



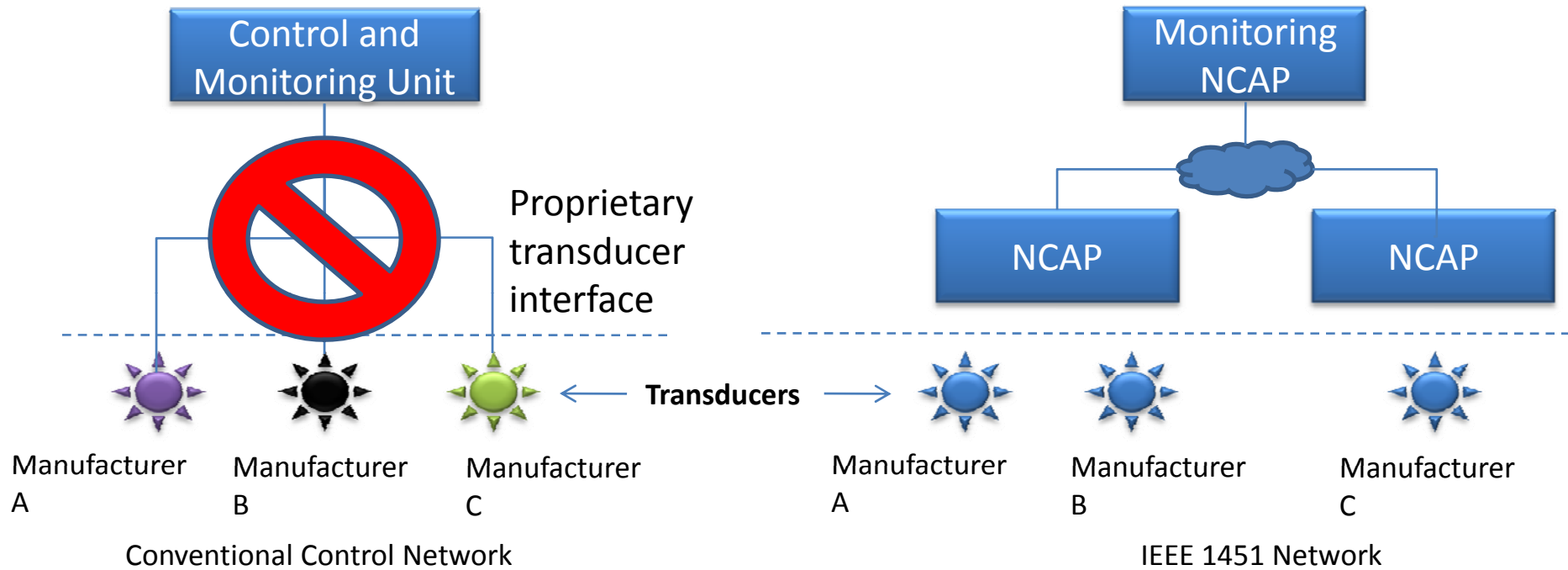
# **Design of a Test Suite for NCAP-to-NCAP Communication based on IEEE 1451**

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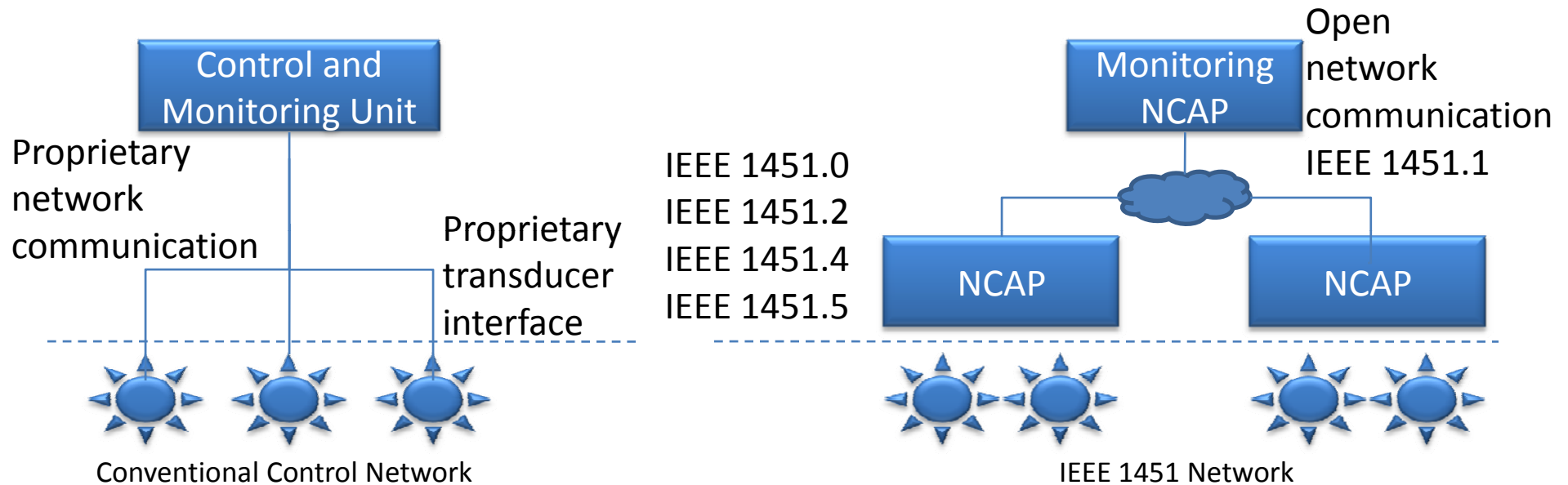
Presented by:  
Anshul Singla

# Motivation



- Lack of interoperability of transducers.
- Increased cost of equipment.
- Lack of a “*TESTBED*” to test standardization of transducers.

# Conventional Control Network Vs IEEE 1451



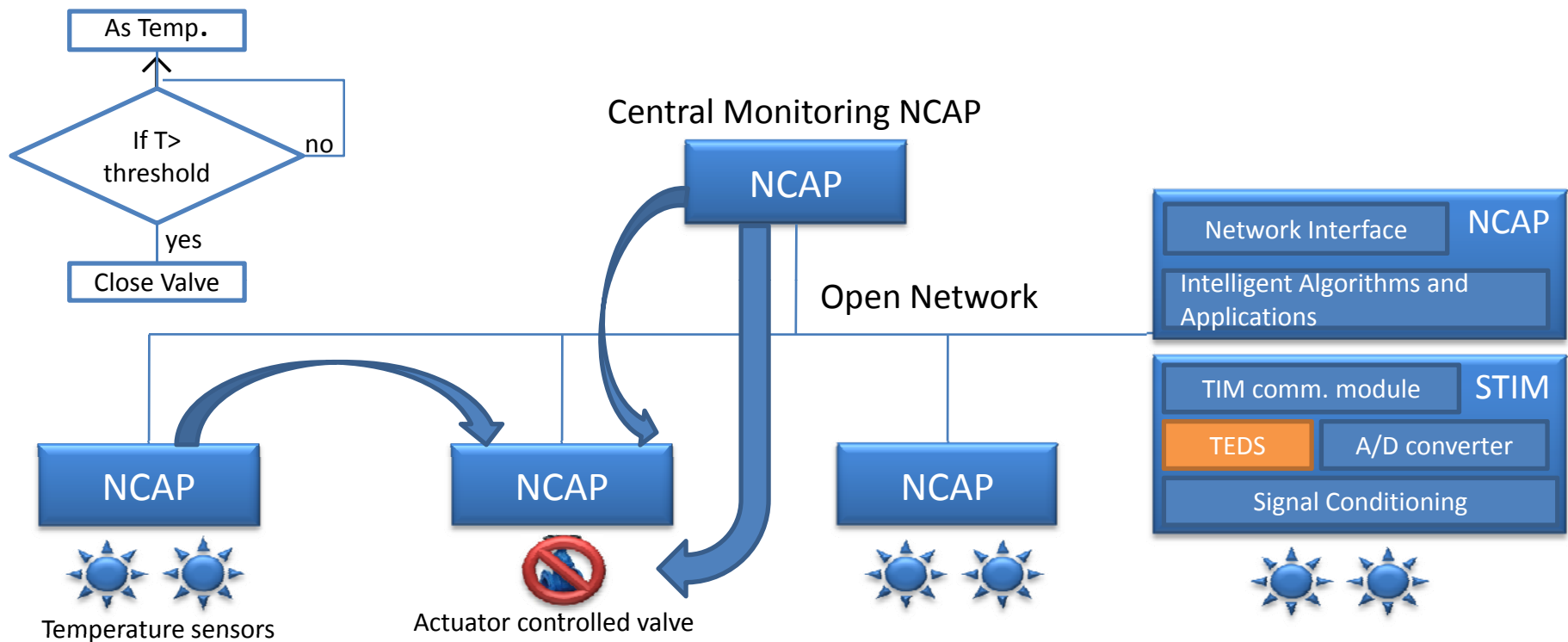
- Have proprietary transducer interfaces.
- Have proprietary network communication.
- Lack of intelligent algorithms and applications.
- Faulty nodes need to be manually tracked as they are hardwired.

- Have open network for communication.
- Have standardized transducer interfaces.
- Runs intelligent algorithms and applications on nodes.
- Nodes can be accessed and controlled anywhere in the network.

# Outline

1. Introduction
2. Functions of NCAP (followed by test procedures)
  - a. NCAP Plug and Play
  - b. Transducer Configuration
  - c. Transducer Control and Access
  - d. Data Access
3. Conclusion and Future Work

# NCAP to NCAP Communication



- The central monitoring NCAP monitors activities of all nodes.
- The nodes can communicate among each other.
- The central monitoring NCAP can also **control and access** information from transducers of other NCAPs.

# Testing

## Conformance Testing

- Header formats

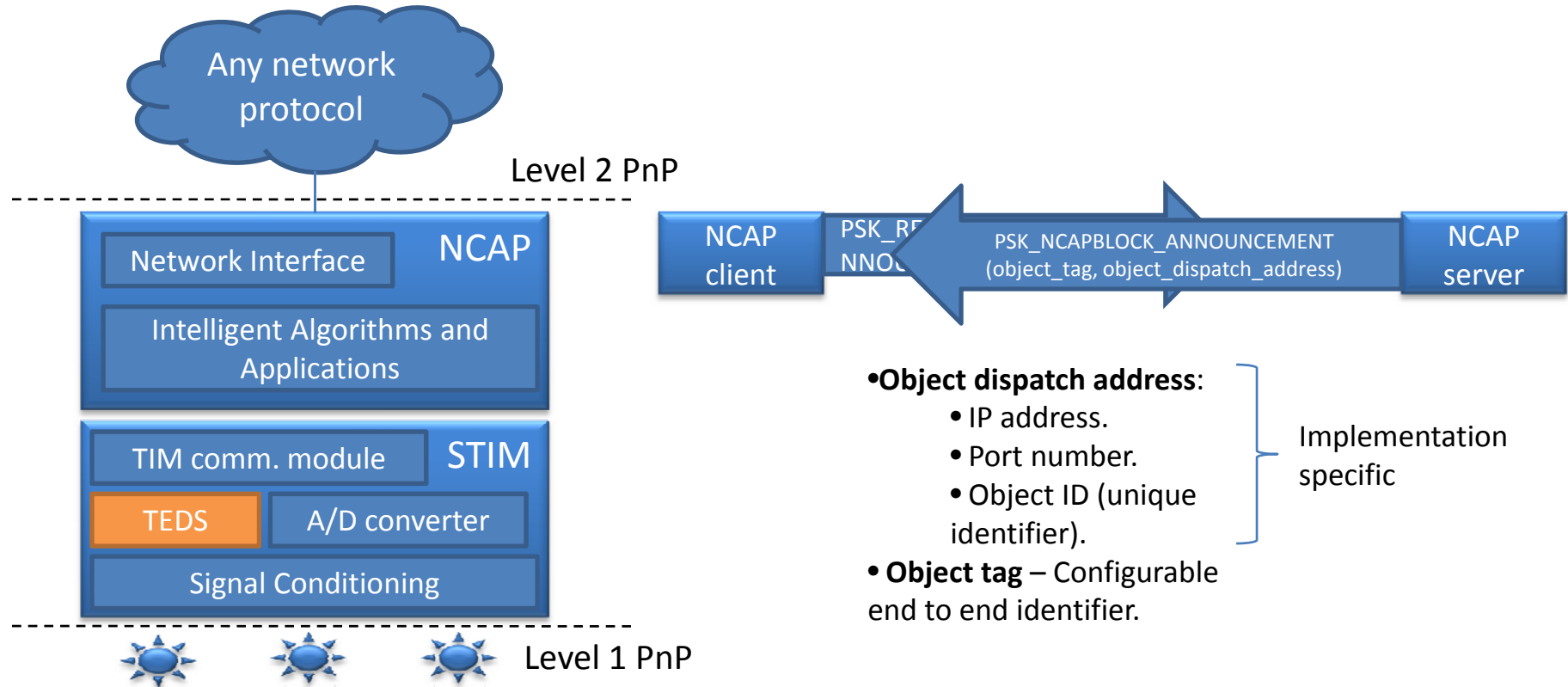
Byte	Interpretation	Details
0-1	Magic Number, Version	0xF7, 0x04
2-3	Total Message Length	0xNN NN
4-5	Header Length	0xNN NN
6	Publication Key	0x02 [NCAP_BLOCK_-ANNOUNCEMENT]
7-14	Publ. Domain	0xFF FF FF FF FF FF FF FF
15-16	Publication Topic	0x00 00 [Not Applicable]
17-21 + N	Publication Contents	0x 00 02 : # of arg.s: object tag and object dispatch address  datatype : (1 byte) object tag  object tag : (N bytes) 1 <sup>st</sup> argument of publication  datatype : (1 byte) object dispatch address  object dispatch address  : (N bytes) 2 <sup>nd</sup> argument

NCAP Block announcement packet

## Functional Testing

- It tests the behavior of a Node under test.
- The tests check the NCAP for constraints laid down by the standard regarding its expected behavior.
- The test cases take into account such scenarios where an NCAP may not behave as expected.

# 2 level Plug and Play

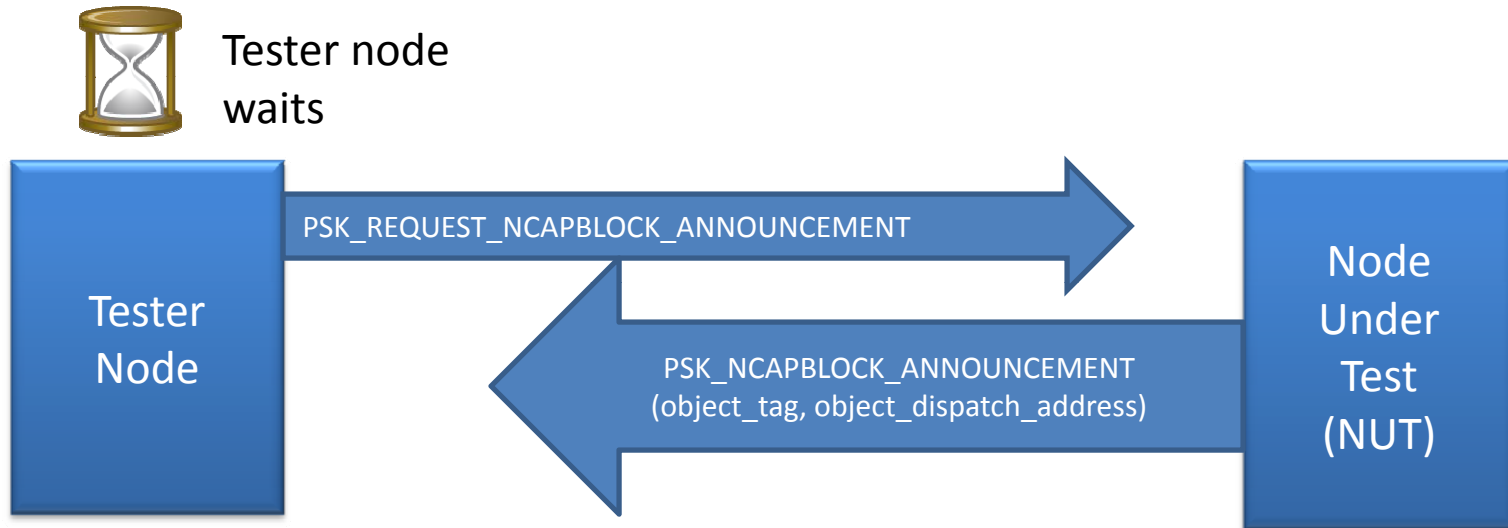


- **Object dispatch address:**
  - IP address.
  - Port number.
  - Object ID (unique identifier).

Implementation specific
- **Object tag** – Configurable end to end identifier.

- TEDS are Transducer Electronic Data Sheets which provides calibration and other important information about the transducer.
- It helps in identification of the transducer which makes it plug and play.

# Test Case for NCAP Plug and Play



No dynamic announcement.  
Announcement not configured.  
Announcement received and validated.

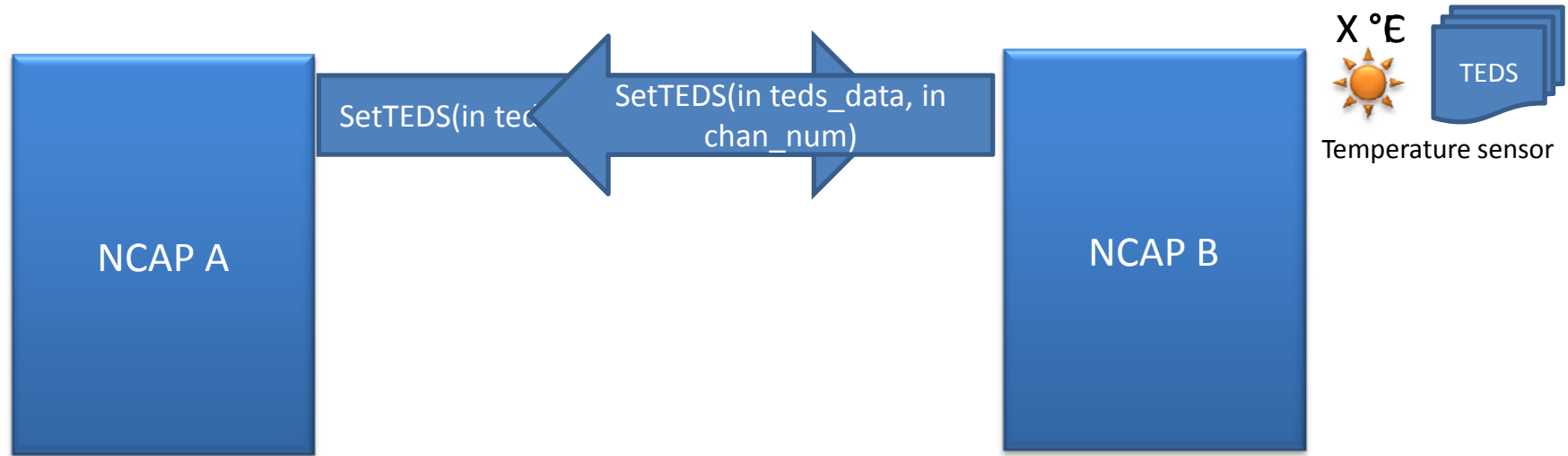
PSK – Publish Subscribe Key. The recipient nodes should subscribe to the publication in order to receive these messages.

Other NCAP attributes:

- Manufacturer ID
- Model number
- Block Version
- NetworkVisibleServerObjectProperties



# Transducer Configuration

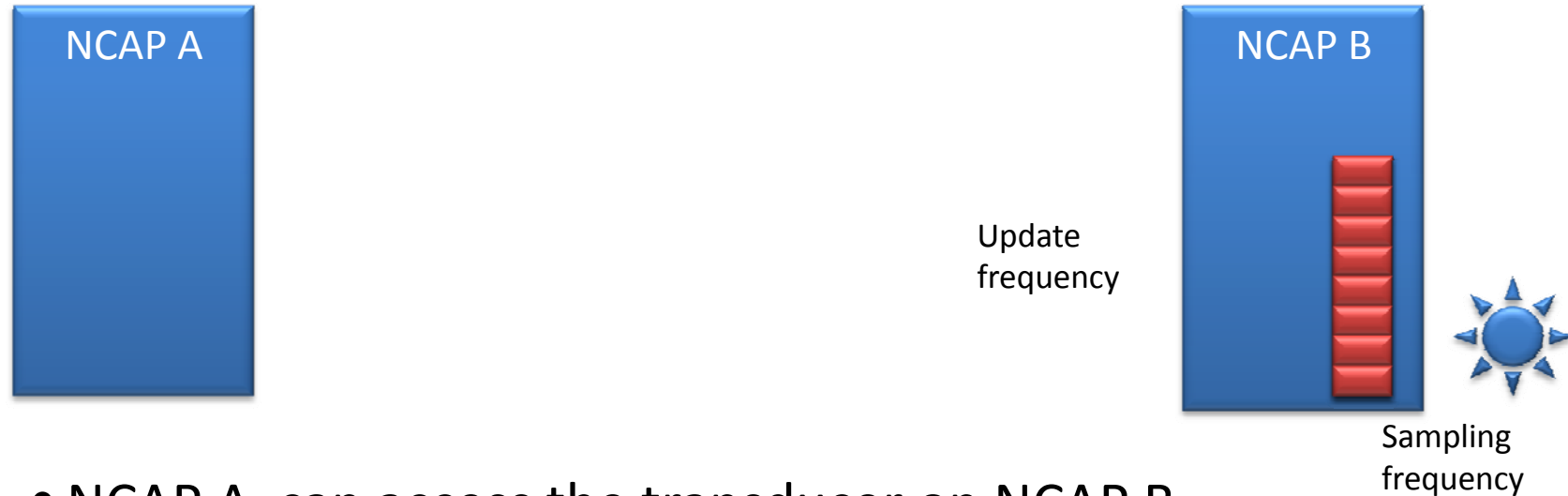


- SetTEDS operation modifies TEDS data for a sensor on another NCAP.
- For example, Celsius converted to Fahrenheit.

## *Test Procedure*

- The return packets are checked for arguments.
- TEDS and data is accessed to confirm the change.

# Transducer Control and Access

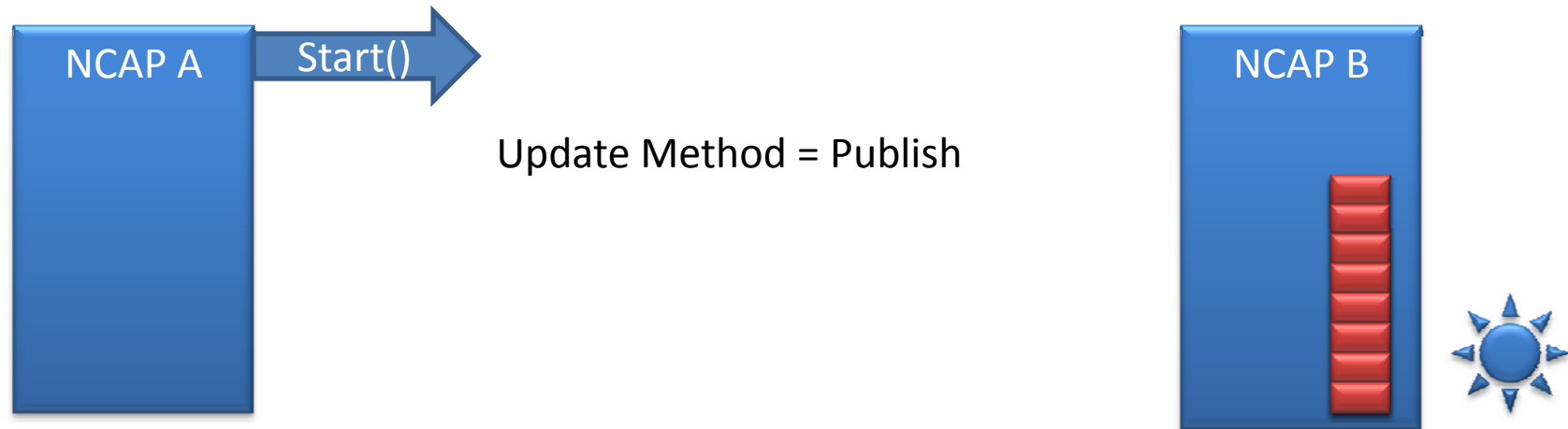


- NCAP A can access the transducer on NCAP B.
- The transducer samples at a particular *sampling frequency*.
- Packets are sent to NCAP A at a set *update frequency*.

## *Test Procedure*

- Update frequency is always less than sampling frequency.
- Sampling frequency and update frequency can be configured and acquired to be tested.

# Data Access - 1



- Start function triggers the multicast publication of data stream.

## *Test Procedure*

- Update method is tested.
- Reception of data is tested.
- Sample contents are validated.

# Data Access - 2

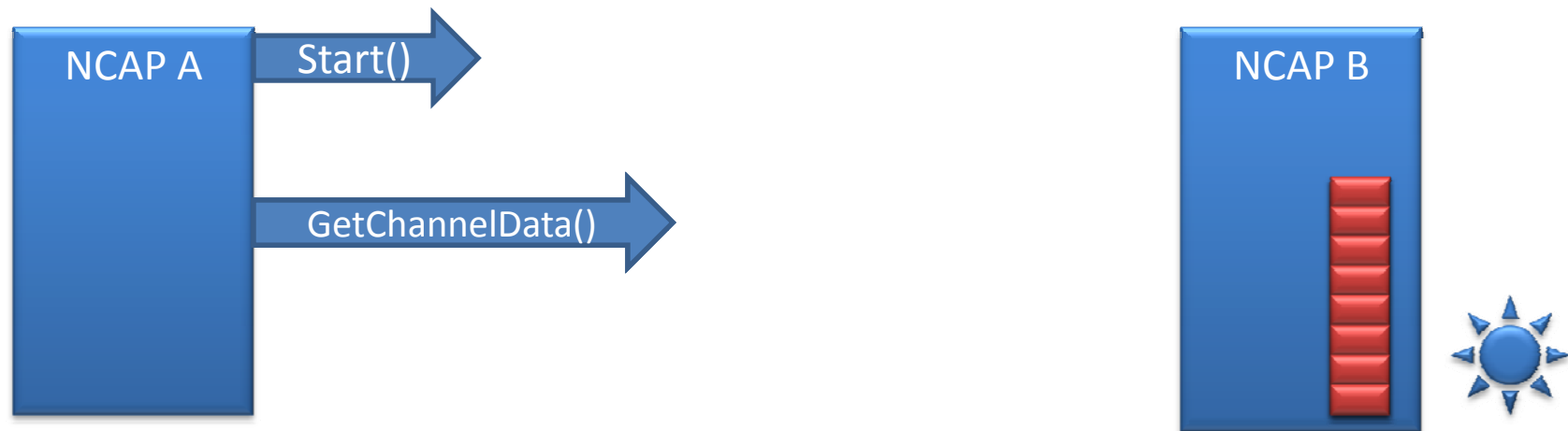


- Start function triggers the sending of data stream.
- Return messages are also sent (as acknowledgement).

## *Test Procedures*

- Update method is tested.
- Reception of data is tested.
- Sample contents are validated.

# Data Access - 3



- A request/response data retrieval process.
- Data is sent after reception and processing of *request*.

## *Test Procedures*

- Update method is tested.
- Reception of data is tested.
- Sample contents are validated.

# Conclusion and Future Work

- The test procedures will help ease the acceptance of IEEE 1451.
- Acceptance of the standard would promote the growth in sensor networks.
- Standardization would reduce the cost of transducers.
- More test cases need to be developed to incorporate more operations from the standard.
- Network performance evaluation.

Thank you!