Kyland
- 控制网络时钟同步专家

许建中

2015-11-04

KYLAND

时间安排

- **公司简介**

- **时钟同步技术**

- **东土SAS解决方案**
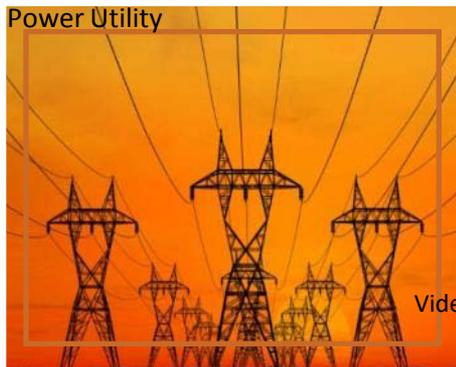
- **产品一览**

公司简介

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基本情况

交通
Transportation

电力
Power Utility

可再生能源
Renewable Energy

视频监控
Video Surveillance

工厂自动化
Factory Automation

煤碳
Coal Mining

- 成立于2004年
  Founded in 2004
- 2012年创业板上市（300353）
  IPO in 2012(Shenzhen, 300353)
- **国内唯一一家工业以太网上市企业**
  The only public Industrial Ethernet vendor in China
- 2011德勤高科技50强
  Deloitte TF50 2011
- 中国工业以太网标准制定者
  Arthur of Chinese Industrial Ethernet Switch Standard
- 三项IEC标准制定
  Attended IEC62439 & IEC61158, IEEE C37.238 drafting

KY/LAND

公司组织

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DIGIgrid

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Xinjinqiao Road Pudong,
Shanghai

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成功案例

典型客户

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市场表现

Leading Suppliers of Industrial Ethernet Switches

2014 Revenues = $1,129.7 Million

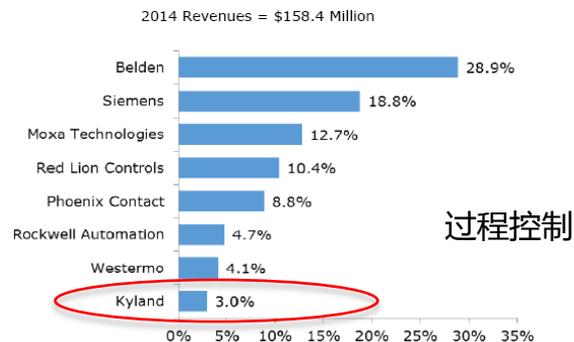| Supplier	Percentage
Belden	20.3%
Siemens	17.6%
Moxa Technologies	12.7%
Cisco	10.4%
Rockwell Automation	6.6%
Phoenix Contact	6.2%
Westermo	4.6%
Red Lion Controls	4.0%
Kyland	3.0%
WAGO	2.1%

Other = 12.5%
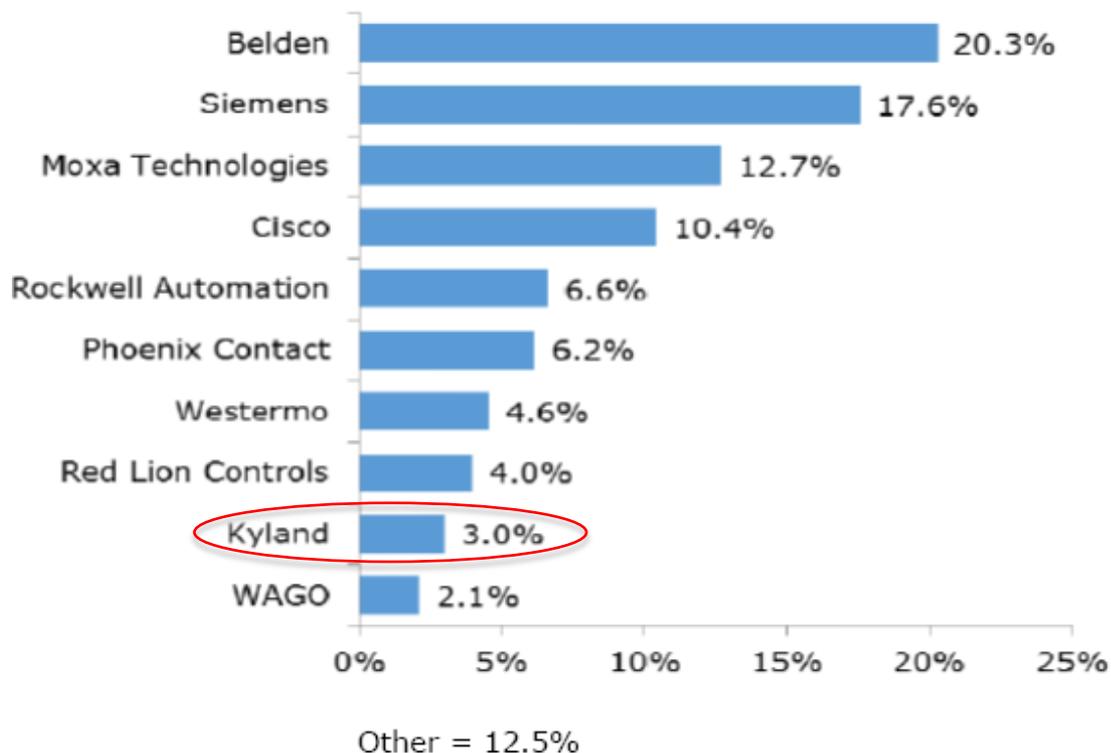
（From 《ARC Industrial Ethernet Switches Global Market Research Study:2014》。以下同)

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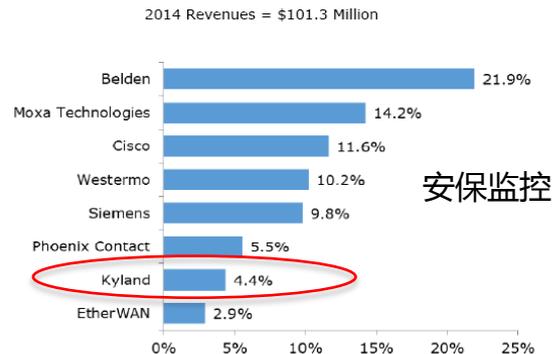**Leading Suppliers of Industrial Ethernet Switches for Asia**

2014 Revenues = $264.9 Million

Supplier	Share
Belden	23.9%
Moxa Technologies	16.8%
Siemens	13.5%
Kyland	11.5%
Phoenix Contact	5.5%
Cisco	3.7%
Rockwell Automation	3.4%
Transcend Communication	3.0%
Advantech	3.0%

亚洲区
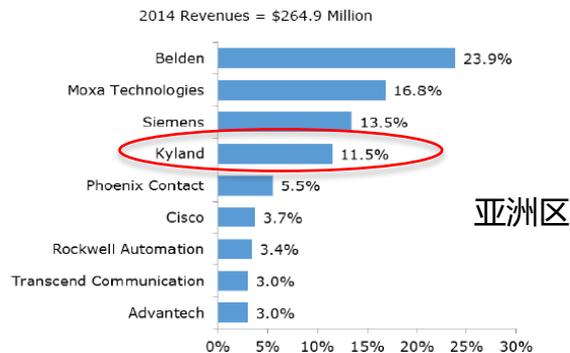
Leading Suppliers of Industrial Ethernet Switches for Process Control

2014 Revenues = $158.4 Million

Supplier	Share
Belden	28.9%
Siemens	18.8%
Moxa Technologies	12.7%
Red Lion Controls	10.4%
Phoenix Contact	8.8%
Rockwell Automation	4.7%
Westermo	4.1%
Kyland	3.0%

过程控制

Leading Suppliers of Industrial Ethernet Switches for Electric Power T&D

2014 Revenues = $156.2 Million

Supplier	Share
Siemens	38.7%
Belden	15.7%
Moxa Technologies	14.7%
Kyland	8.7%
Cisco	7.6%
Red Lion Controls	2.0%

输配电
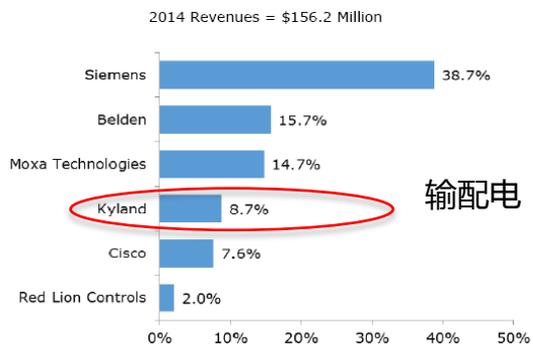
Leading Suppliers of Industrial Ethernet Switches for Security/Surveillance

2014 Revenues = $101.3 Million

Supplier	Share
Belden	21.9%
Moxa Technologies	14.2%
Cisco	11.6%
Westermo	10.2%
Siemens	9.8%
Phoenix Contact	5.5%
Kyland	4.4%
EtherWAN	2.9%

安保监控

Leading Suppliers of Industrial Ethernet Switches for Lightly Managed

2014 Revenues = $115.7 Million

Supplier	Share
Siemens	60.9%
Phoenix Contact	15.1%
Advantech	6.9%
Kyland	5.9%
Belden	2.7%

弱管理型
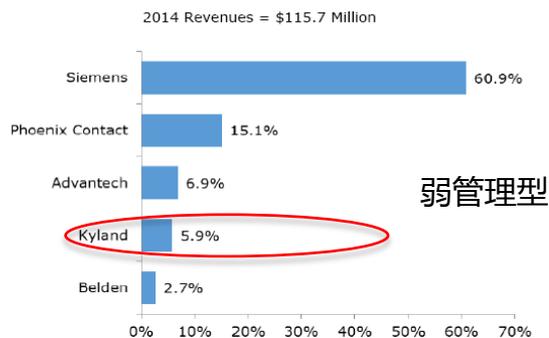
Leading Suppliers of Industrial Ethernet Switches for General Purpose

2014 Revenues = $284.2 Million

Supplier	Share
Moxa Technologies	42.9%
Belden	21.3%
Kyland	11.9%
WAGO	4.5%
Harting	4.5%
Transcend Communication	2.8%

通用型

时钟同步技术

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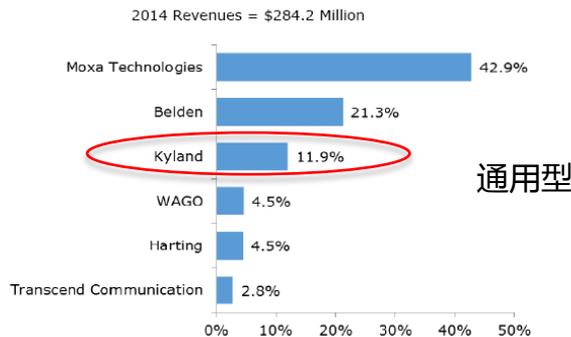
时钟同步的概念

1. 通过网络进行同步

2. 频率 + 相位 = 同步成功

频率

Watch A

Watch B

相位

Watch A

Watch B

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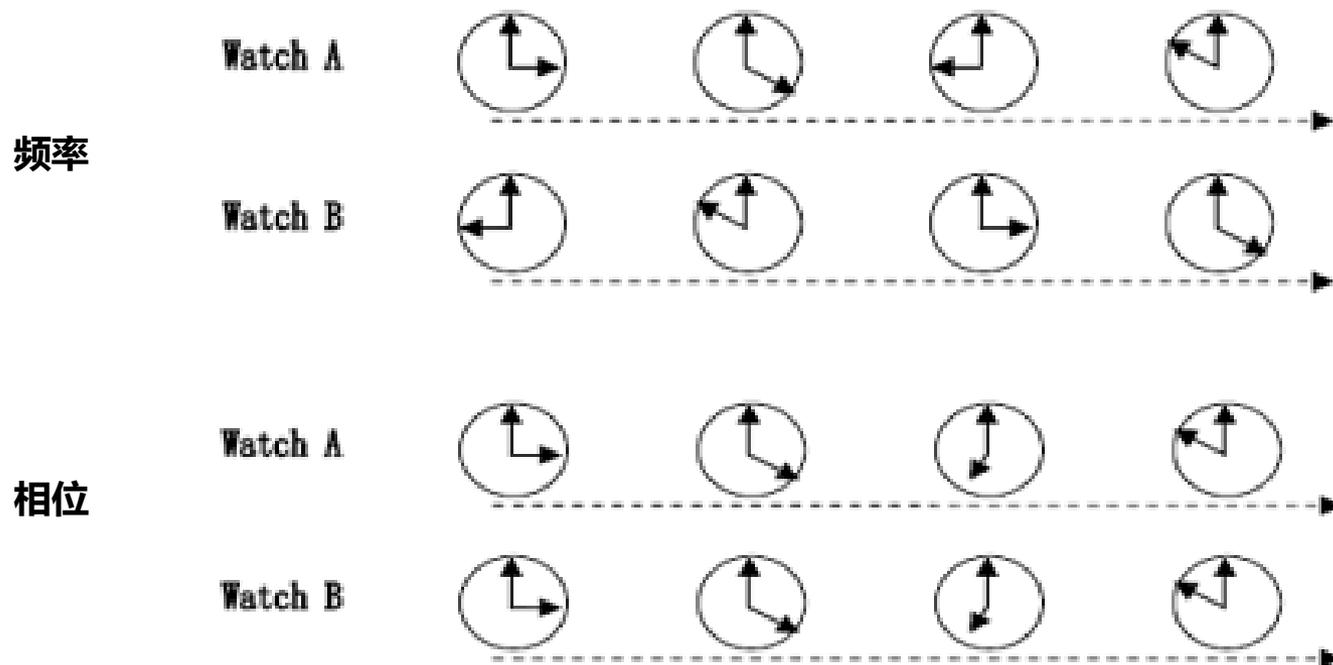
时钟传输方式
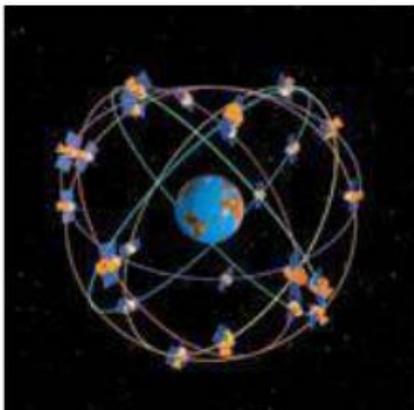
1 PPS Signal waveform

Every new second is indicated by the rising edge of the 1PPS pulse.

Maximum light level

New second   New second

Minimum light level

卫星	时钟编码	网络协议
BEIDOU	DCF77	NTP
GPS	IRIG-B	SNTP
GLONASS	PPS+TOD	PTP(IEEE1588)

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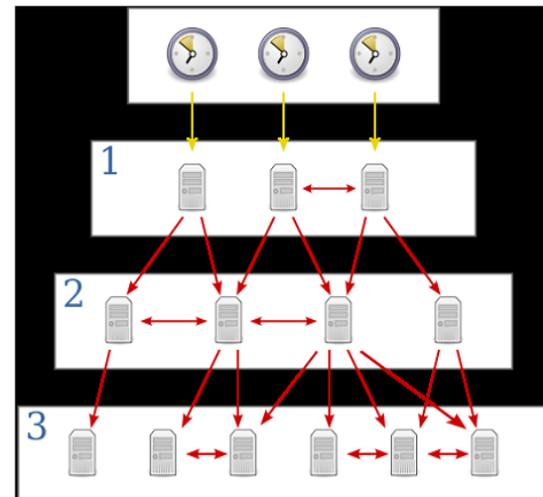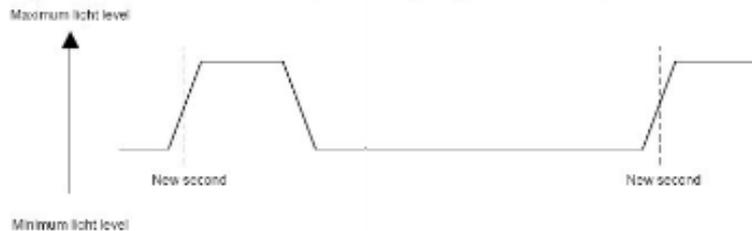
几种时钟技术的对比

	SNTP	GPS	IEEE 1588
Application Area	Wide Area	Wide Area	a few Subnets
Communication	Internet	Satellites	LAN
Accuracy	some ms	< μs	< μs
Administration	configured	n/a	self-organized
special Hardware	no	Receiver	with or without

Table 1

| Time Protocols	Accuracy	Network
IRIG-B (DC)	100 millisecond range	Dedicated timing network
IRIG-B (AC)	100 millisecond range	Dedicated timing network
NTP	Millisecond range	Timing information and data are transferred in a same network
SNTP	Millisecond range	Timing information and data are transferred in a same network
PTP	Nanosecond range	Precision time information and data are transferred in a same network

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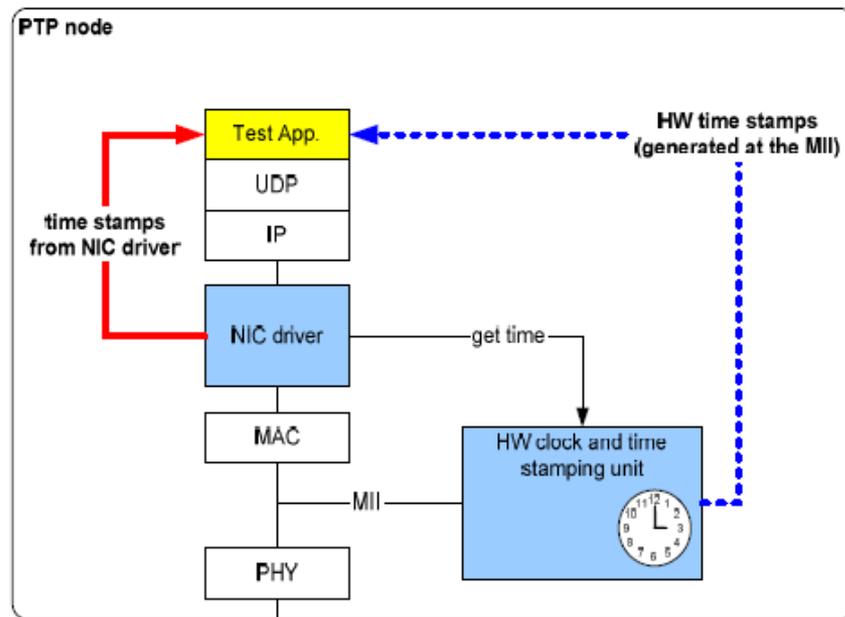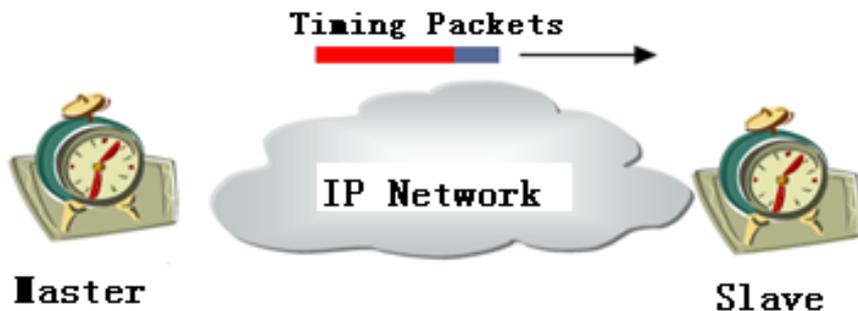
IEEE1588是什么？

- **IEEE1588v2：硬件支持的网络时钟协议，精度可达纳秒级**.

    - 映射为802.3/UDP 封包

    - 使用 BMC(Best Clock) 逻辑建立主从结构

    - 不同的时钟类型: Boundary Clock/Transparent Clock/Ordinary Clock

    - 不同的延时机制: Request-response, Peer-to-peer

    - 用于管理的SNMP MIBs
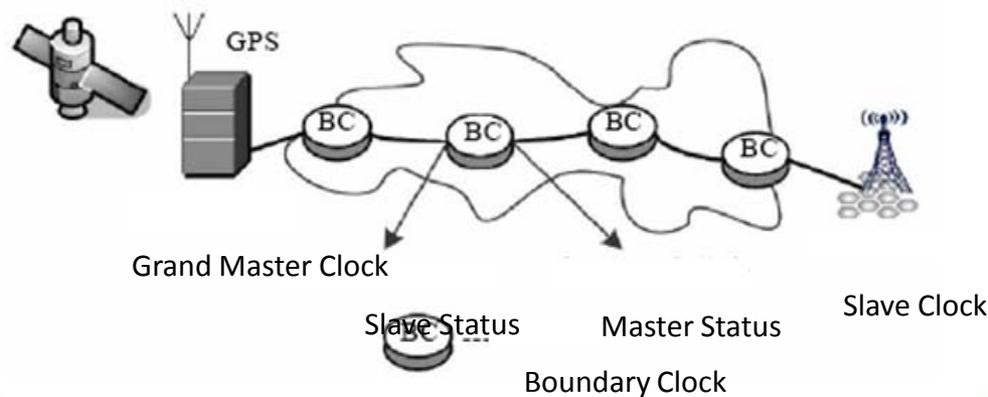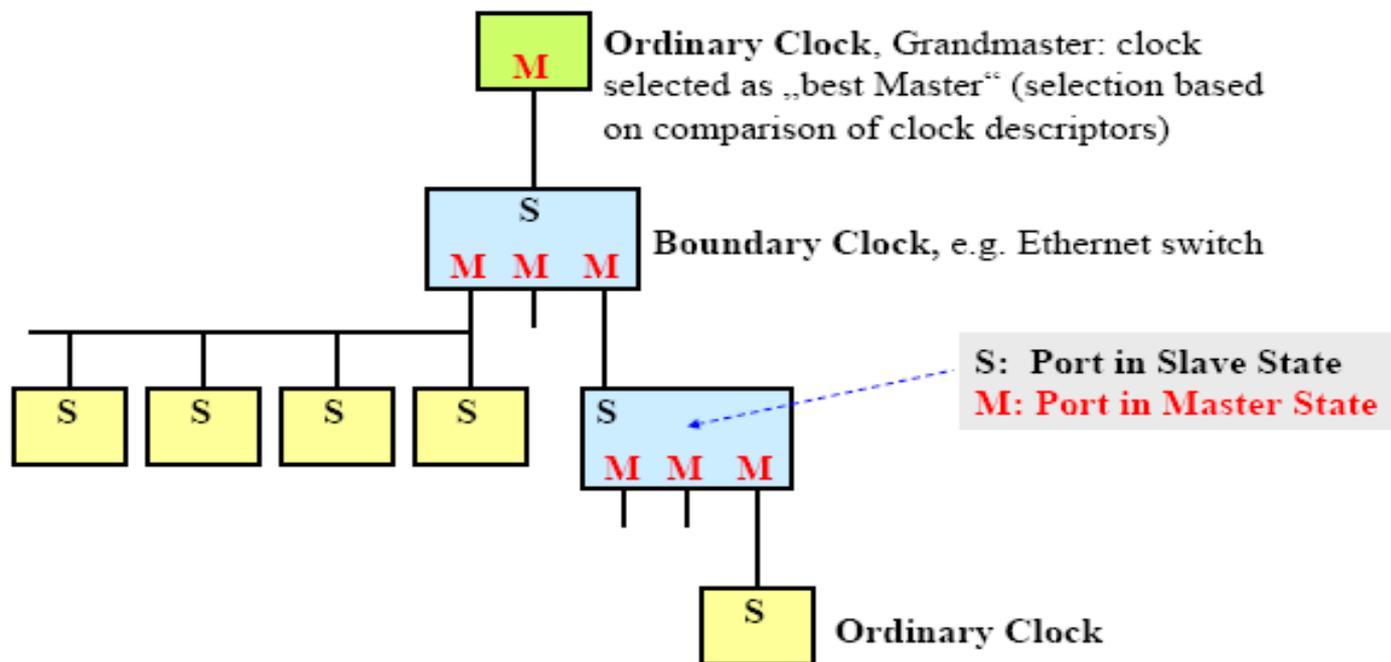
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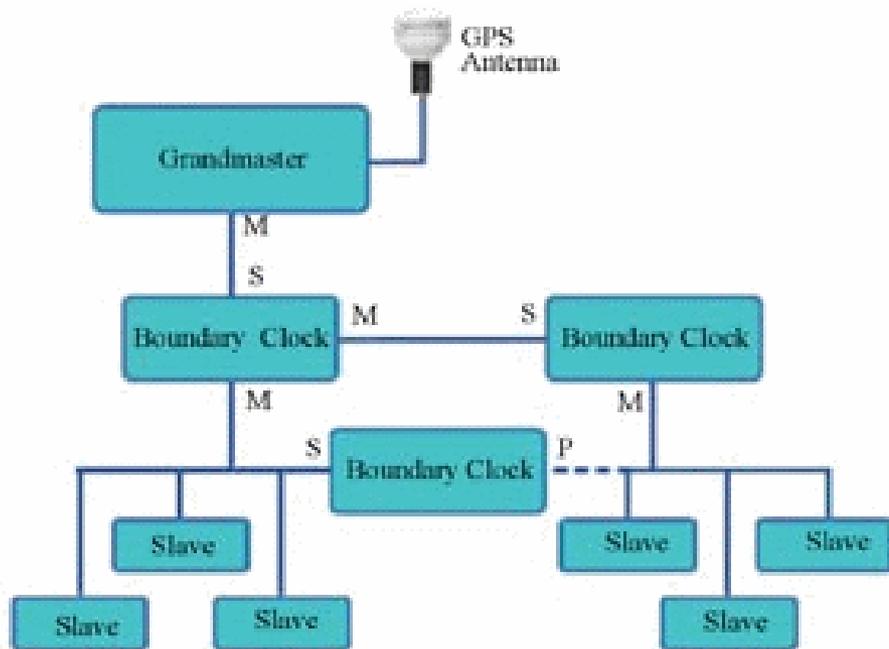
主从结构

- GMC
  - 主时钟
  - 用BMC算法选举成为参考时钟
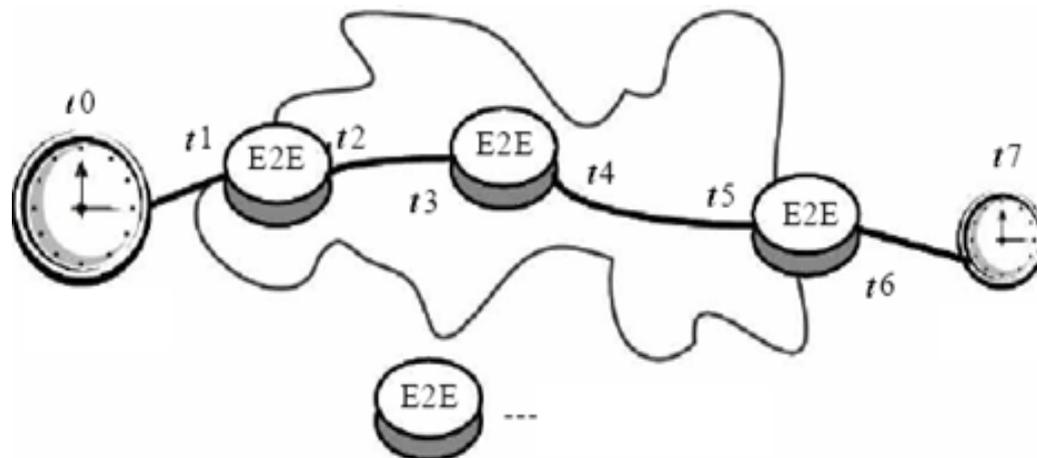 - 每个网络一个 GMC
  - 从稳定性，准确性和追踪性上都是网络中最好的
- 主/从结构
  从时钟和主钟同步

时钟节点：BC(边界时钟)&OC(普通时钟)

Ordinary Clock, Grandmaster: clock selected as „best Master" (selection based on comparison of clock descriptors)

Boundary Clock, e.g. Ethernet switch

S: Port in Slave State
M: Port in Master State

Ordinary Clock

GPS

BC BC BC BC

Grand Master Clock

Slave Status   Master Status   Slave Clock

Boundary Clock

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时钟节点：TC(透传时钟)

E2E TC
(End-to-End)

P2P TC
(Peer-to-Peer)

Grand Master Clock

Slave Clock

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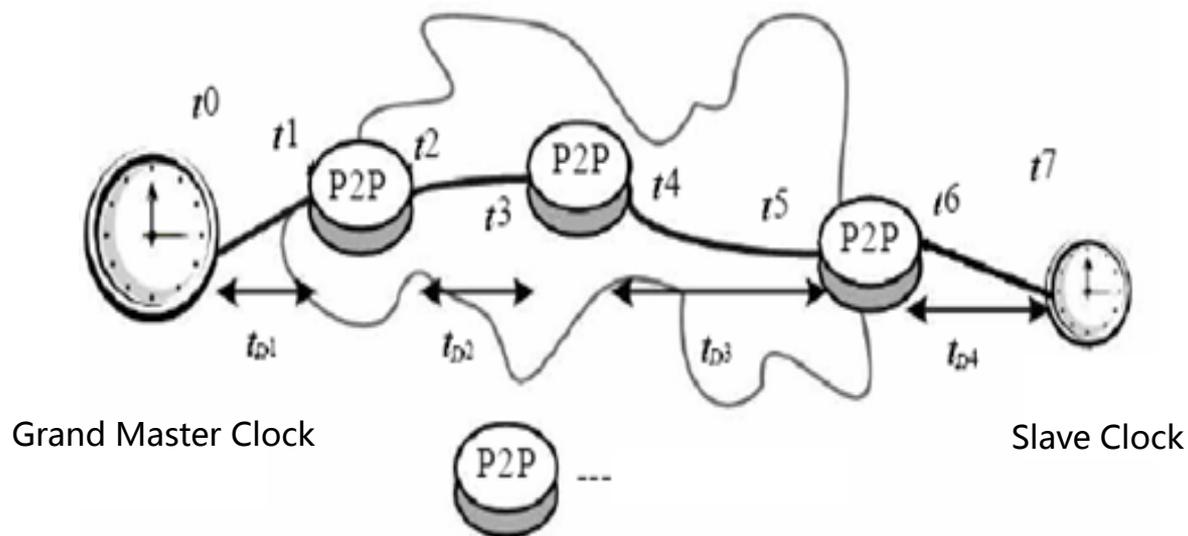
SyncE – G.8261/8262

同步以太网，是 ITU-T用于计算机网络以及设备上，在以太网物理层传输时钟信号的标准，这个信号也可以对外部时钟追踪.

Synchronous

Master Colock

Slave Colock

MAC   PHY

8B/10B Coding

PHY   MAC

GPS

IED
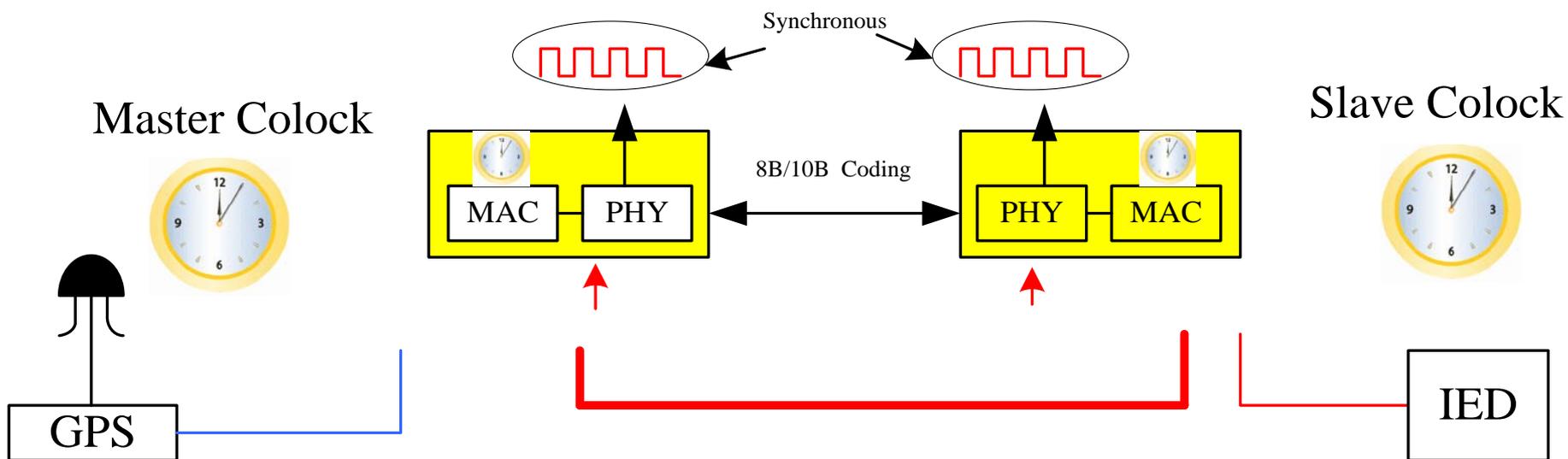
常用术语

- TAI

- UTC

- GMT

- Leap Second

- GPS Time

- Time Zone

几个时间的转换

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东土科技时钟网络解决方案

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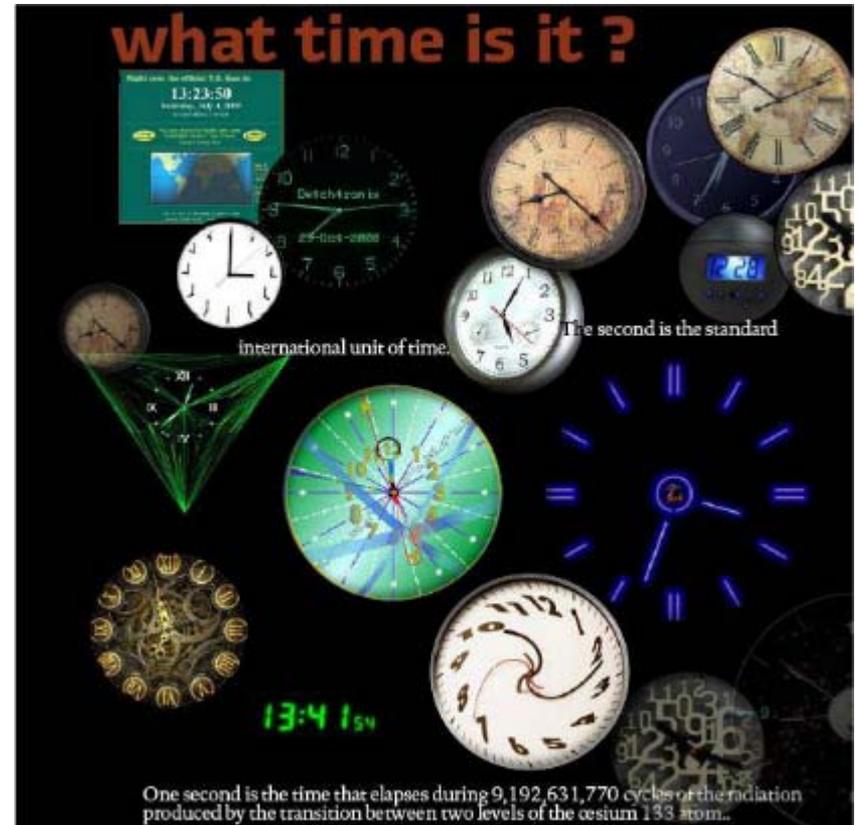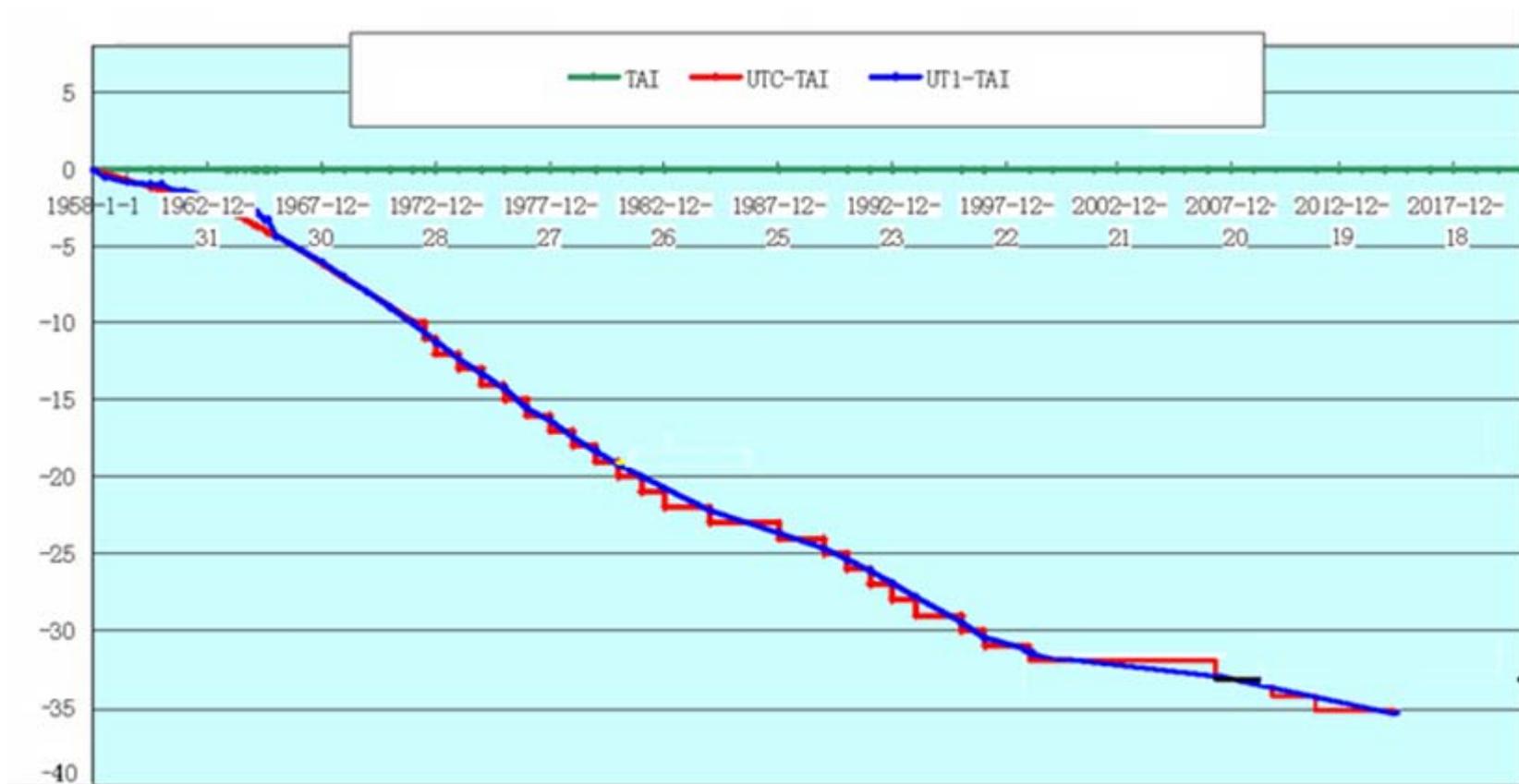
国家电网中的时间同步

Application	Need	Absolute Accuracy	Relative Accuracy	Data Sampling Interval	Precision
Substation Automation					
Fault detection / recording	Fault measurements (i.e. digital protective relays)	1 ms	1 ms	50 ms	1 ms
Event ordering	Chronological list of device change-of-state	1 ms	1 ms	event based	1 ms
Process bus synchronization	Synchronization across process bus	1 µs	1 µs	varies	< 1 µs
Energy management systems	Measurement and aggregation of data within process bays	1 ms	1 ms		1 ms
Local data acquisition		1 µs	1 µs	varies	< 1 µs
Transmission and Distribution Automation					
End-to-end line testing	Synchronized line testing requiring coordinated actions at both ends of the line	N/A	1 ms	N/A	1 ms
Wide area data acquisition [Synchrophasors]	Measurement and aggregation of data across a distributed network	26 µs	26 µs	33 ms	1 µs
Meter synchronization	Synchronization of meters for pricing	> 1 ms	> 1 ms		

更精确! < 1us

更多实时应用!

From 《Fletcher & Moyne; Smart Grid Time Synchronization requirement ; draft report to NIST》

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IEC61850的要求

标准智能设备控制和保护事件的同步

| Time Perf. Class	Accuracy[ms]	Purpose
T1	1	Time tagging of events
T2	0.1	Time tagging of zero crossing and of data for the distributed synchrocheck.Time tags to support point on wave switching

标准智能设备仪表变压器的同步

Time Perf.Class	Accuracy [us]	Reference		Phase angle 50Hz	Phase angle 60Hz	Fault location [m]
T3	25	P1		27	32	7500
T4	4	P2	M1	4	5	1200
T5	1	P3	M2/M3	1	1	300

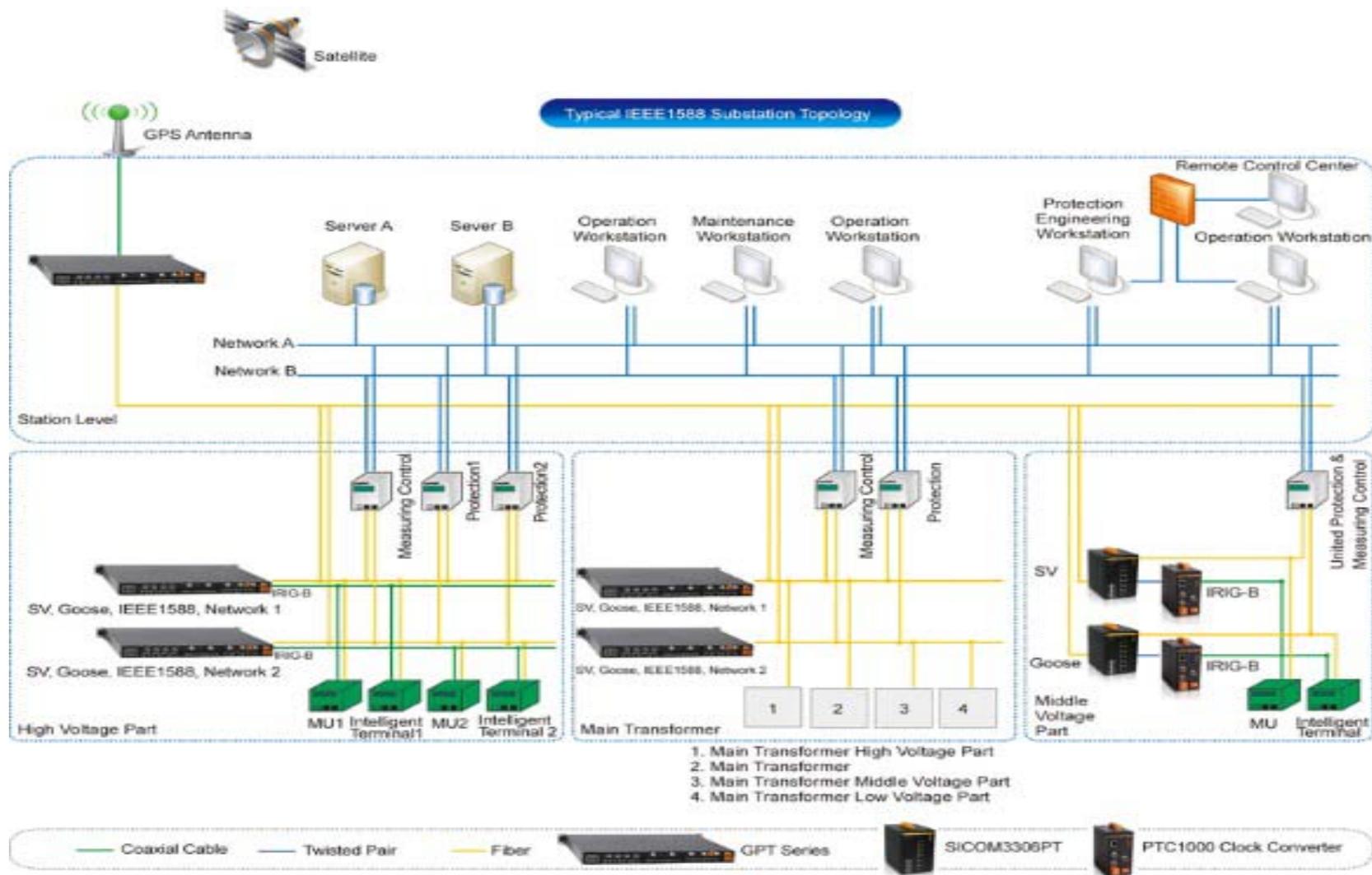# 智能变电站中时间同步的要求

- **同步准确**
    - 变电站级: <1s
    - 间隔层Bay level: < 1ms
    - 过程层: <1us
- **守时性能**
- **信号丢失情况下的多时间参考源**
    - 不同卫星系统之间备份
    - 卫星系统和地面时钟备份
- **关键系统的冗余设计**
- **不同的时钟同步输出**
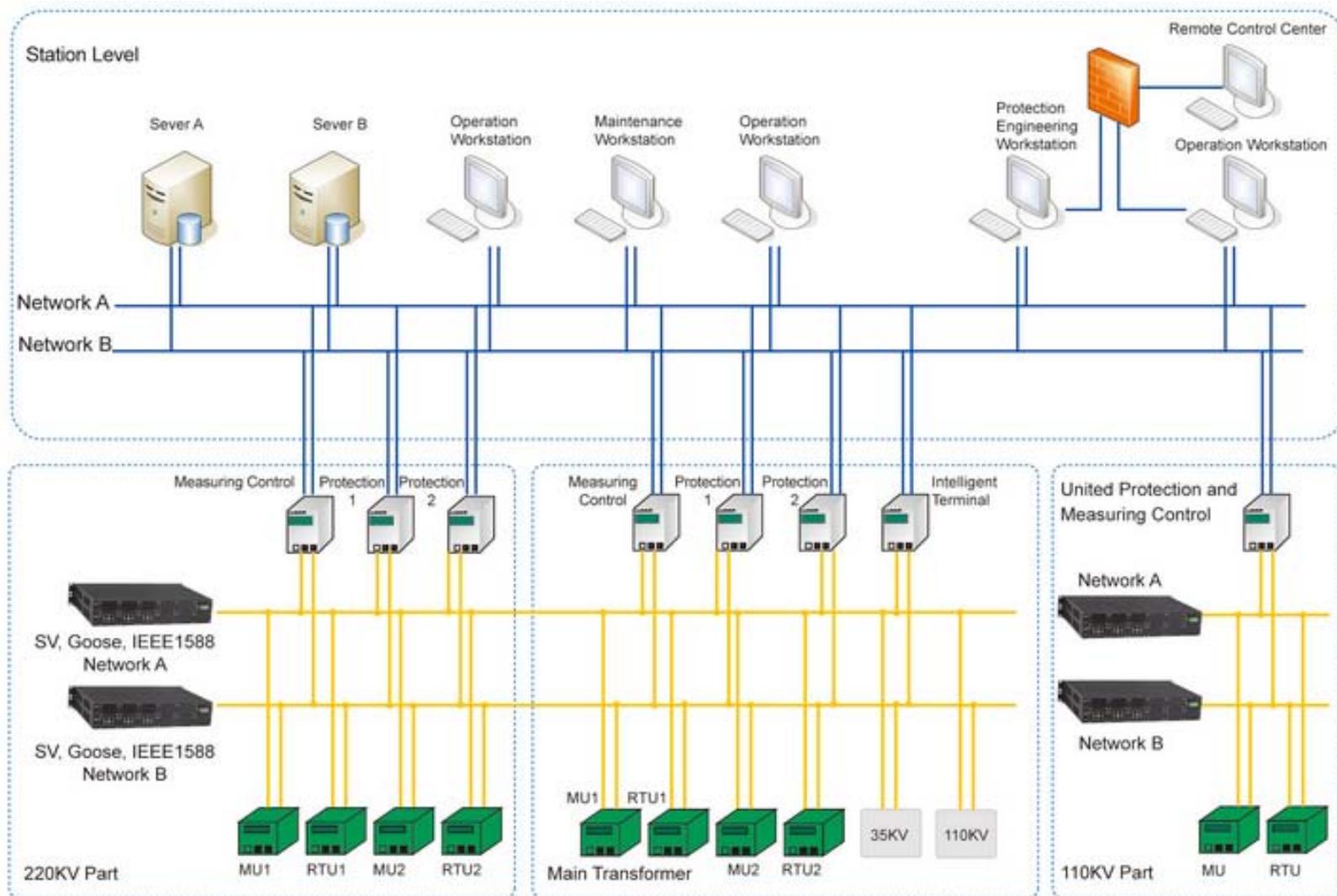   - IRIG-B
    - PPS
    - NTP
    - PTP

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变电站时钟同步解决方案—传统专有时间信号连接
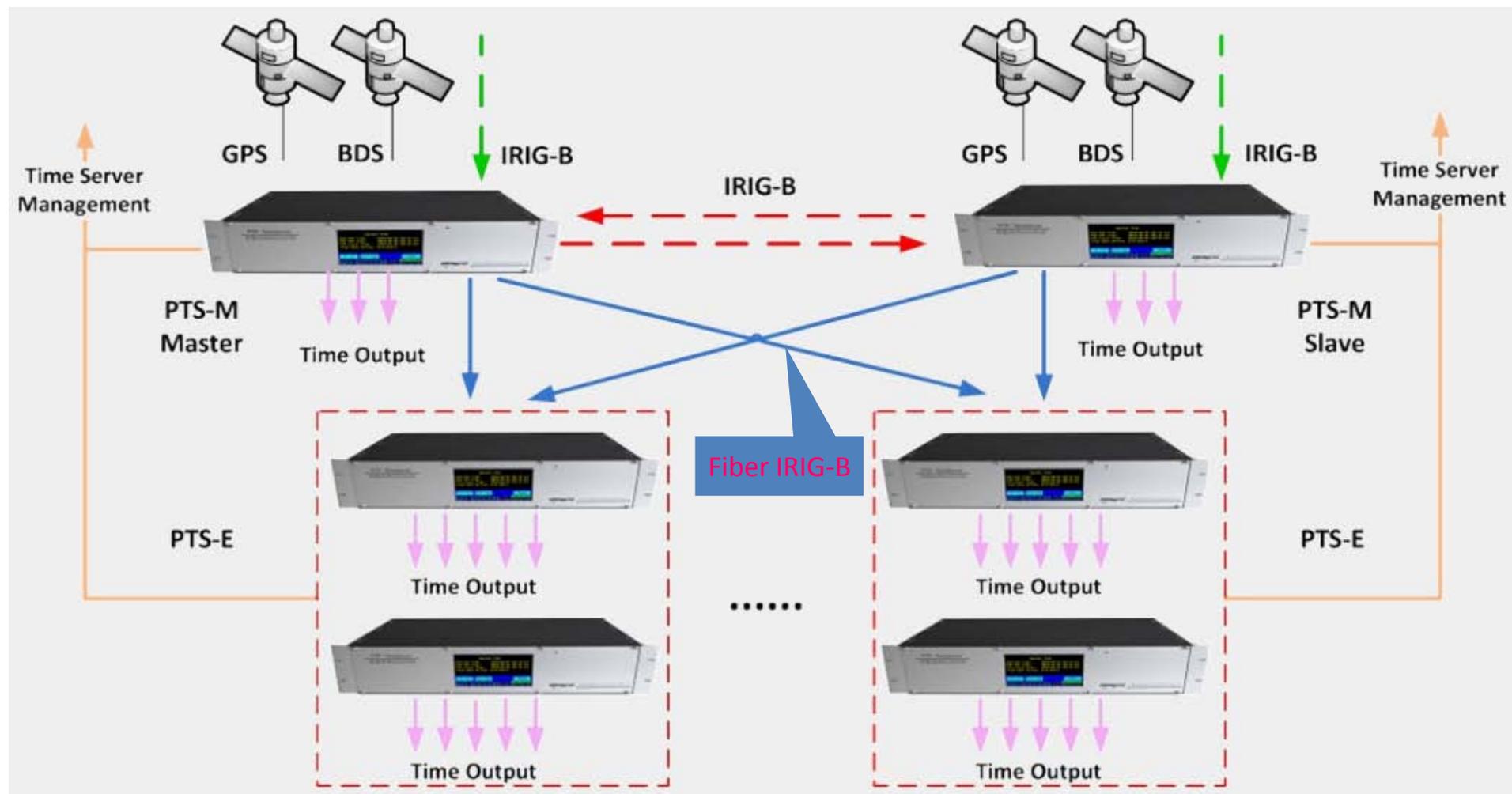
变电站时钟同步解决方案—过渡方案：PTP+原总线

变电站时钟同步解决方案—完全PTP解决方案

目前变电站PTP应用的优缺点

- **优点**
  - 1us 准确度满足所有变电站要求
  - 所有以太网变电站不需要额外的时钟网络布线

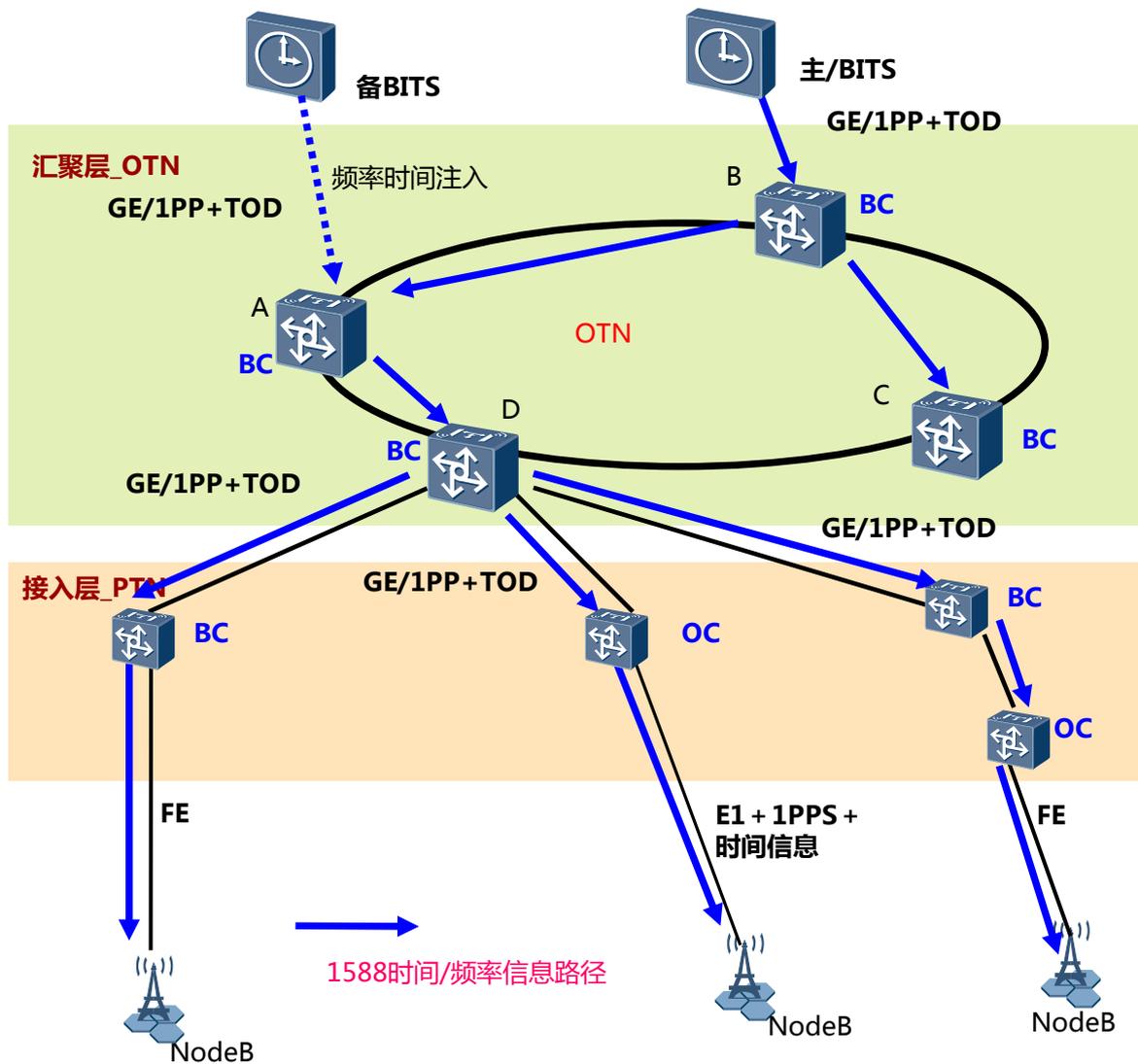- **IEEE1588部署的障碍**
  - 技术的成熟度
    - 支持IEEE1588的IEDs
    - IEEE1588 以太网交换机
    - IEEE 1588 时钟服务器
  - 互操作性: Time server+ Ethernet Switch+ IEDs
    - 每年在ISPCS中举办的互操作测试给厂商提供互相交流的机会
  - 电力系统中一致的 IEEE1588 配置
    - PC37.238 标准
  - 如何测试和排除故障
    - IEEE1588测试设备
  - 工程经验
    - 第一个IEEE1588变电站完成于2010年

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ISPCS

- 2015在北京（东土主办）

- 2014 in Austin

- 2013 in Lemgo

移动承载网时钟同步解决方案

使用双时钟源输入，通过BMC算法实现最优主时钟选择

在承载网络中全网采用IEEE 1588 PTP同步技术进行时钟的传输和分发，实现频率同步和时间同步

优点：

每站点均进行时钟、时间同步，保证同步效果

可逐点测量补偿不对称，提供同步精度

时钟同步在工业自动化中的应用

- 石油石化大范围DCS/混合控制系统

- 公路/公安系统监控系统的时钟同步

- 工业商业一体化全网路系统的时钟同步

东土科技时钟同步产品系列

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PTS：高精度模块化时钟服务器

- 1PPS/1PPM/1PPH/10KHz output

- IRIG-B-DC/AC output

- RS-232/485 Serial output

- DCF77 output (Optional)

- NTP/SNTP ,PTP V2 output

- Screen display(3U-Touch Screen/1U-LCD Screen)

- Monitoring(MMS/IEC60870-5-104/SNMP(Optional))

- Alarm Contact output

- Dual Power Supply (3U)

- BD,GPS,IRIG-B,TOD,PTP etc. to use as time source

- OXCO or Rubidium oscillator optional

- Reliable multiple source selection algorithm

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PTS 服务器的主要特点

- 多时钟源选择算法

- 高时间精度和守时性能

- 时钟源状态监视和报告

- 时间调整步长配置 (默认 200ns/s)

- UTC 闰秒指示和调整

- 输出通道时间补偿包括PPS

- 可编程输出通道 (SO,O1~O5)包括时间信号

- EMC 4级支持恶劣电磁环境

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SICOM3028GPT 模组化全千兆多功能PTP以太网交换机

- Layer 2/3,Flexible modular design for easy expansion, 1U rack-mounting

- Supports up to 28 Gigabit ports

- Precise time synchronization supporting IEEE1588v2 and ITU-T.G.8261/G.8262 (Sync-E)

- Supports redundancy protocols: IEC62439-6(DRP), DT-Ring family, MSTP, and VRRP

- Extensive GPS and IRIG-B modules available

- Exceeds IEC61850-3 and IEEE 1613

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GPS模块
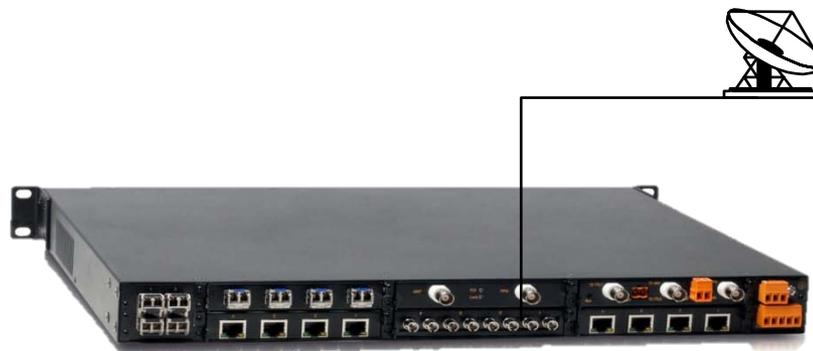
- GPS module for SICOM3028GPT Series

- 14 channels GPS C/A coding receiver

- High precision time source from GPS with ±100ns accuracy of PPS

- High-stability oscillators for holdover performance and various options for upgrade

- One GPS antenna input with BNC connector

- One PPS +5V TTL level output with BNC connector

- FIX and Lock LEDs for working status indication

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PTC1000 – PTP Clock Convertor

IEEE1588 PTP Clock → **PPS IRIG-B**

1. Supports IEEE1588v2, the synchronization accuracy reaches ±100ns

2. Support ITU-T.G.8261/G.8262 SyncE, the synchronization accuracy can reach ±50ns with SyncE enabled

3. Support C37.238 Power Profile

4. Support C37.118 Standard for Synchrophasors for Power Systems (Support to Version 2005 already realized, support to Version 2011 still under development)

5. Support Telecom Profile (Under development)

6. Supported IRIG-B format:B000, B002, B003, B120, B122, B123. Newly added: B001, B004, B005, B006, B007, B121, B124, B125, B126, B127, B1344 DCLS, B1344 AM

7. Support 1 100Base-FX SC/ST/FC or 1 10/100Base-TX RJ45 input. Support 1 PPS output, 2 IRIG-B TTL outputs, 2 IRIG-B AM modulation outputs and 1 IRIG-B RS422 output

IEC61850-3 IEEE1613 | IEEE1588v2 SyncE | High Voltage Supported

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IRIGB 模块

- Synchronized time conversion from IEEE1588 to time code output for legacy devices

- One channel for PPS output, two channels for IRIG-B (DC) output , two channels for IRIG-B (AC) output

- Supports time code: B000, B002, B003, B120, B122, B123. Newly added: B001, B004, B005, B006, B007, B121, B124, B125, B126, B127, B1344 DCLS, B1344 AM
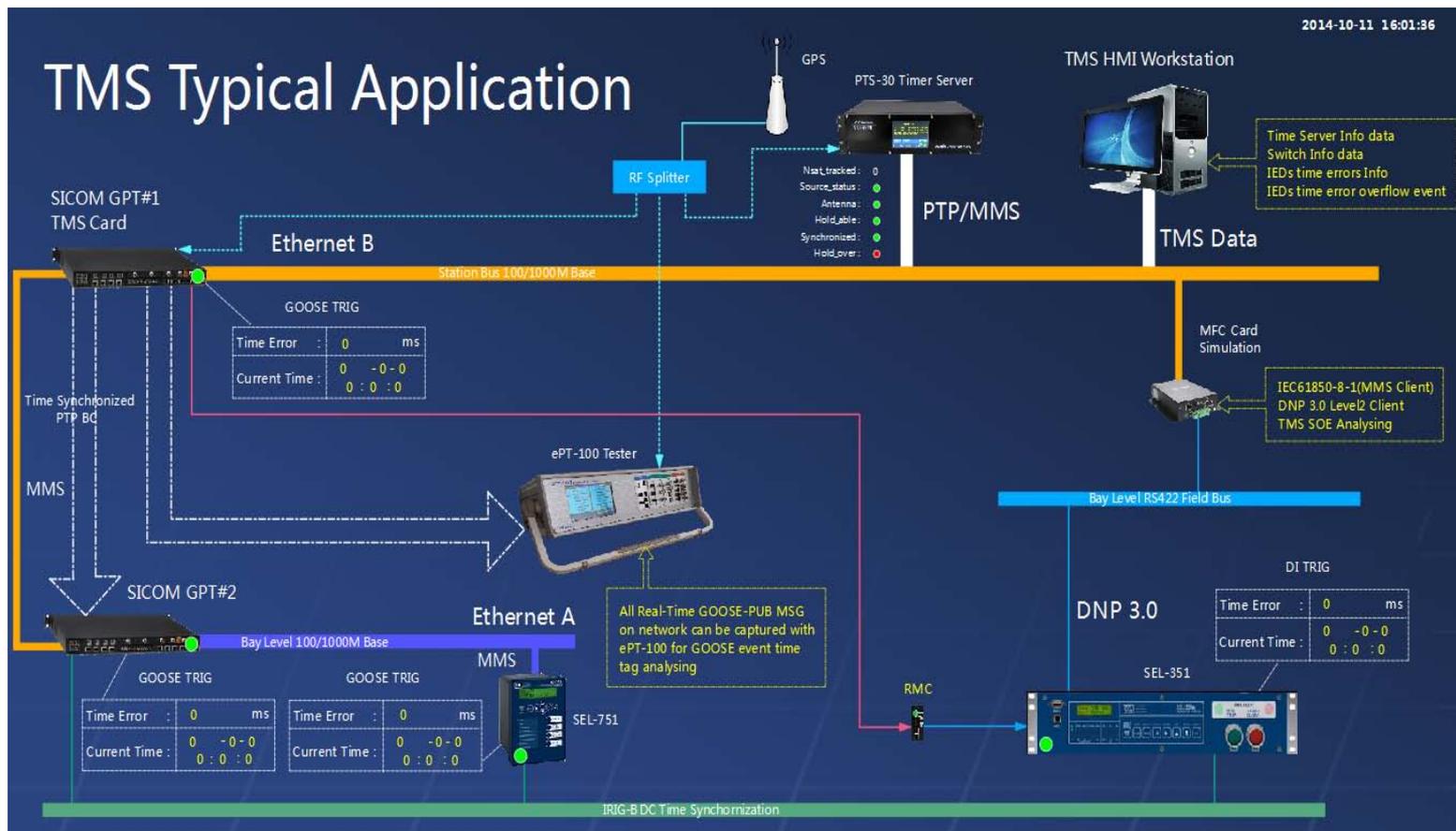
- Module Running LED

ePT100 – 时钟测试仪

	Accuracy	Resolution
GPS	30ns	8ns
IRIG-B-DC	50ns	20ns
IRIG-B-DC-Modified Manchester Codes	50ns	20ns
IRIG-B-AC	1us	20n
Serial time+PPS	100ns	20ns
Frenquency	1Hz	1Hz
Pulse	50ns	20n
SOE	1ms	1ms
PTP	50ns	8ns
NTP	1us	8ns
IEC61850 9-1/9-2	1us	1us
IEC61850 GOOSE	1us	1us

TMS – 时钟管理系统

评估系统时间同步状态

系统节点时间跟踪

监视系统节点实时的时钟偏离状况

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Kyland - 东土科技

- 国内领先的工业以太网设备供应商

- 工业同步以太网专家及解决方案供应商

- 国内行业应用解决方案供应商

谢谢
THANKS

KYLAND