

**AEROSPACE
TESTING
EXPO 2005
North America**

**Synchronization of measurement data
acquired with DAQ systems
from different manufacturers**

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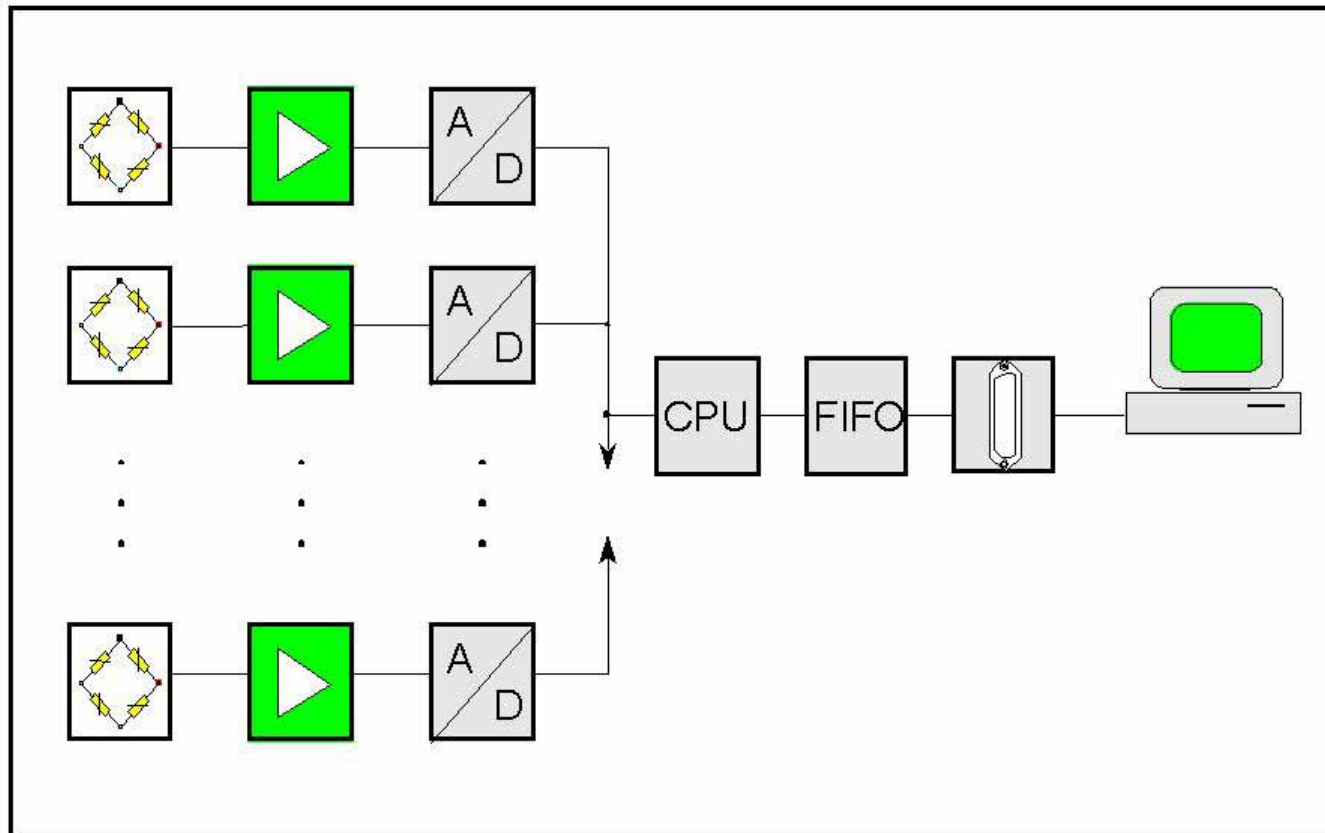


measurement with confidence

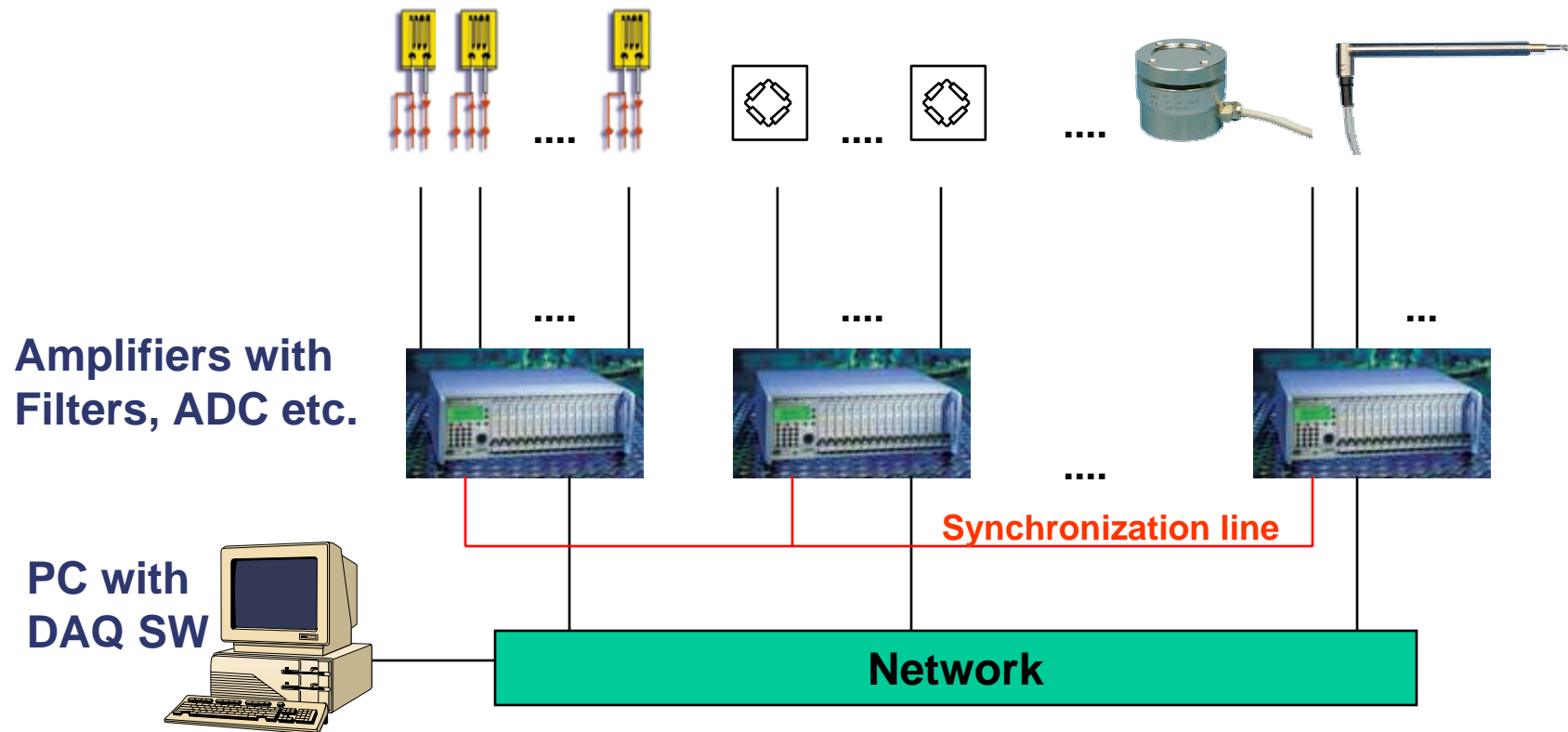
Block diagram of a multi channel DAQ system



**System wide synchronized A/D converters:
i.e. one timestamp per scan line**



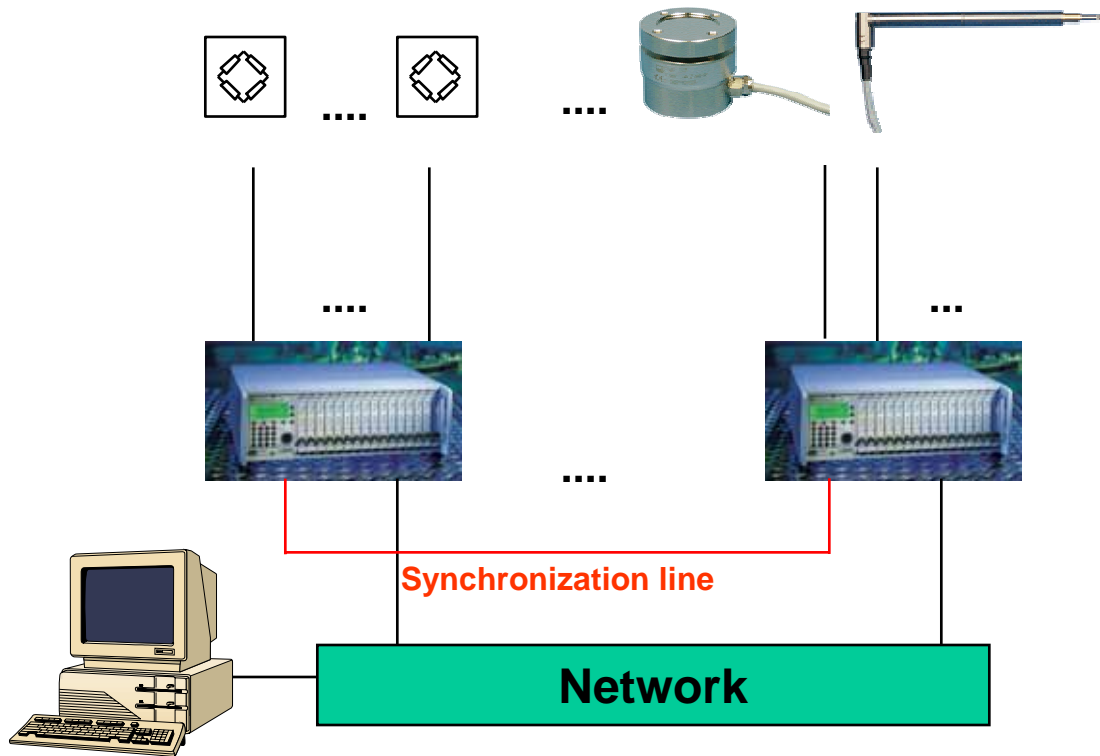
Strain gages and transducers



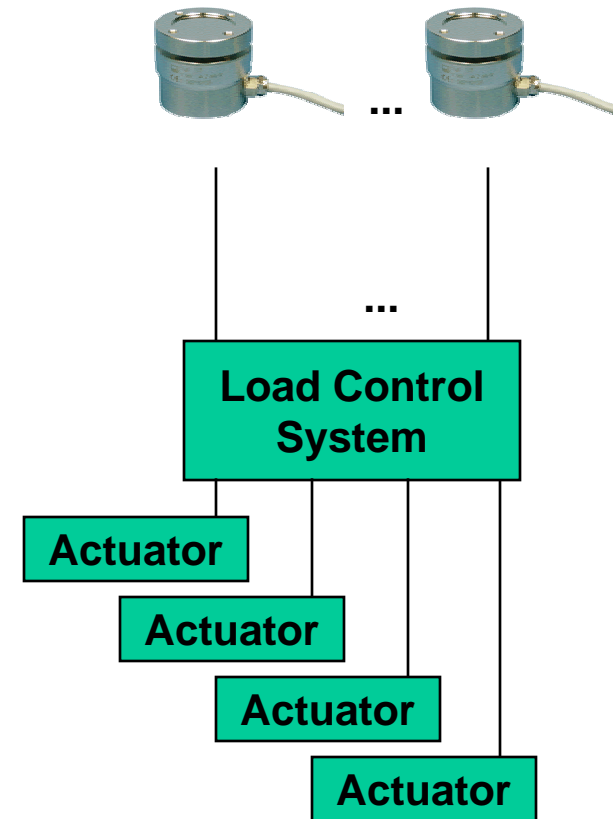
DAQ and LCS system e.g. for static and fatigue tests



Data acquisition system with strain gages and transducers



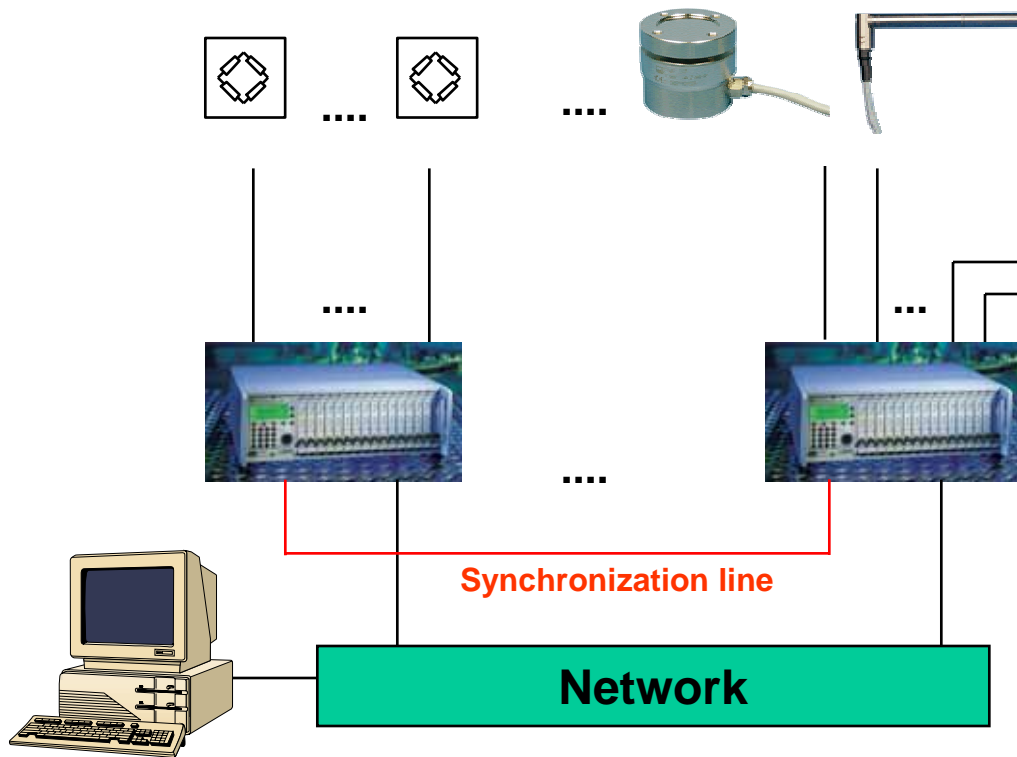
Load control system with actuators and transducers for force, displacement etc.



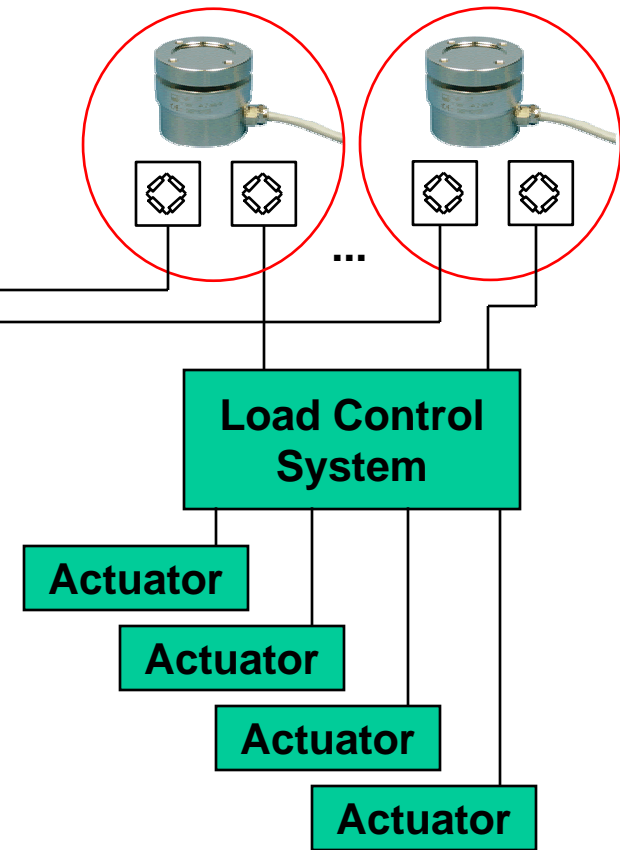
DAQ and LCS system e.g. for static and fatigue tests



Data acquisition system



Force transducers with double or triple bridges

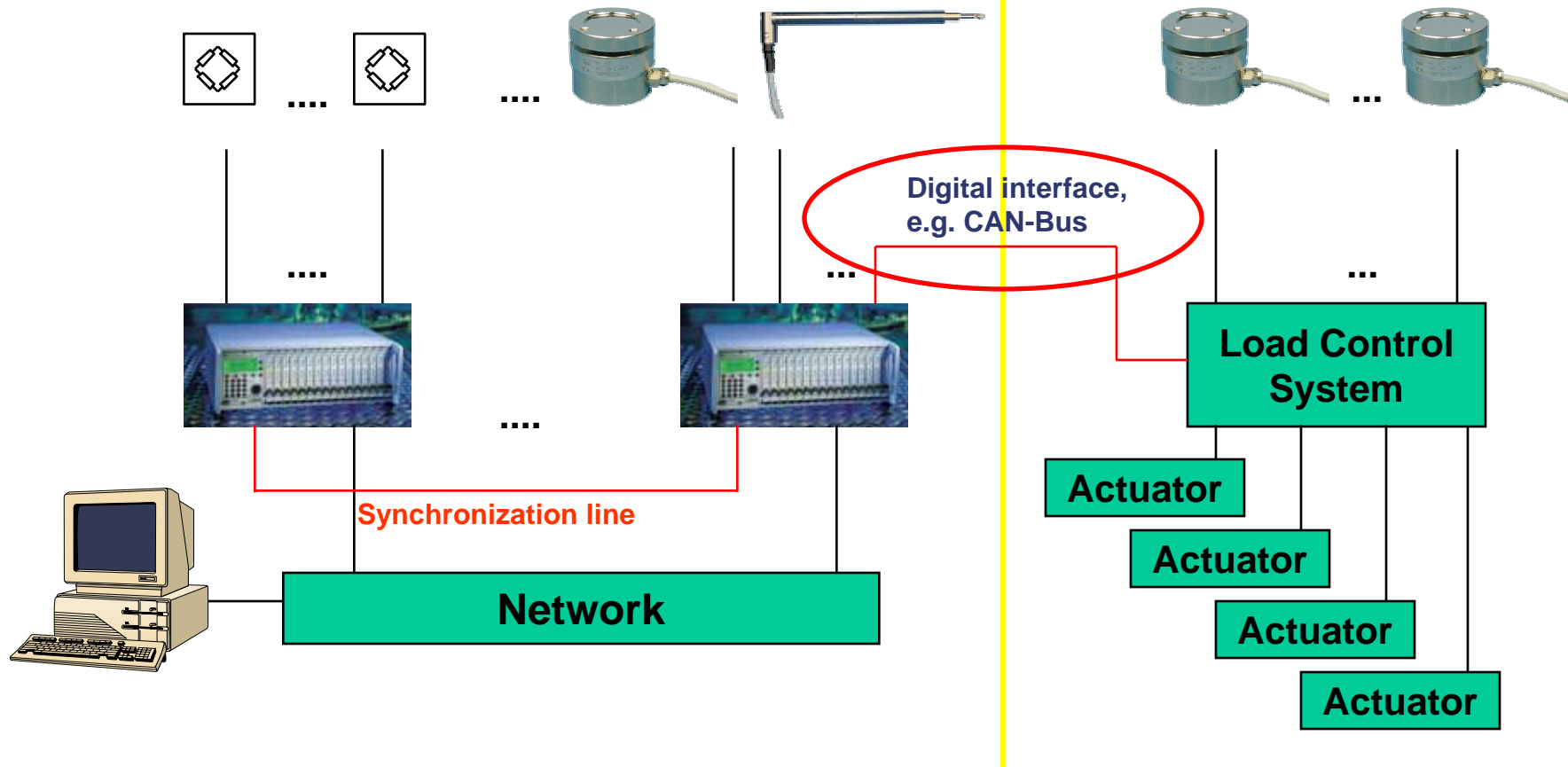


DAQ and LCS system e.g. for static and fatigue tests



Strain gages and transducers

Load control system With actuators and Transducers for Force, displacement etc.

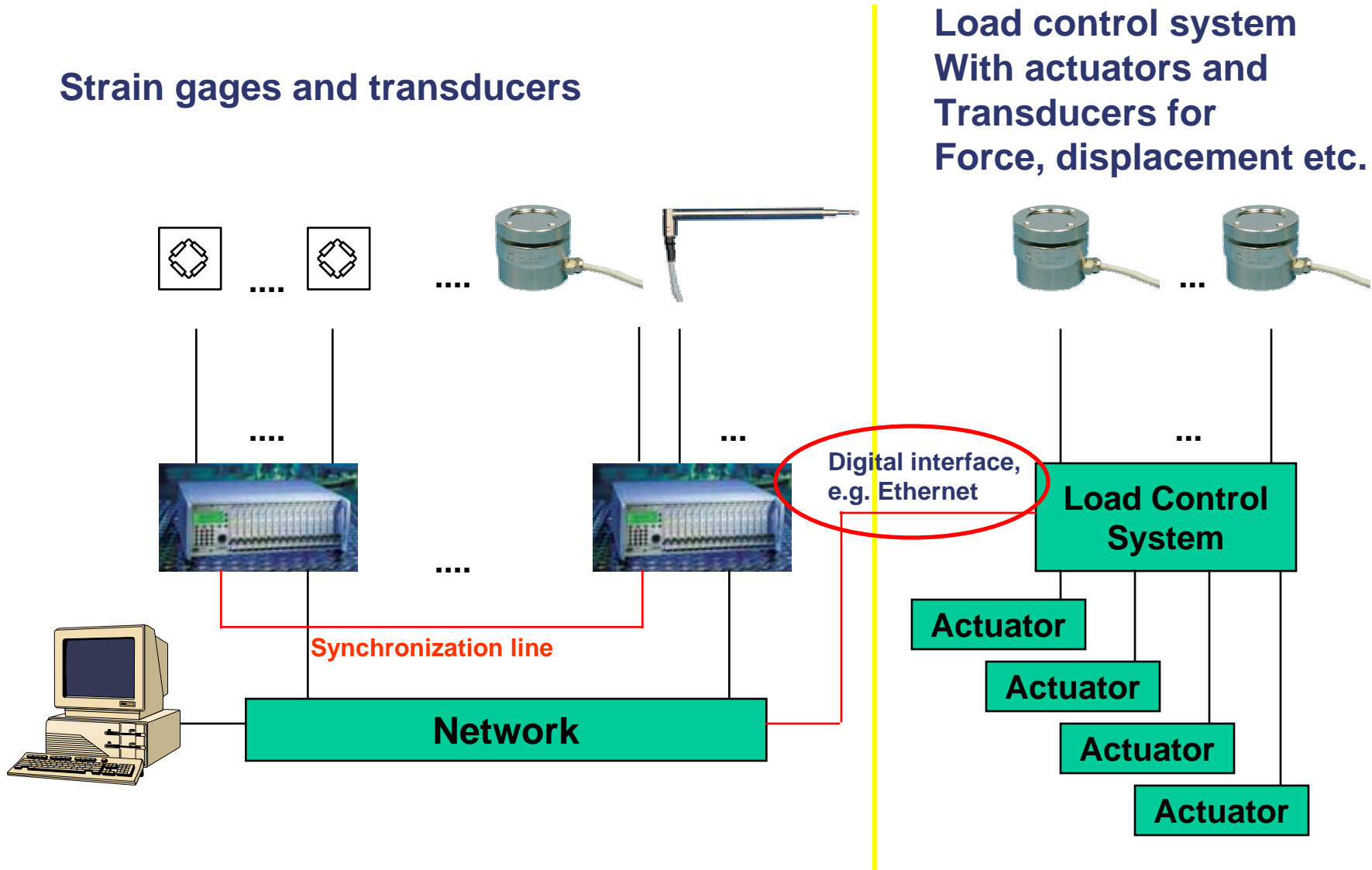


DAQ and LCS system e.g. for static and fatigue tests

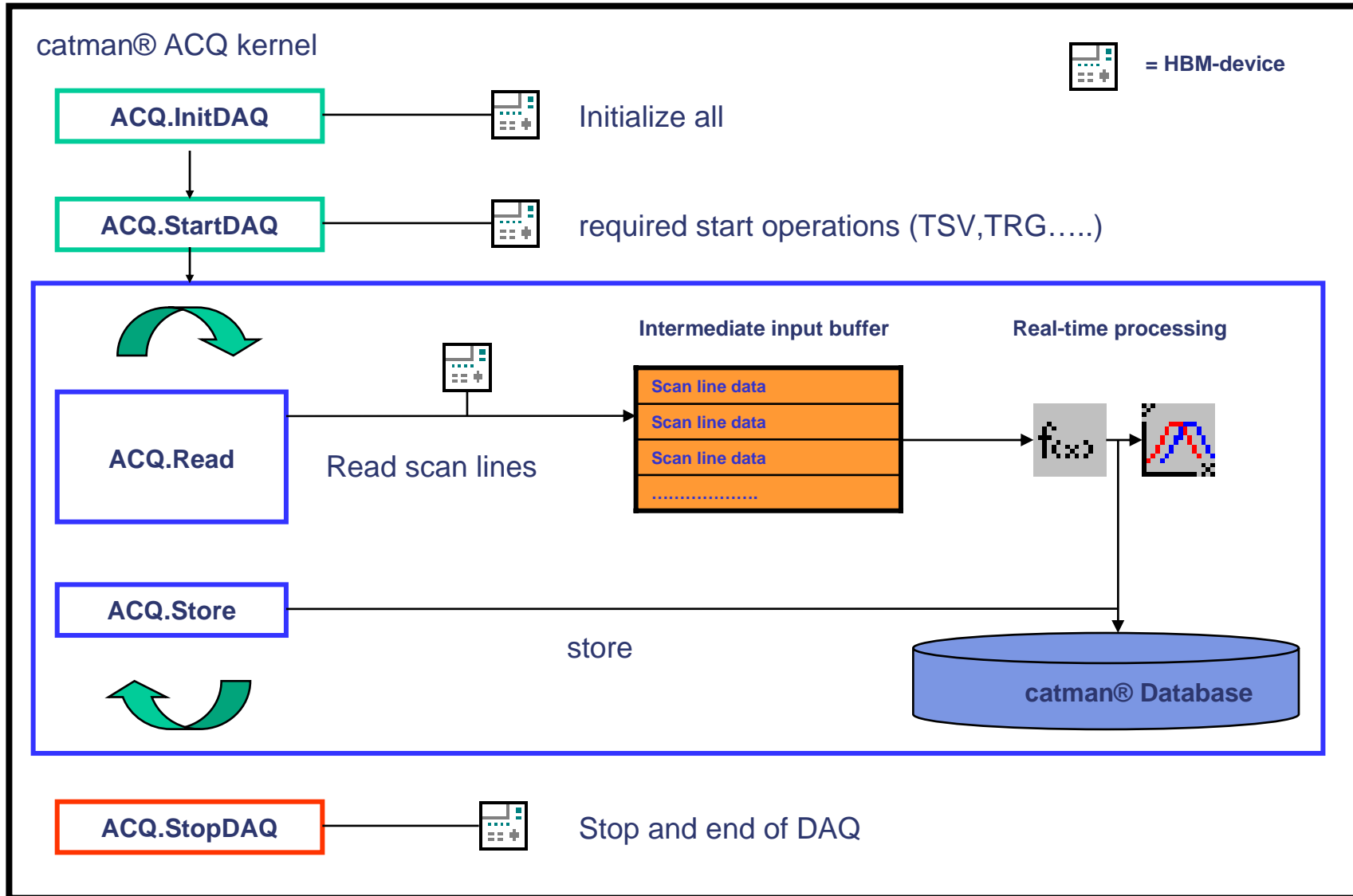


Strain gages and transducers

Load control system With actuators and Transducers for Force, displacement etc.



General data acquisition in catman®



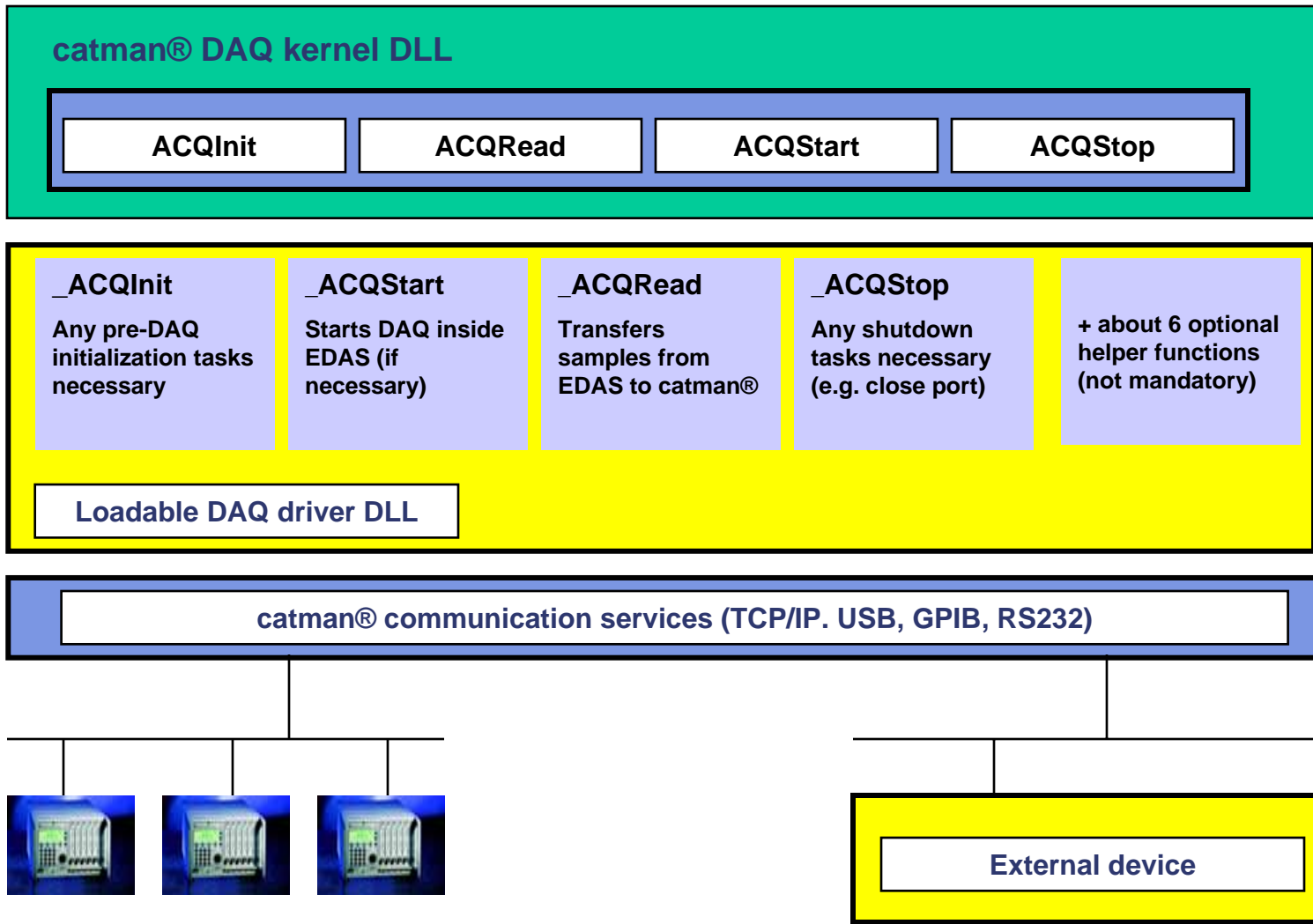
Requirements:

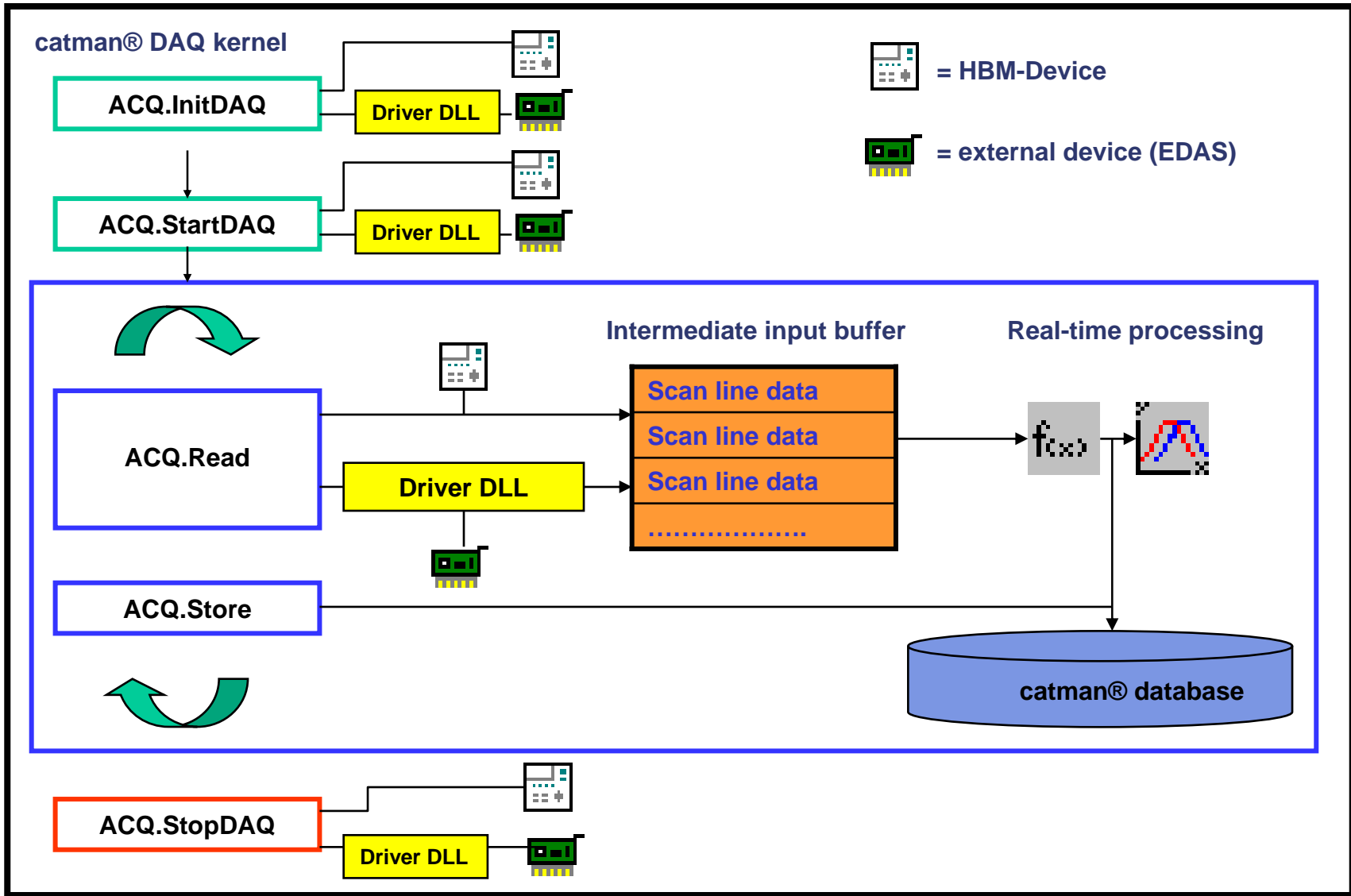
- Read measurement data from external system
- Synchronization of external data with the HBM system (MGCplus) data
- Provide channel information for catman® I/O-Definition.

Solution: loadable drivers:

- No changes necessary in core-code of catman®
- Can be developed by external company
- No knowledge about external device necessary at HBM

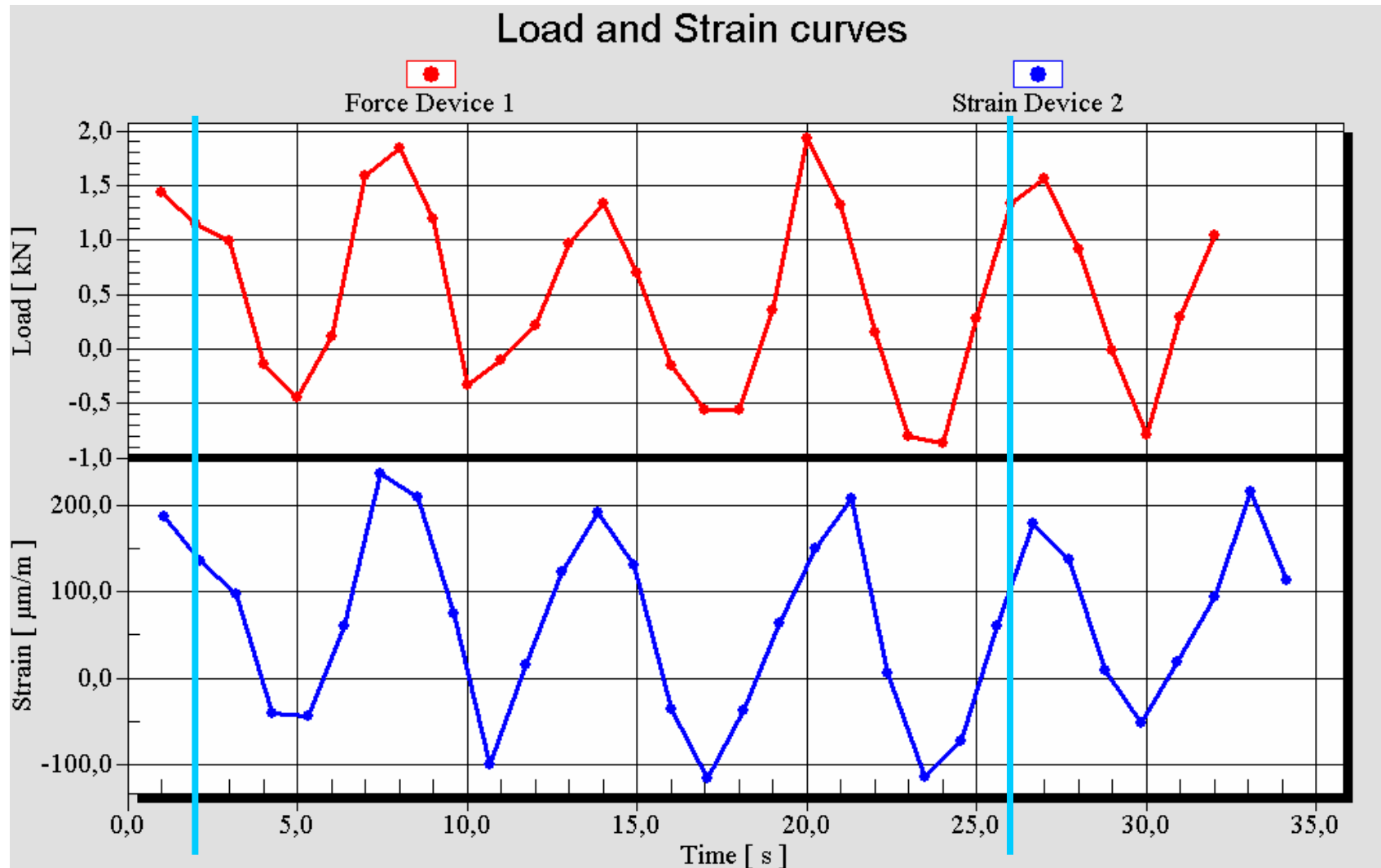
Driver structure





- Data streams from different devices are not correlated regarding the time, or this is limited to just a common time of start only.
- Knowledge of the relationship of measurement data from different devices regarding the time is necessary.
- Hardware synchronization is not possible normally.
- Required accuracy of synchronization is less than 5 ms in many applications.

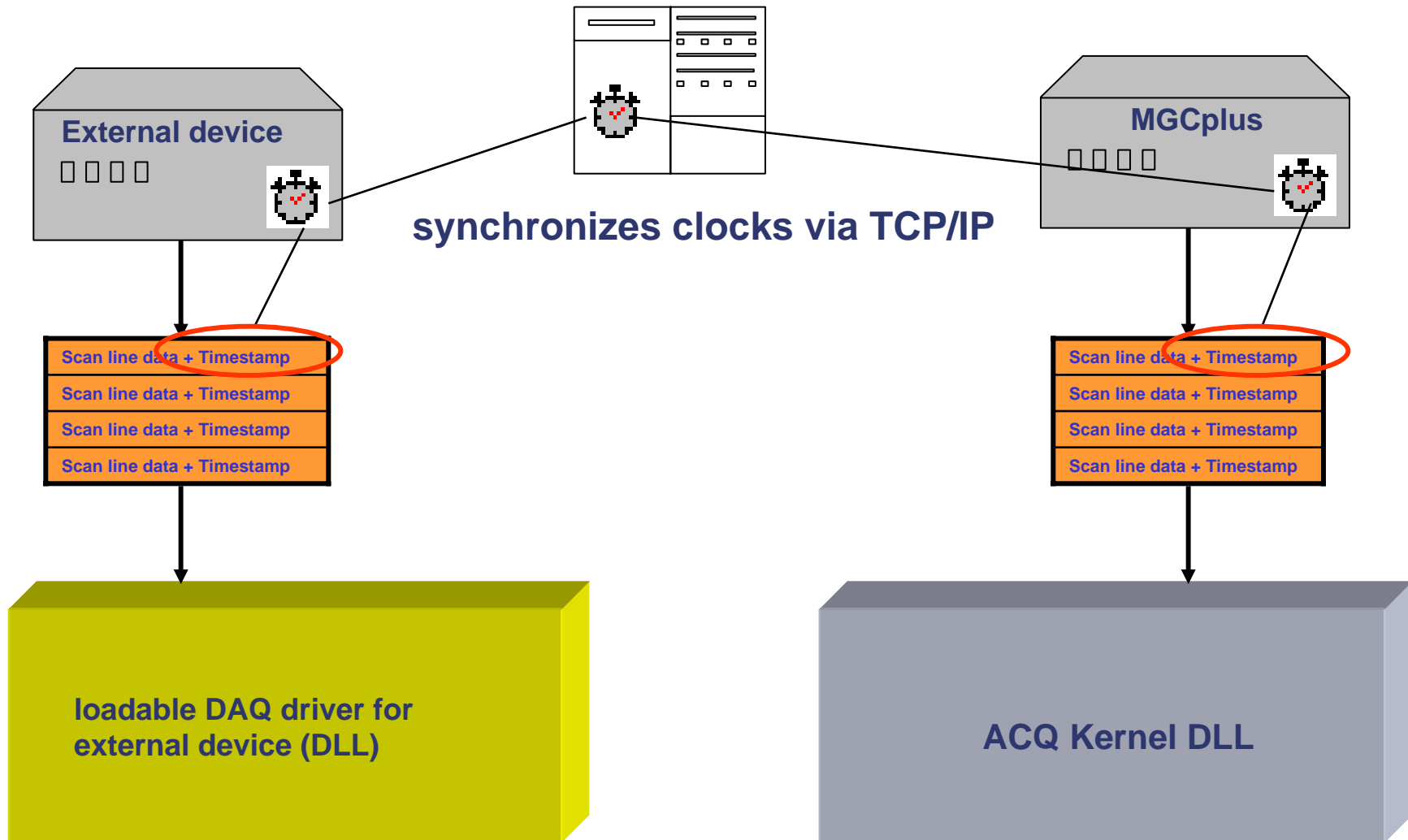
Timing problem with not synchronized systems



Principle of synchronization



Time-server (NTP Server)



- **devices („NTP clients“) cyclically ask the server for the time**
- **server takes into account the delay time of the request**
- **client takes into account the delay time of the answer**
- **from the received time and the difference to the own clock control parameters are determined to adjust the clock**
- **the settling time depends on the initial time difference and can be minutes**
- **in local networks the accuracy can be better than 1 ms**

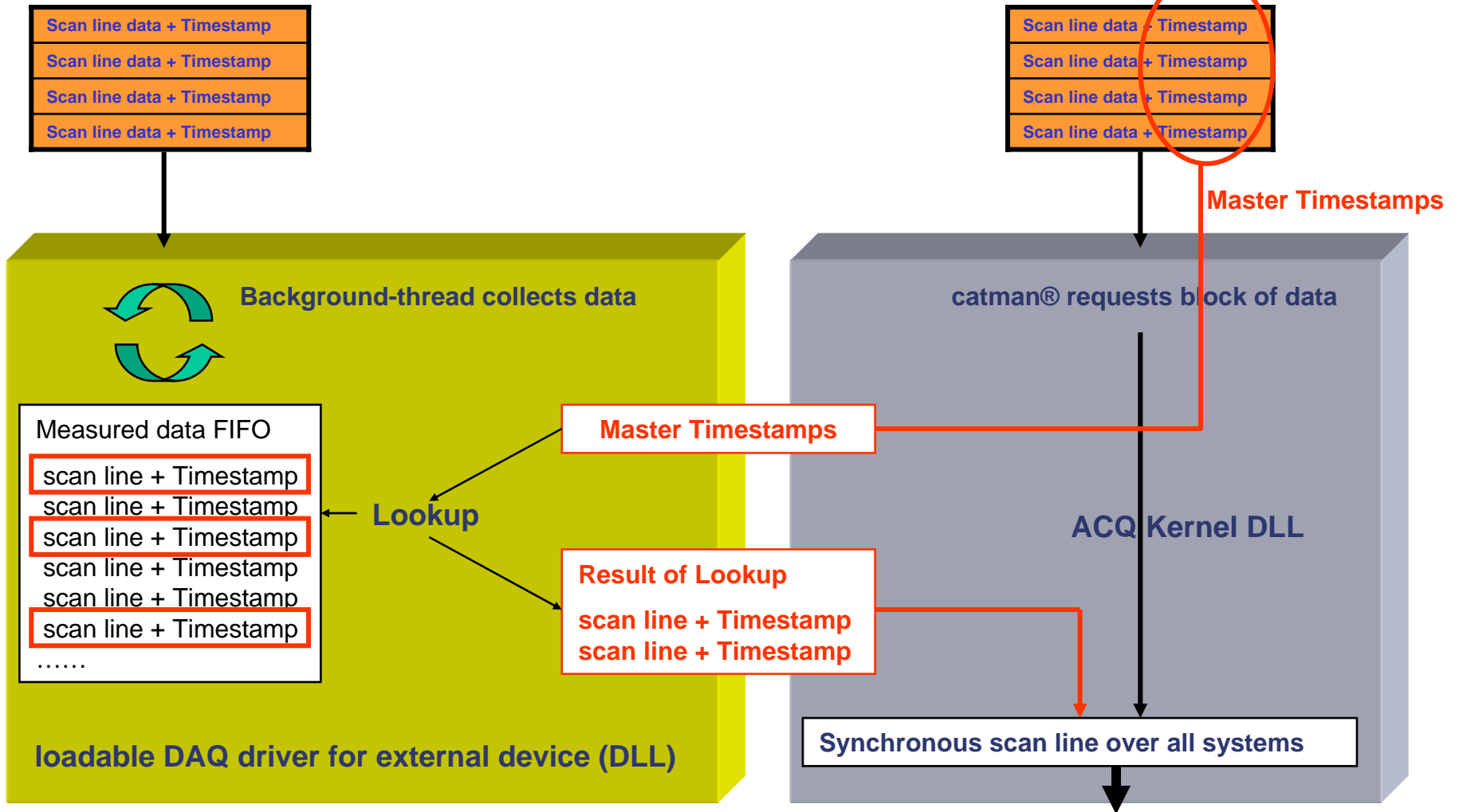
- **Must be supported by external device**
- **At the time being only possible with MGCplus/CP42**
- **Requires TCP/IP and access to a NTP server**
- **NTP client software must run in all systems**

Synchronization in the FCS-Standard driver

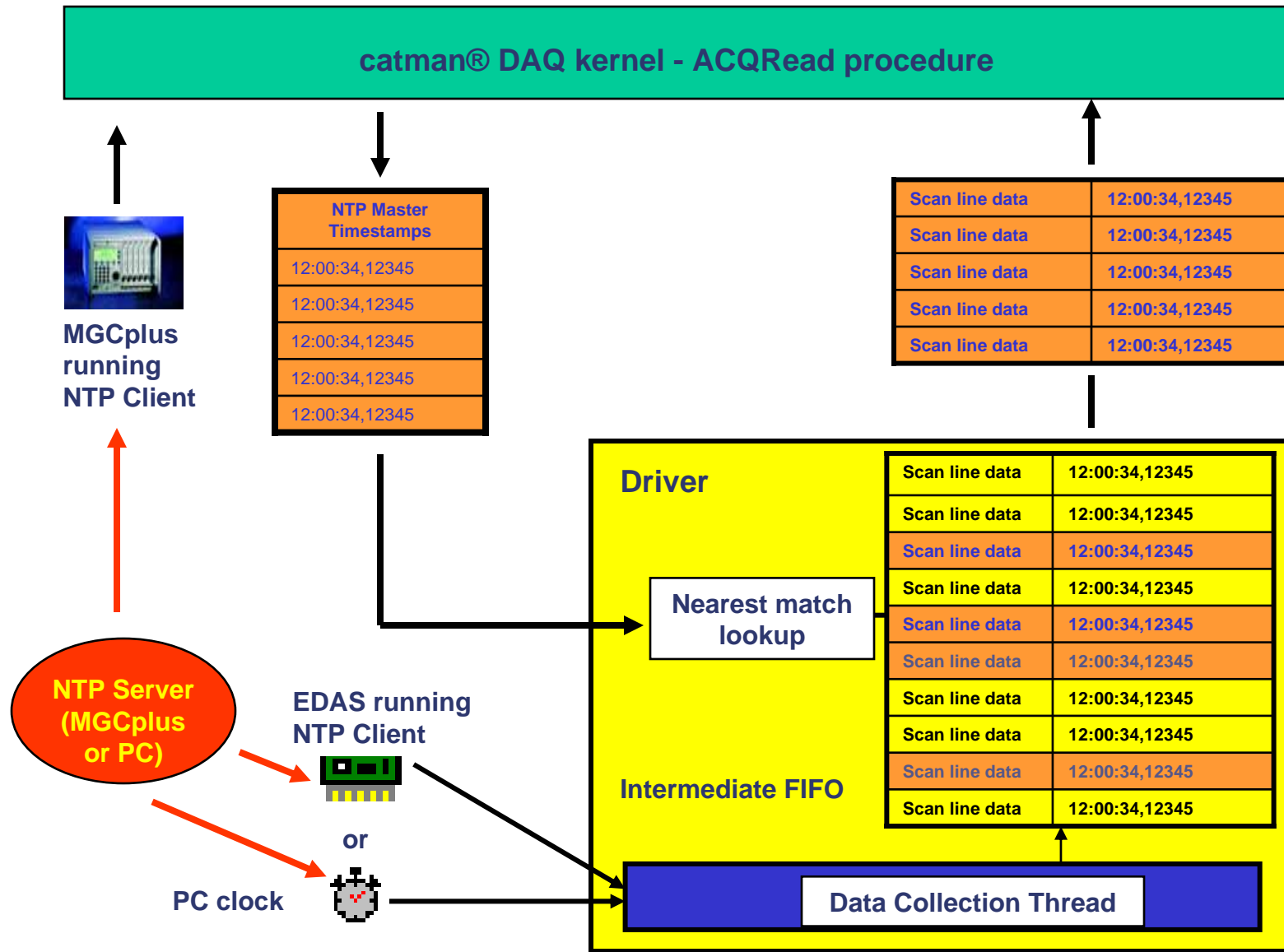


External device (FCS RTFE)

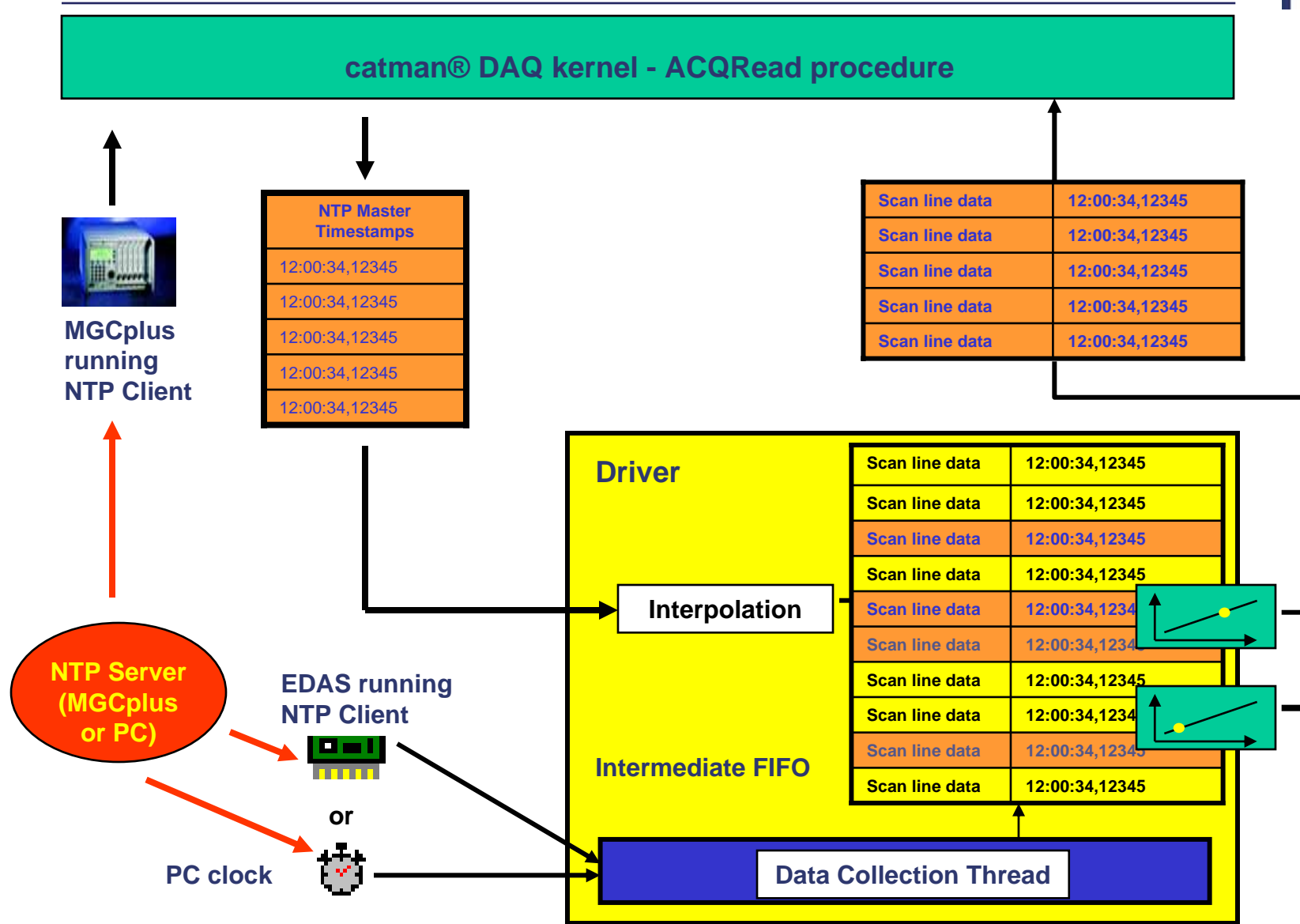
MGCplus



NTP Timestamp Lookup I



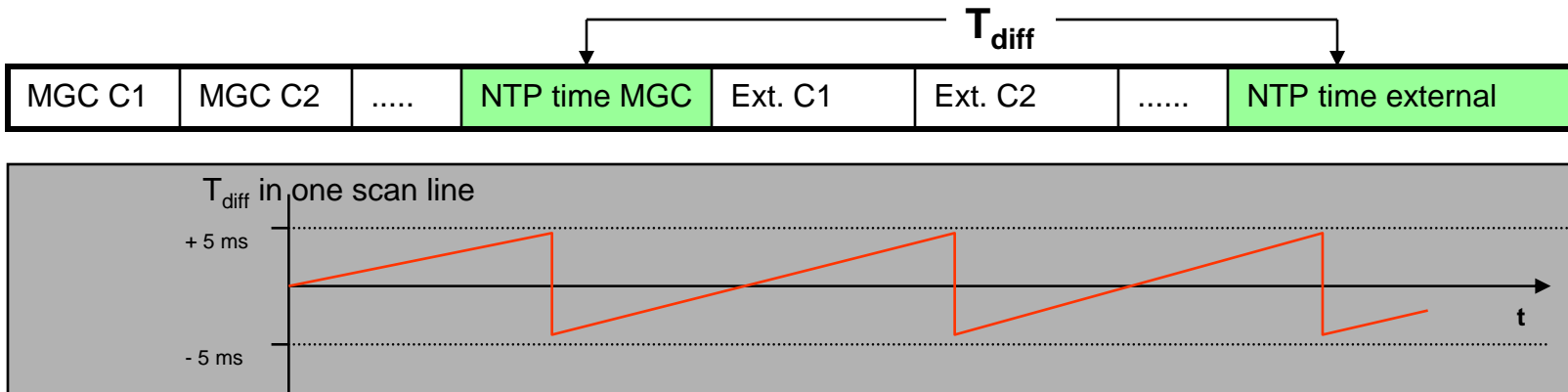
NTP Timestamp Lookup II



Quality of synchronization

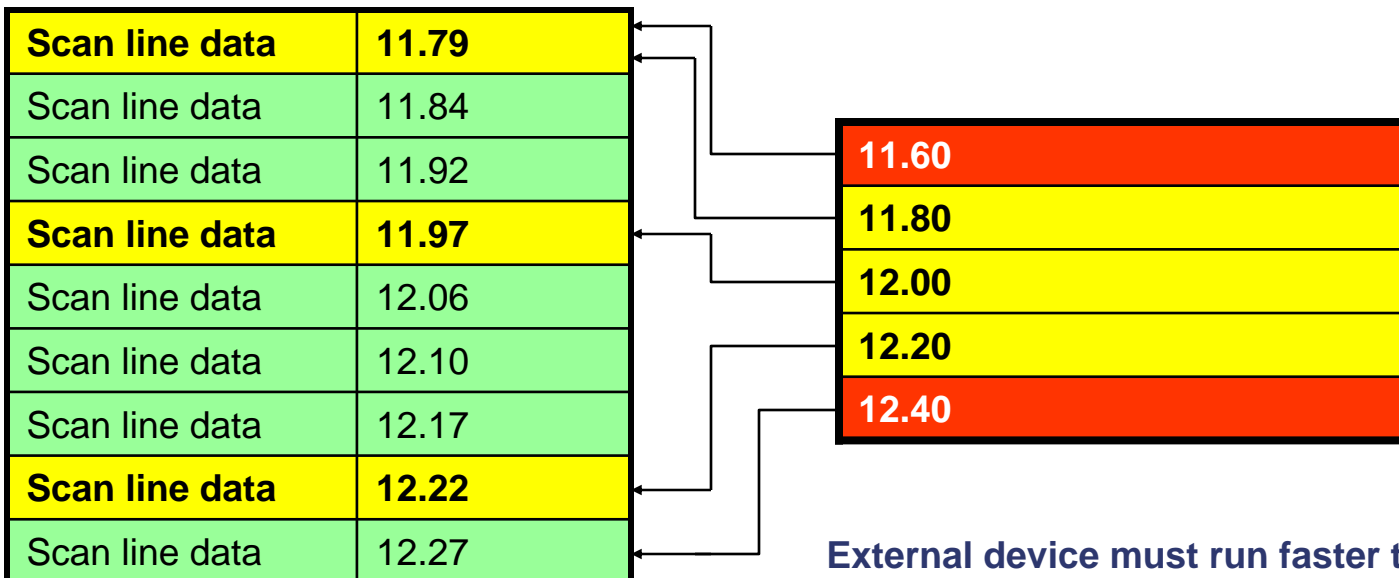


All values of a scan line are assumed to be isochronously.



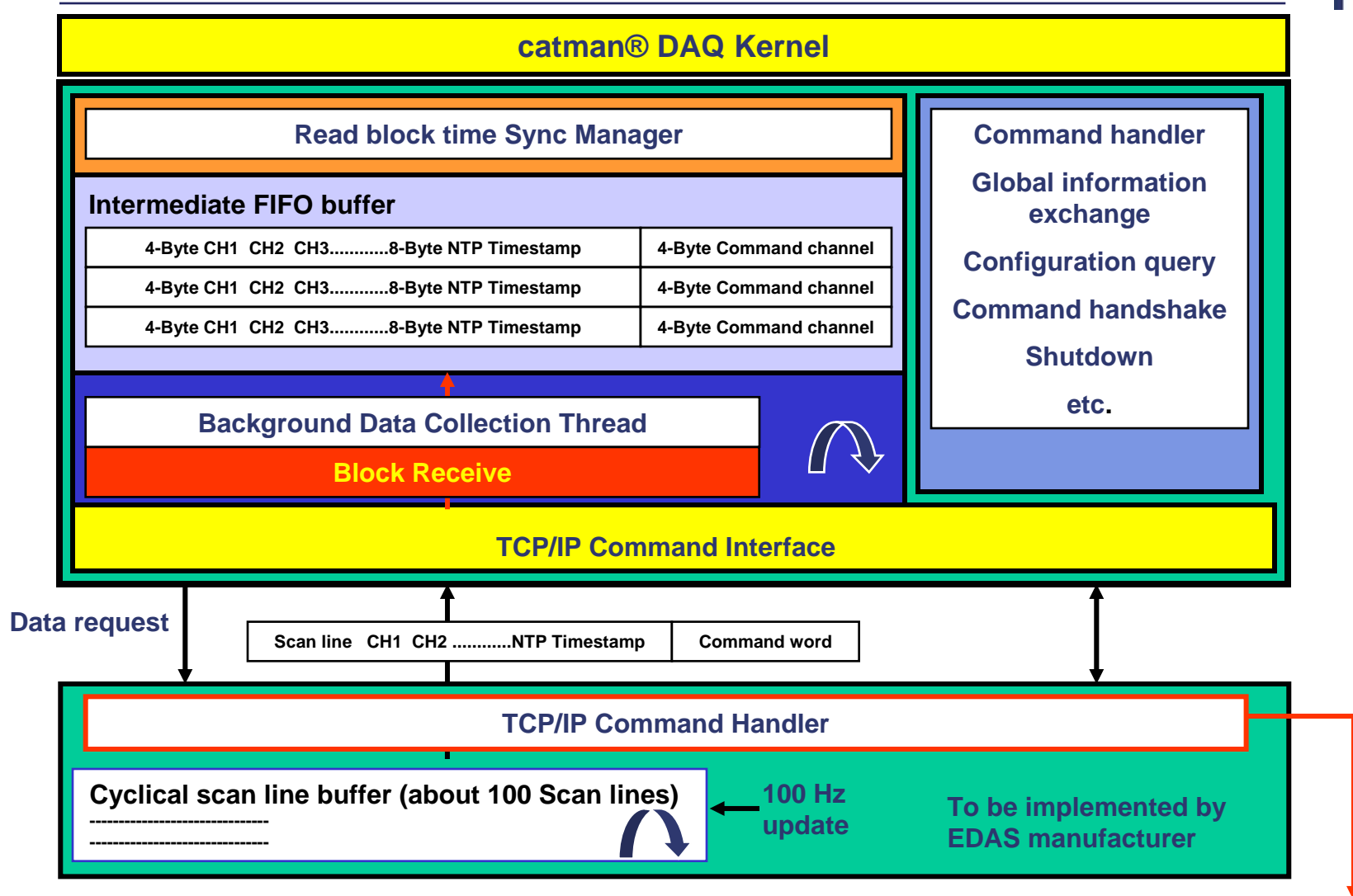
Driver FIFO (Oversampling e.g. 100 Hz)

MGCplus Master Timestamp Block (e.g. 10 Hz)

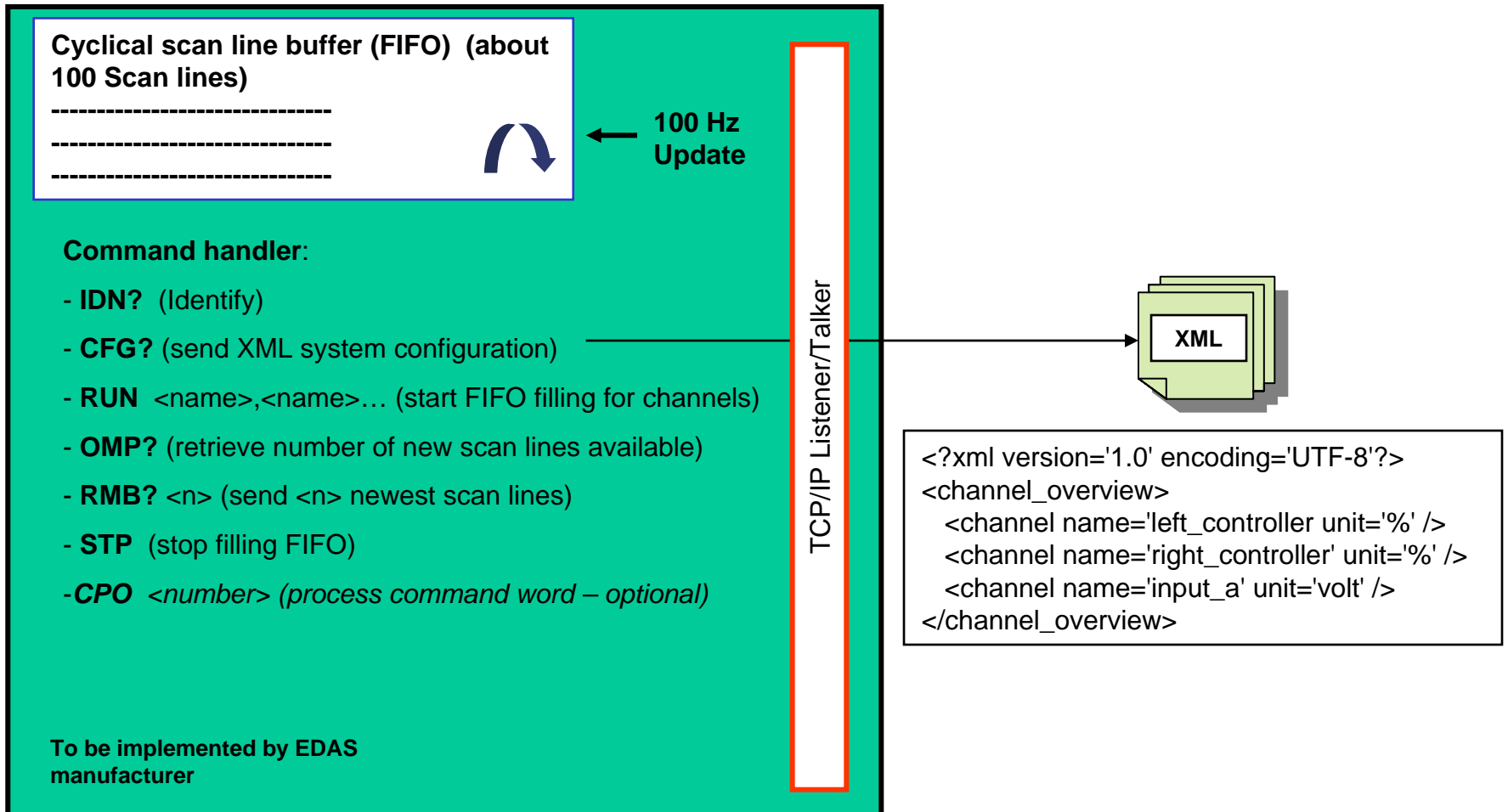


External device must run faster than MGCplus !

Standard TCP/IP driver module provided by HBM

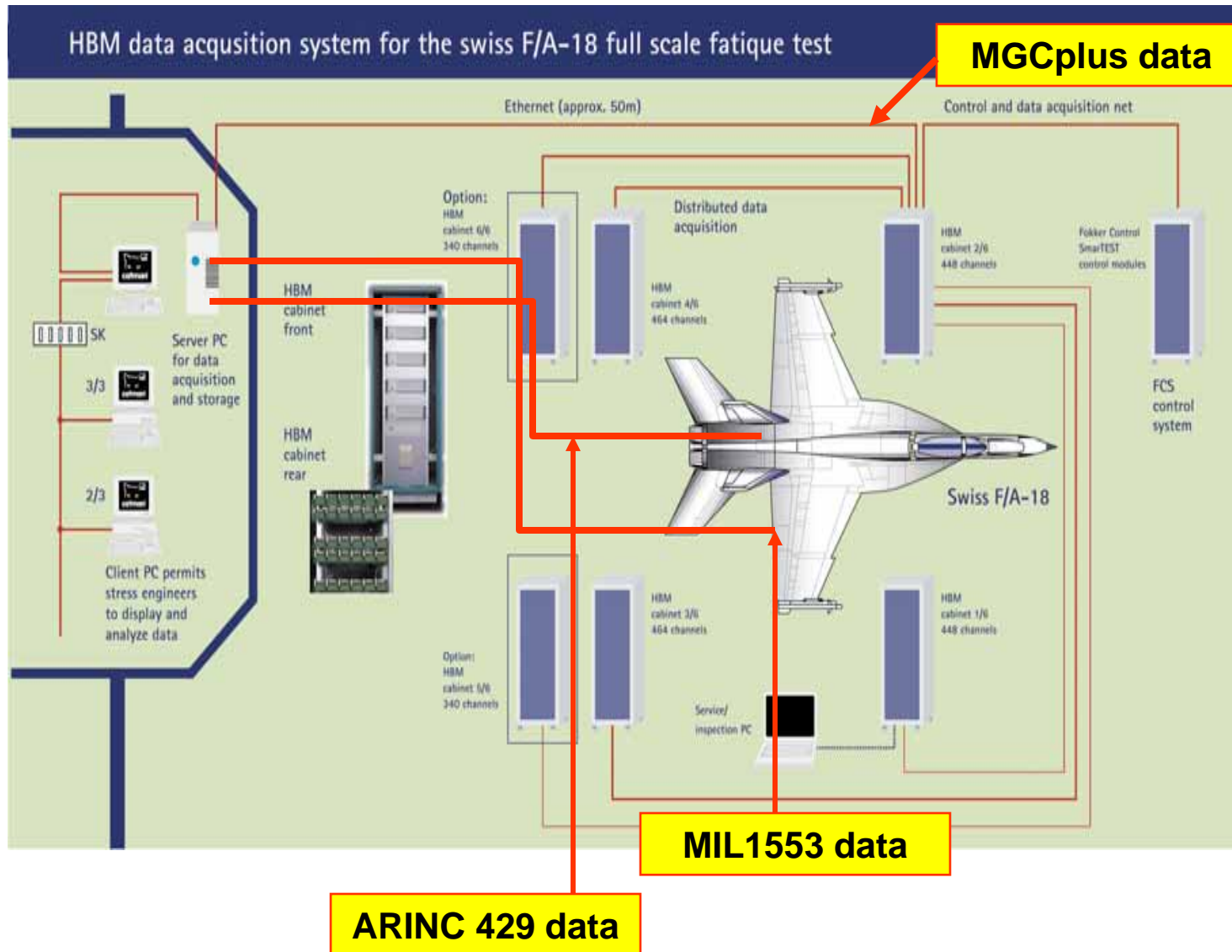


Requires a TCP/IP interface defined by HBM, which has to be implemented by the supplier of the external device.



At this time implemented by FCS, Krypton, General Dynamics

Integration of Avionics-Busses in catman®Enterprise



- **Aeronautical Radio, Incorporated (ARINC) 1929**
- **Defines how avionics equipment and systems should communicate with each other**
- **2-wire twisted pair, unidirectional data bus (12.5 or 100 kBit/s)**
- **Point-to-point protocol, one transmitter per wire pair, up to 20 receivers per wire pair**
- **Sequential transmission of 32 bit data words („ARINC labels“)**
- **Labels are standardized (e.g. „Tire pressure nose“ = ID 064) and organized in so called „Equipment types“ (e.g. ID 002 = „Flight Management Computer“)**
- **Installed in A310/320, A330/A340, Boeing 727,737,747,757 and 767**

ARINC429 Standard: Labels and Equipment IDs



ARINC Word (32 Bit)

P 32	SSM 30-31	Data 11-29	SDI 9-10	LABEL 1-8
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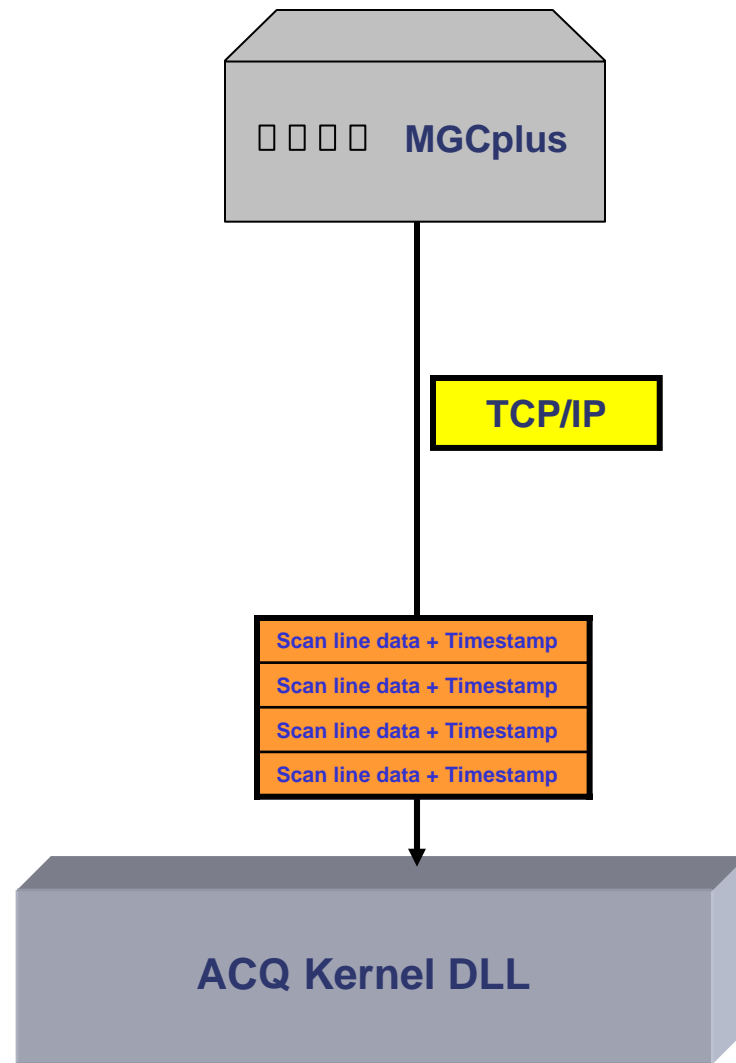
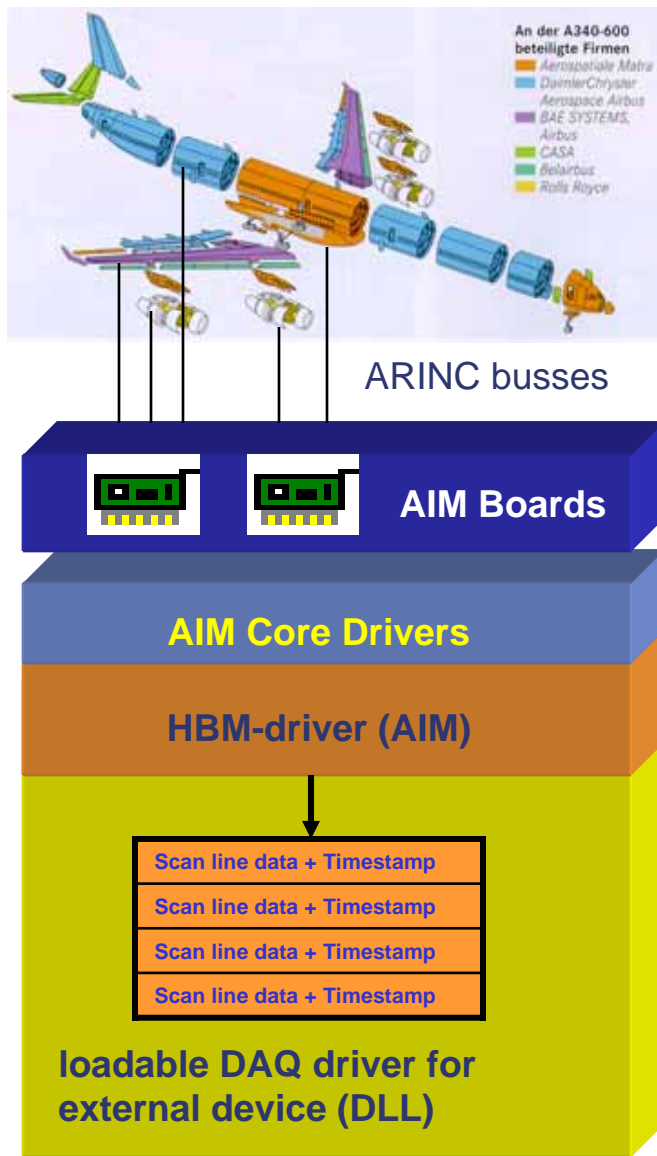
BCD, BNR (binary), Discrete (bits)

LABEL	EQUIP ID	NAME	UNITS	RANGE	Digits	+
010	002	Position: Latitude	Deg-Min	180N-180S	6	N
014	004	Magnetic Heading	Degrees	0-359.9	4	

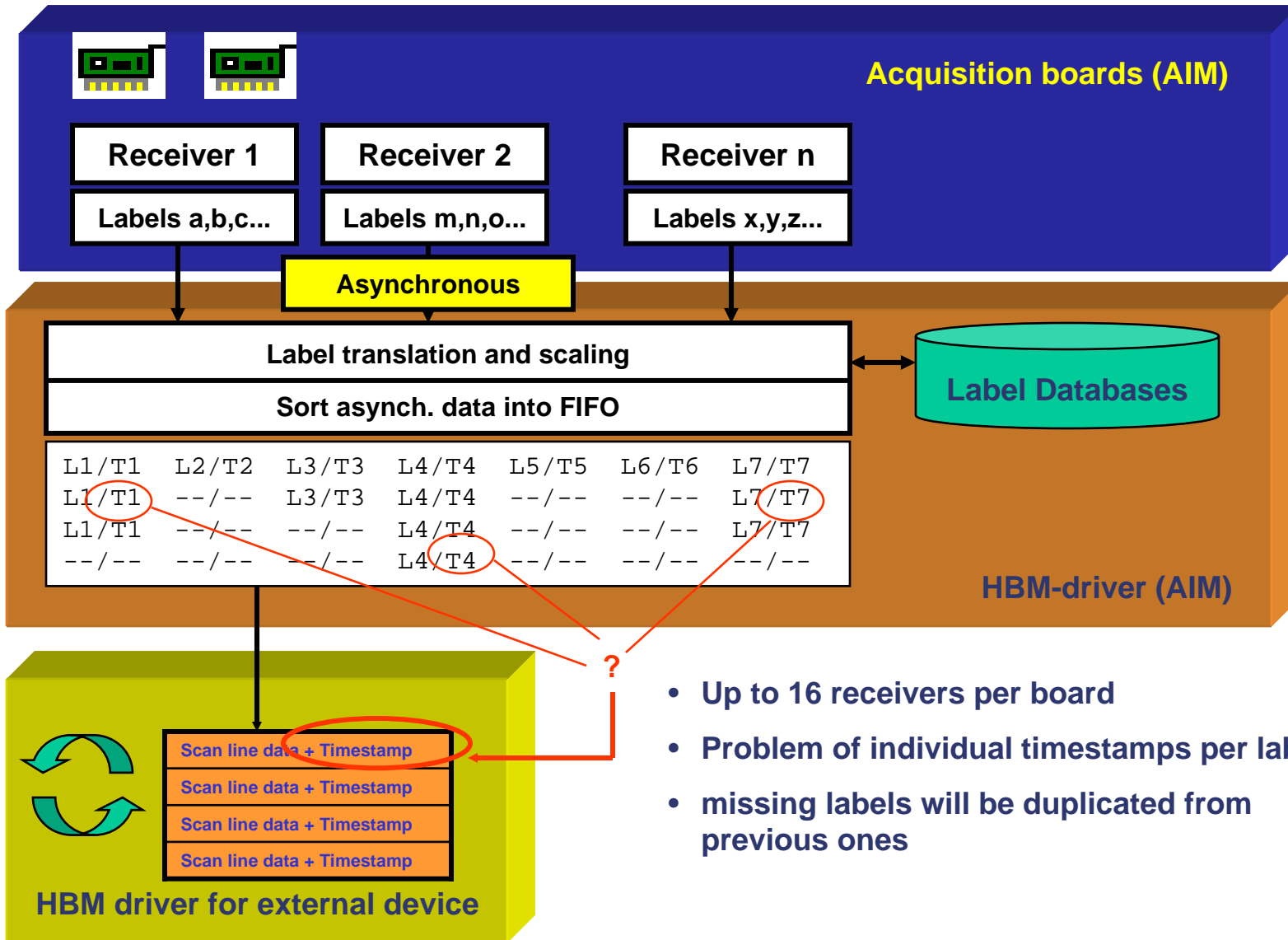
Equipment ID	Equipment type
001	Flight Control Computer
002	Flight Management System
003	Thrust Control Computer
004	Inertial Reference System
005	Altitude and Heading Reference System
.....

Contrary to e.g. CANBUS the labels are standardized in label-databases.

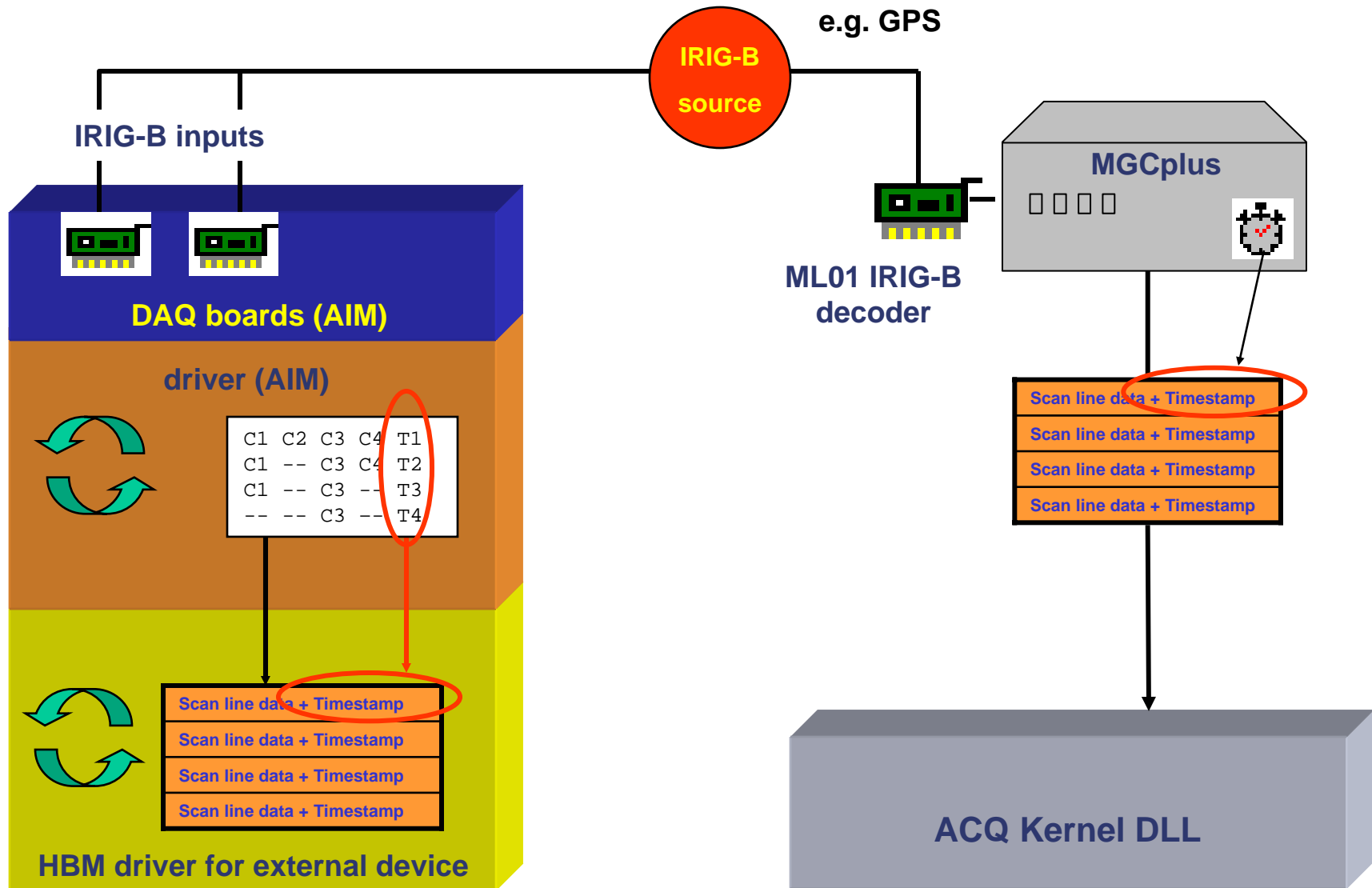
Integration of Avionics-Busses



Functions of AIM-driver



Synchronization of Avionics-Busses using IRIG-B

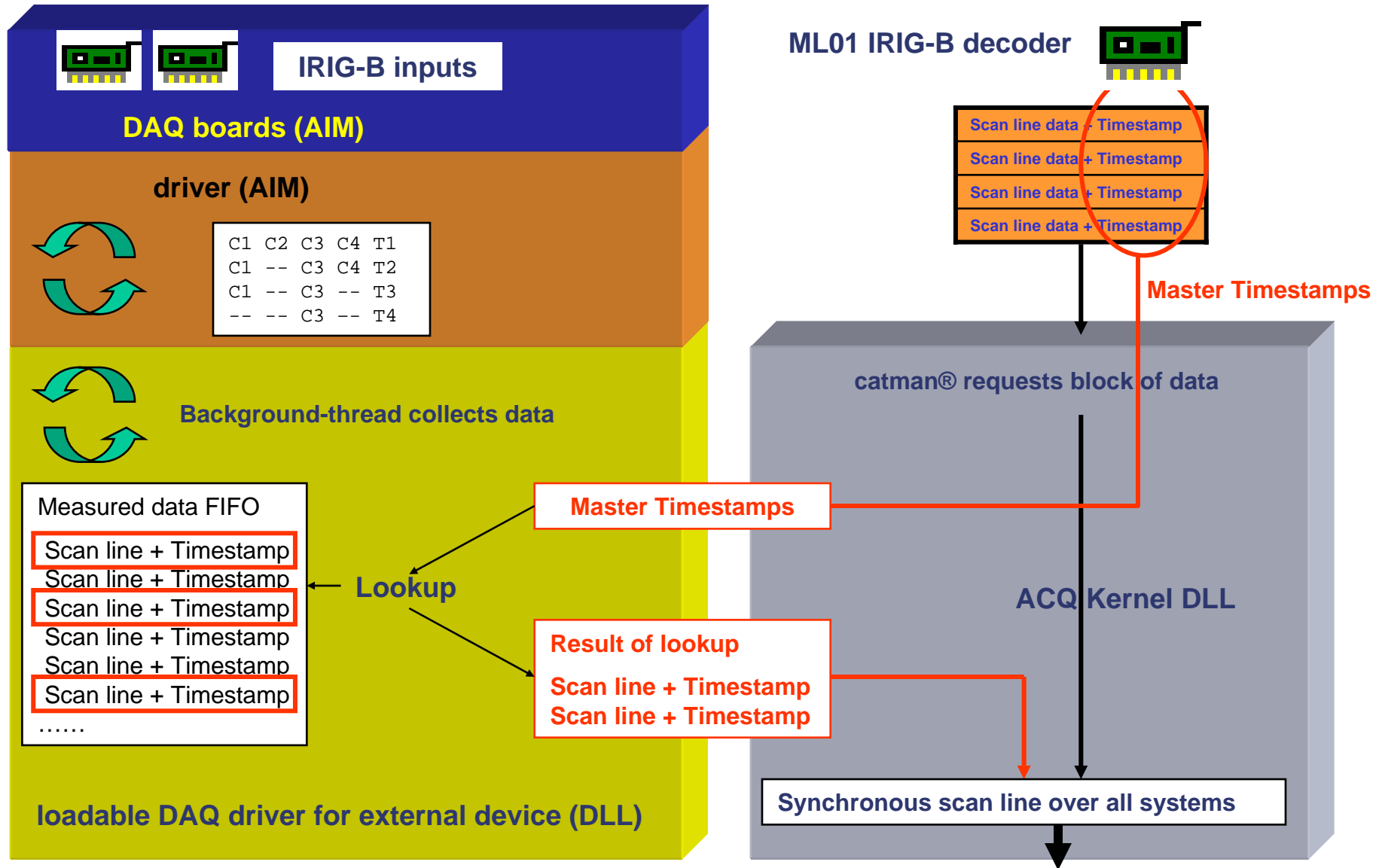


Synchronization of Avionics-Busses using IRIG-B



- **Standardized time code by Inter Range Instrumentation Group under the authority of the US Department of Defense (DoD)**
- **Standardization of time codes allows equipment to be synchronized to a known reference time.**
- **IRIG time code can be created from GPS Satellite time and distributed to other devices for synchronization.**
- **Amplitude modulated on an audio sine wave carrier.**
- **The most common version is IRIG-B, which encodes day of year, hour, minute, and second data on a 1 kHz carrier frequency, with an update rate of once per second.**
- **Special version of HBM ML01 amplifier decodes IRIG-B and inserts timestamps into MGCplus Link data stream – resolution ~ 1 ms**

Synchronization like in FCS standard driver



Thank you ...

... for your attention

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