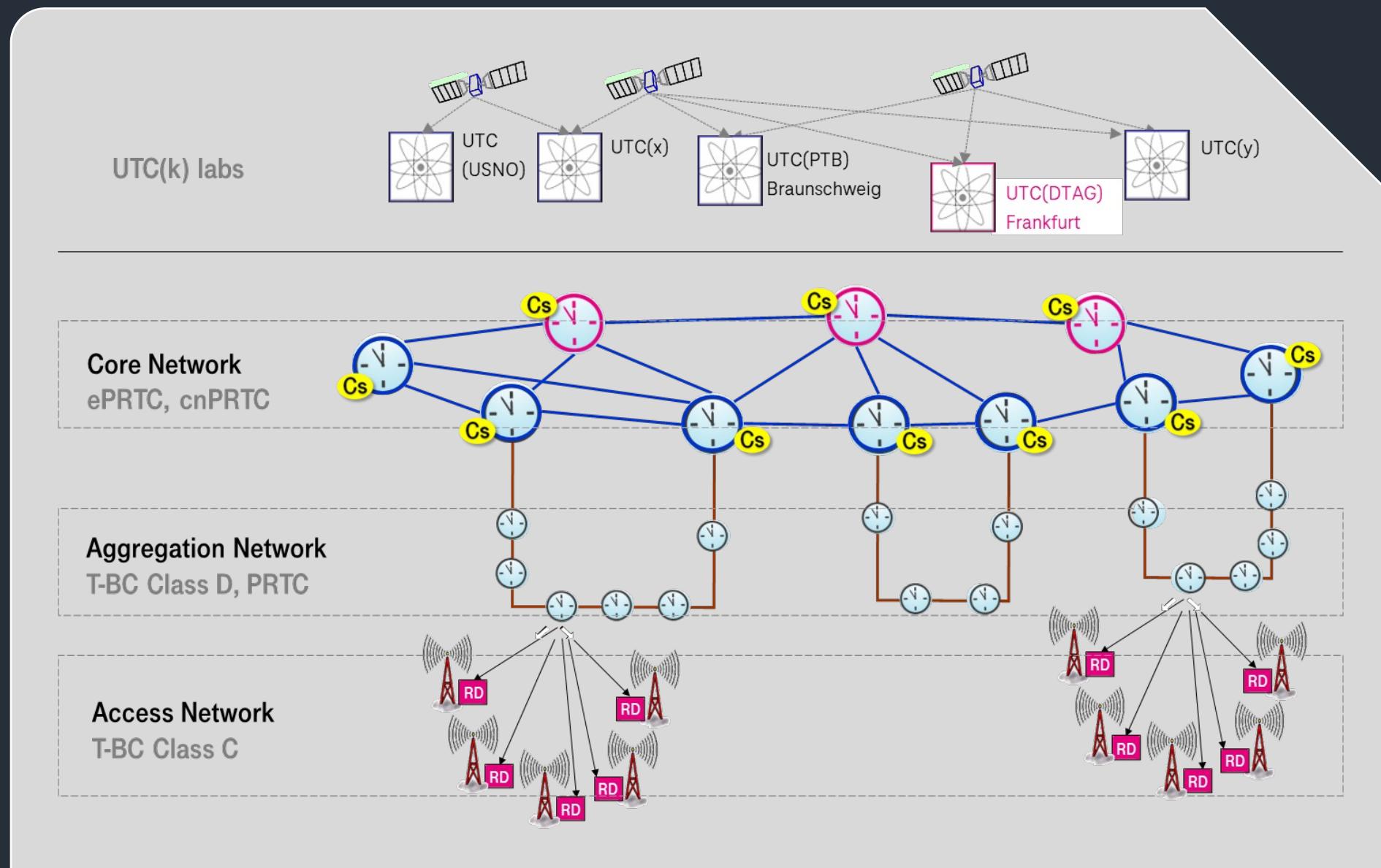
Excavator cable damage



Defect components,
vandalism

Time and frequency @ Telekom

Telekom
@



Generation and distribution of high precision, secure synchronization services

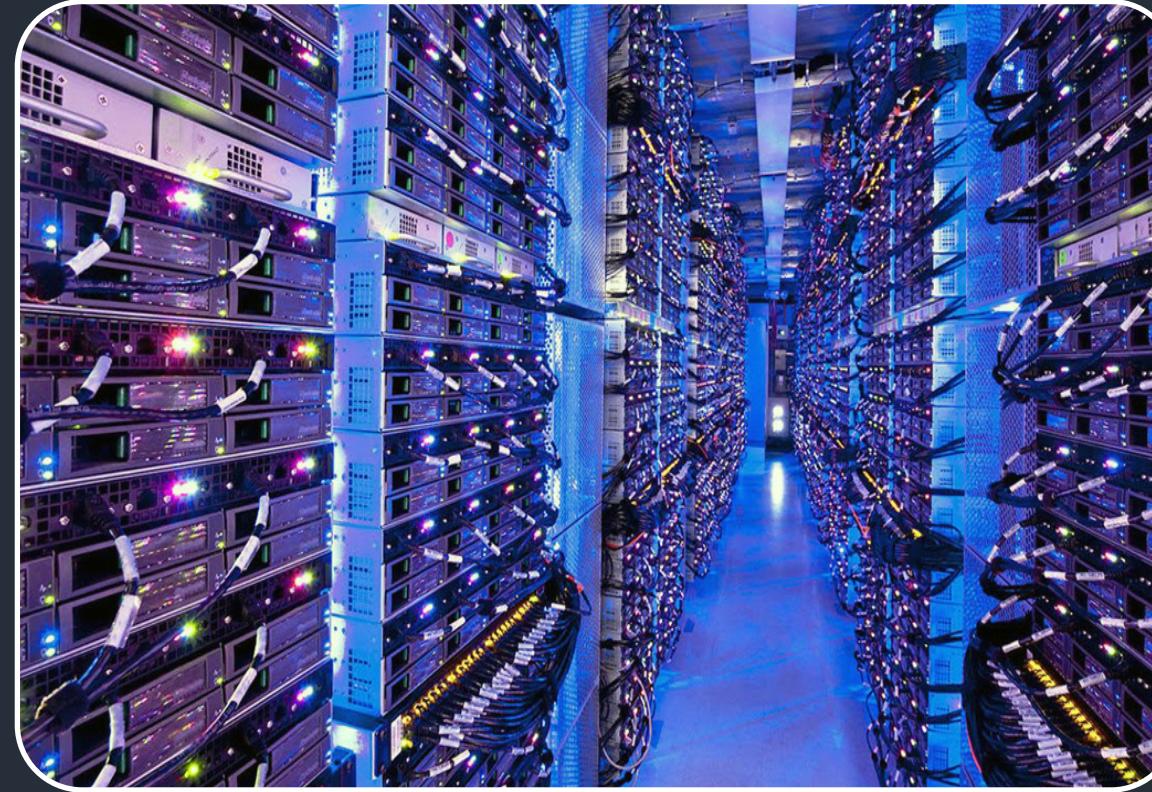
Ensuring time synchronization through the NTP system network

$n \cdot 10000$ base stations are synchronized

UTC (DTAG) as a measurement reference for core network

Use Cases

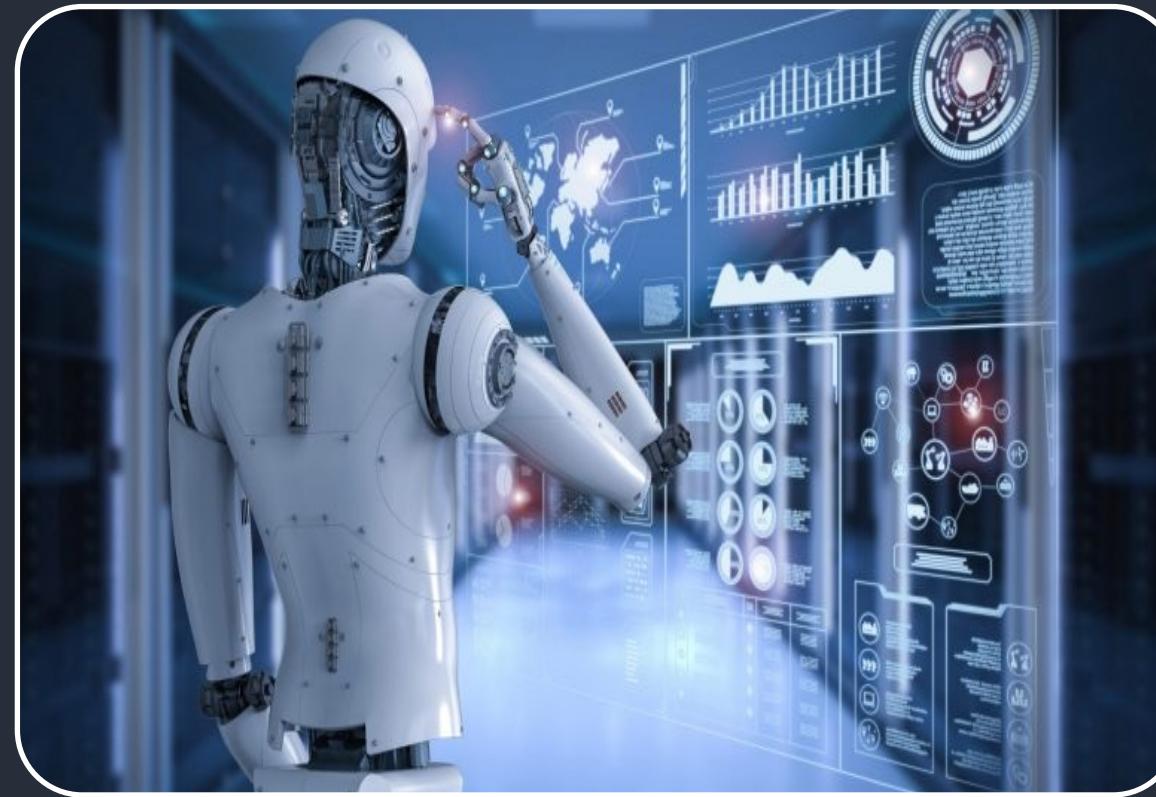
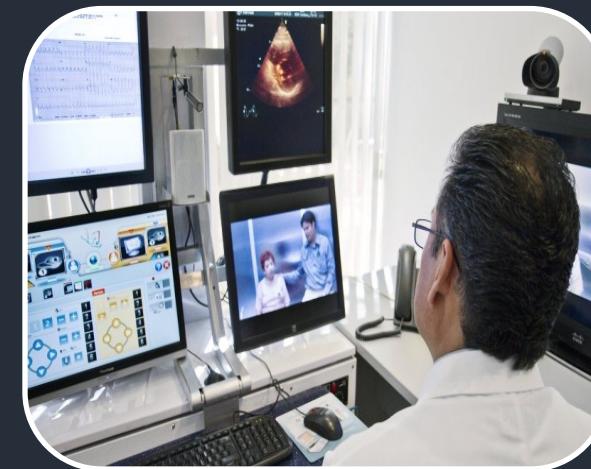
Present



Time Sync

Use Cases

Future



Time Sync

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Thank You.

— Claudia & Sebastian —

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