CiA® 812

Application note

Use cases for CiA® 457 devices

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HISTORY

Date	Changes
2011-08-09	*Publication of Version 1.0.0* as application note NOTE: This document has been converted into “docx format”. The conversion caused minor layout differences to the predecessor document in “doc format”. The technical content word-by-word is the very same.

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1 Scope

This application note describes use cases CANopen devices support communication capabilities as specified in CiA 315 “CANopen Generic frame for wireless tunnelling of CAN messages and for transfer of diagnostic data”.

2 References

/CiA301/ CiA 301, CANopen application layer and communication profile

/CiA302-7/ CiA 302, CANopen additional application layer functions – Part 7: Multi-level networking

/CiA309/ CiA 309, Interfacing CANopen with TCP/IP

/CiA315/ CiA 315, CANopen Generic frame for wireless tunneling of CAN messages and for transfer of diagnostic data

/CiA457/ CiA 457, CANopen device profile for wireless transmission media based CANopen devices

3 Abbreviations and definitions

3.1 Abbreviations

The abbreviations given in /CiA301/, /CiA302-7/, /CiA309/, /CiA315/ and /CiA457/ apply to this application note.

3.2 Definitions

In addition to the definitions in this sub-clause, the definitions given in /CiA301/, /CiA302-7/, /CiA309/, /CiA315/ and /CiA457/ apply to this application note.

3.2.1 application master

programmable functional element that controls the entire application

4 Use cases and functional principles

4.1 General

This clause describes use cases and their impacts on the design of gateway or router/bridge devices in relation to their CANopen interfaces. Although CANopen normally uses the CAN (controller area network) data link layer and physical layers, it is possible to implement CANopen also on other data link layers and wireless physical layers. There exist only a few dependencies between CAN and CANopen. For wireless communication techniques there exist some standardized physical layers as well as data link layers (e.g. Bluetooth, Zigbee, etc.). In order to combine the advantages of CANopen (e.g. well-defined device profiles, communication objects, etc,) and the advantages of a wireless communication link, this application note contains the description for integration of wireless nodes into CANopen networks.

The considered use cases require an application master, which controls the entire network architecture. The consideration of non-hierarchical network architectures without a dedicated application master is not in the scope of this application note.

Based on the use cases, the related requirements on the CANopen interfaces are described. The gateway or router/bridge devices – connecting CAN-based CANopen networks to wireless networks – implement only those functions that are required for the desired use cases. In the use cases, there are on the one hand described gateway or router/bridge devices with just one CAN-based CANopen port and just one wireless network port. On the other hand there is a router device described, supporting just one CAN-based CANopen port and two wireless network ports. Those devices may support more ports of each kind. The port limits are given by the used services and protocols (see /CiA302-7/).

4.2 Use case 1: Sub-layered wireless network without CANopen application layer

The CAN-based CANopen (backbone) network is the hierarchical higher network; the sub-layered wireless network does not use a CANopen application layer. This use case is applicable for collecting additional inputs and setting additional outputs via a wireless network from the application master's viewpoint. An example of use case 1 is shown in

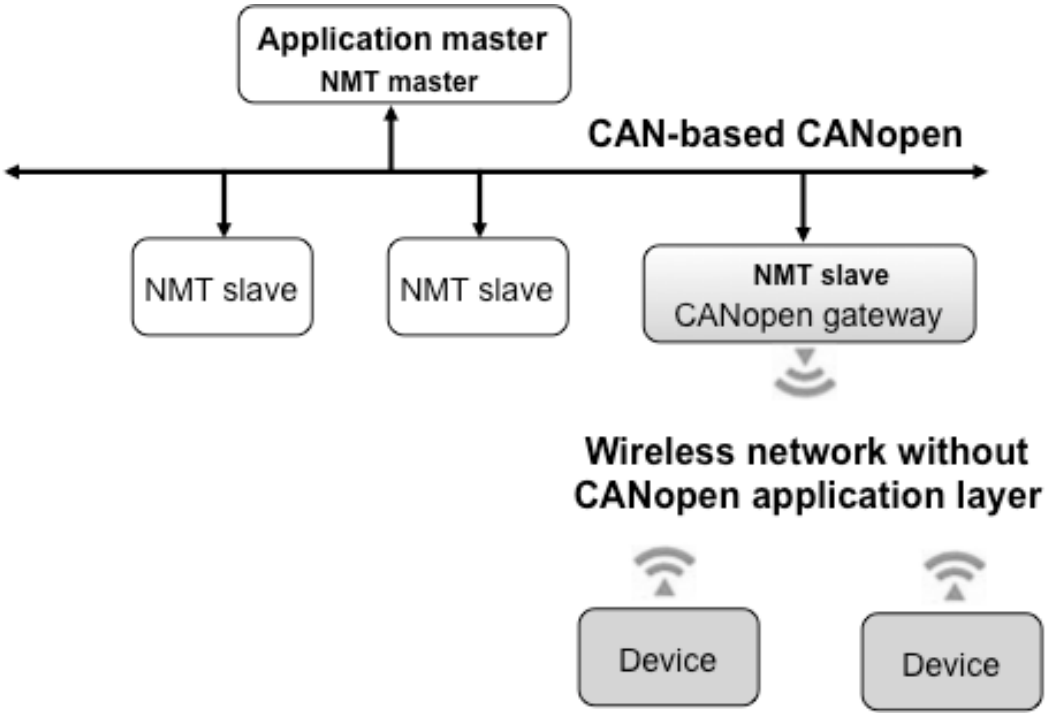

Figure 1.

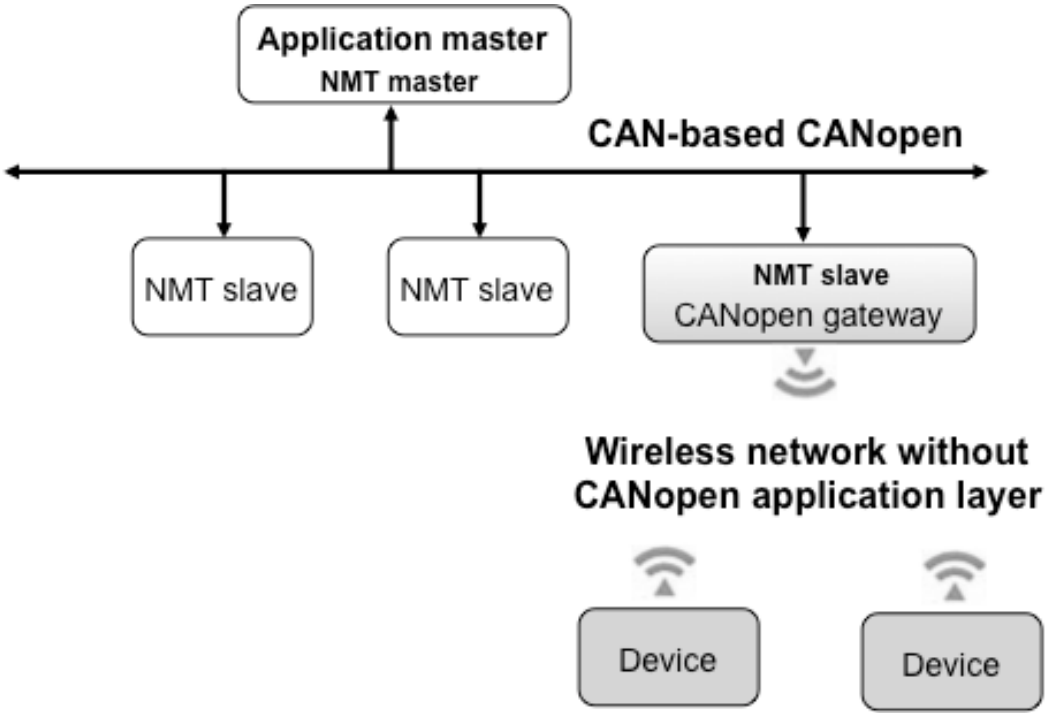

Figure 1 – Block diagram of a use case 1 example

CANopen gateways designed for use case 1 enable access to the process data of the wireless network devices. In minimum just one device is linked wireless to the CANopen gateway (e.g. wireless remote I/O module used as user interface). On the CANopen side the

gateway may implement CiA 401 representing the wireless process data as generic analogue and/or digital I/O lines. This implies that it is not possible to configure the wireless network from the application master.

If a detailed WTM-specific configuration and diagnostics of the wireless network by means of the application master is required, the gateway needs to implement a dedicated interface/device profile for the wireless network.

If the CiA 401 profile is implemented, each logical device (see /CiA301/) may represent a single device in the wireless network. Other mappings of process data are also possible, but than the device transparency is not given. The wireless network architecture is hidden to the application master located in the CAN-based CANopen network.

4.3 Use case 2: Sub-layered wireless network with CANopen application layer

The CAN-based CANopen (backbone) network is the hierarchical higher network; the sub-layered wireless network uses a CANopen application layer, which allows data transparency on the CANopen (device or application) profile level. This use case is applicable for controlling and monitoring wireless connected devices by means of Remote SDO and Remote Emergency services as specified in /CiA302-7). An example of use case 2 is shown in Figure 2.

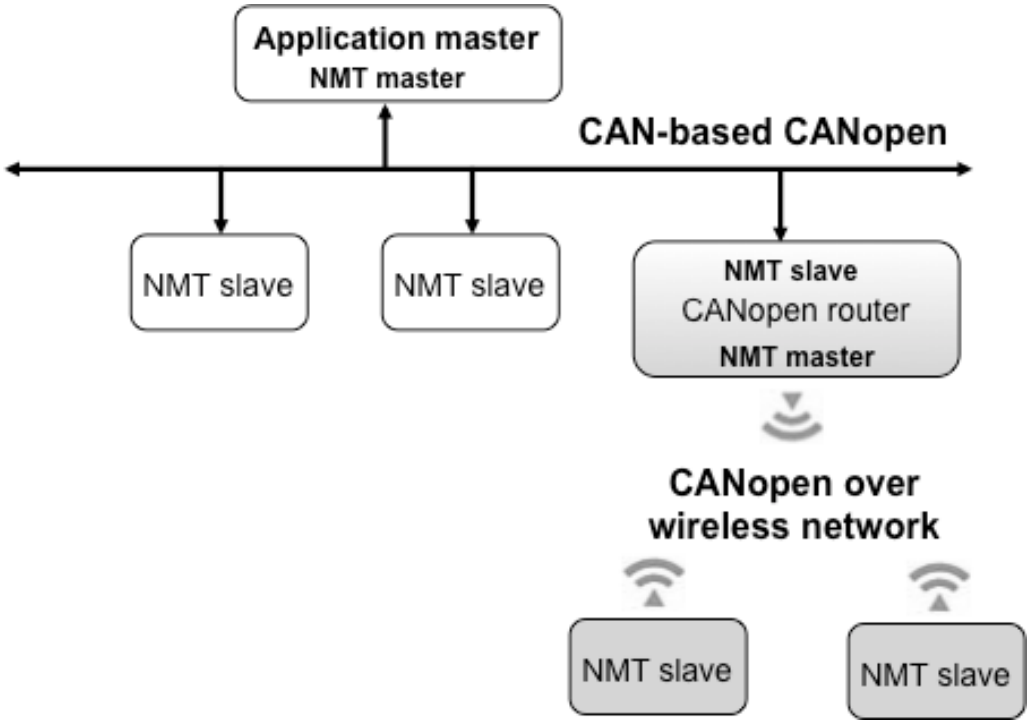

Figure 2 – Block diagram of a use case 2 example

CANopen router/bridges designed for use case 2 enable access to the CANopen object dictionaries of the wireless network devices. The Remote SDO and Remote Emergency services need to be supported by the application master. The PDO bridge use the system variables as specified in /CiA302-7/.

The mapping of the CANopen communication services and implementation of CANopen communication protocols on the specific wireless network technology is not in the scope of this part of the specification.

4.4 Use case 3: Super-layered wireless network without CANopen application layer

The wireless network is the hierarchical higher network; it do not use a CANopen application layer. An example of use case 2 is shown in

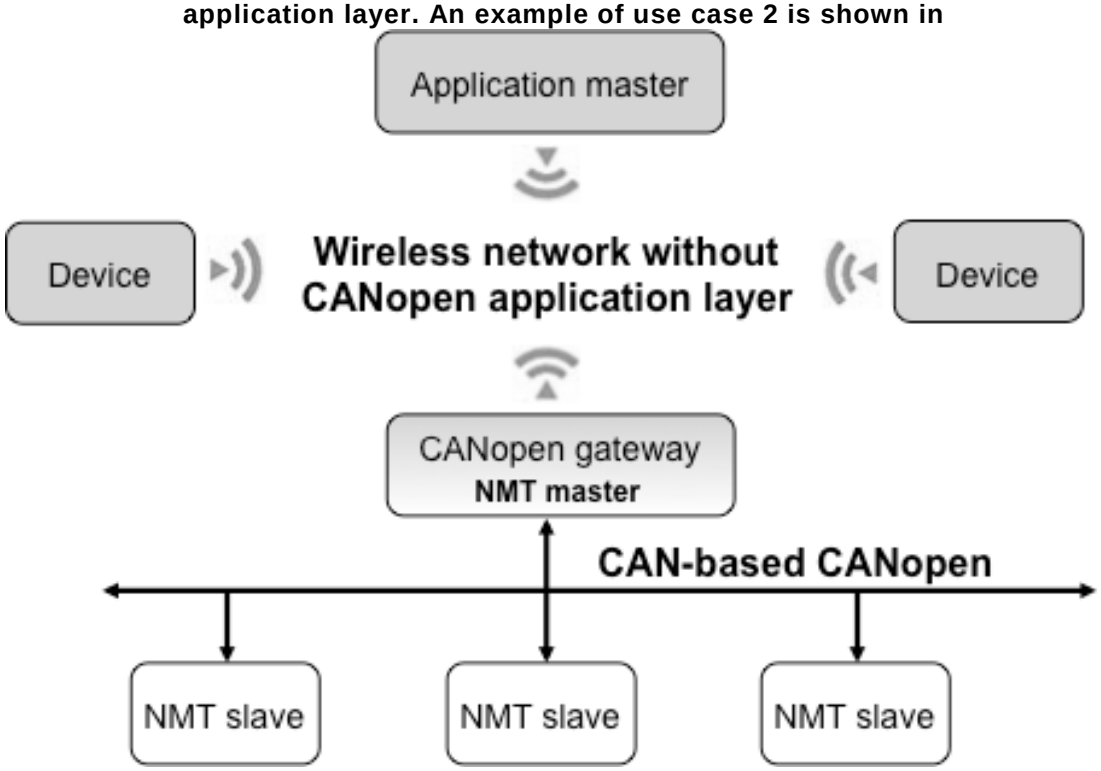

Figure 3.

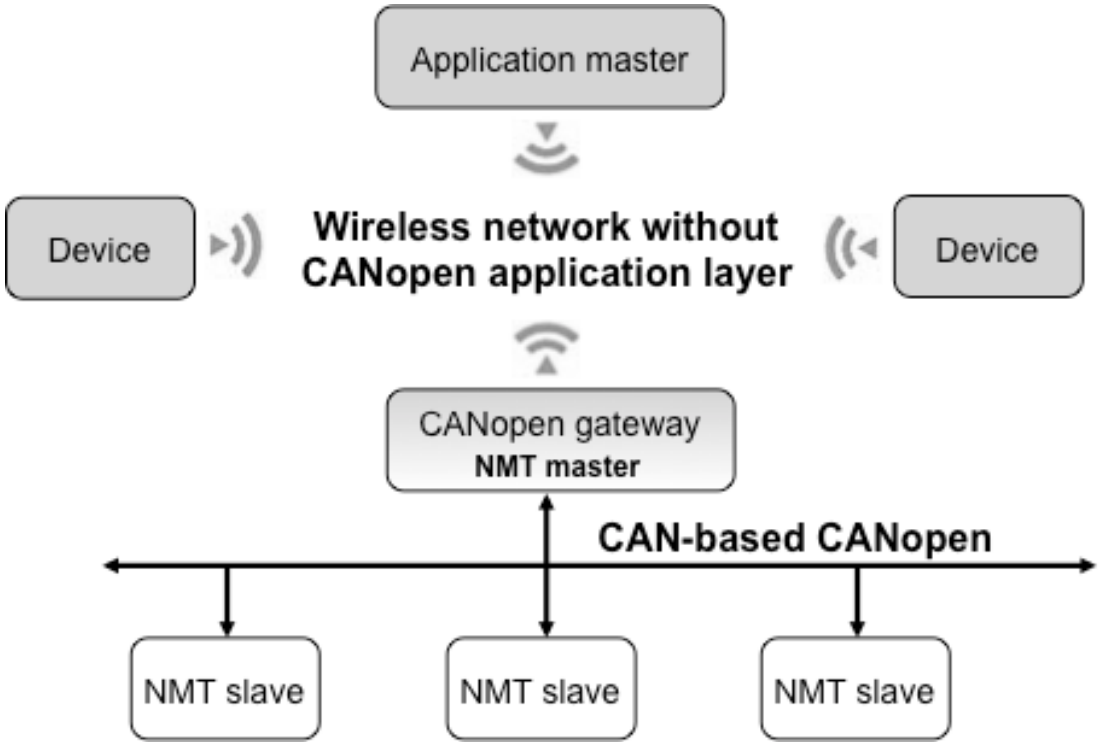

Figure 3 – Block diagram of a use case 3 example

If the application master is not the CANopen gateway device, it may implement the CANopen communication services and protocols as specified in /CiA309-1/ respectively in /CiA309-2/. The CANopen gateway needs to implement the corresponding services and protocols. It is not necessary that the gateway provides CANopen NMT master functionality.

4.5 Use case 4: Higher-layered wireless network without CANopen application layer

The wireless network is the hierarchical higher network; it uses a CANopen application layer. An example of use case 4 is shown in Figure 4.

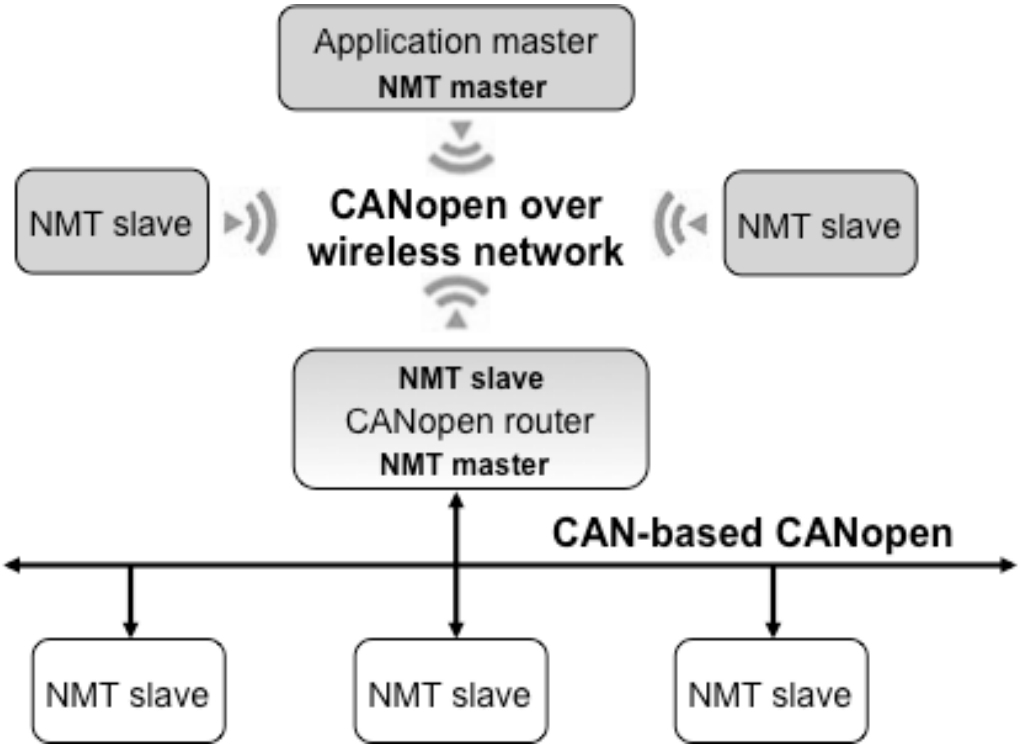

Figure 4 – Block diagram of a use case 4 example

If the application master is not the CANopen router/bridge device, it implements the Remote SDO and Remote EMCY services and protocols in order to access the CANopen devices in the sub-layered CAN-based network. The CANopen router/bridge needs to implement the corresponding services and protocols as specified in /CiA302-7/. It is not necessary that the router/bridge provides CANopen NMT master functionality.

4.6 Use case 5: Wireless network without CANopen application layer

The wireless network is the central network in the multiple network architecture; it does not use the CANopen application layer. It interconnects two or more CAN-based CANopen networks. An example of use case 5 is shown in Figure 5.

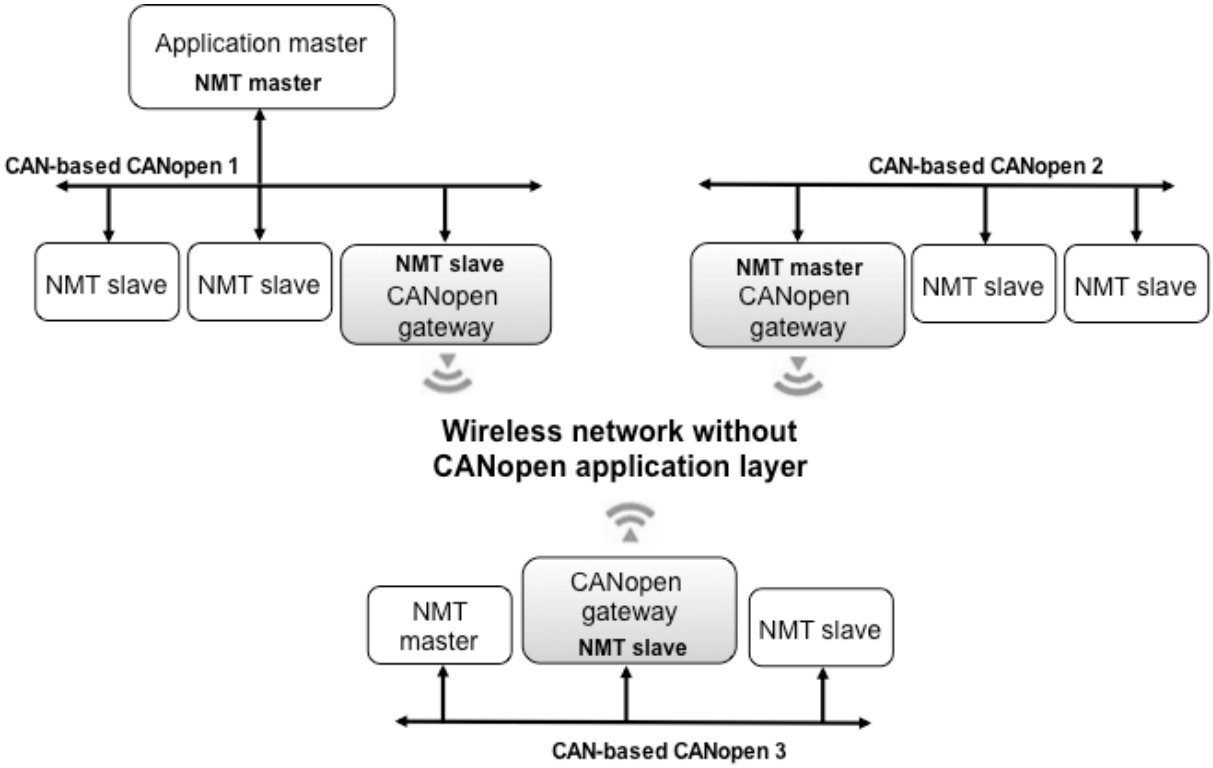

Figure 5 – Block diagram of a use case 5 example

The CANopen gateway connected to the CANopen network 1 and the application master implement the services and protocols as specified in /CiA309-1/ and /CiA309-3/.

4.7 Use case 6: Wireless network with CANopen application layer

The wireless network is the central network in the multiple network architecture; it uses the CANopen application layer. It interconnects two or more CAN-based CANopen networks. An example of use case 6 is shown in Figure 6.

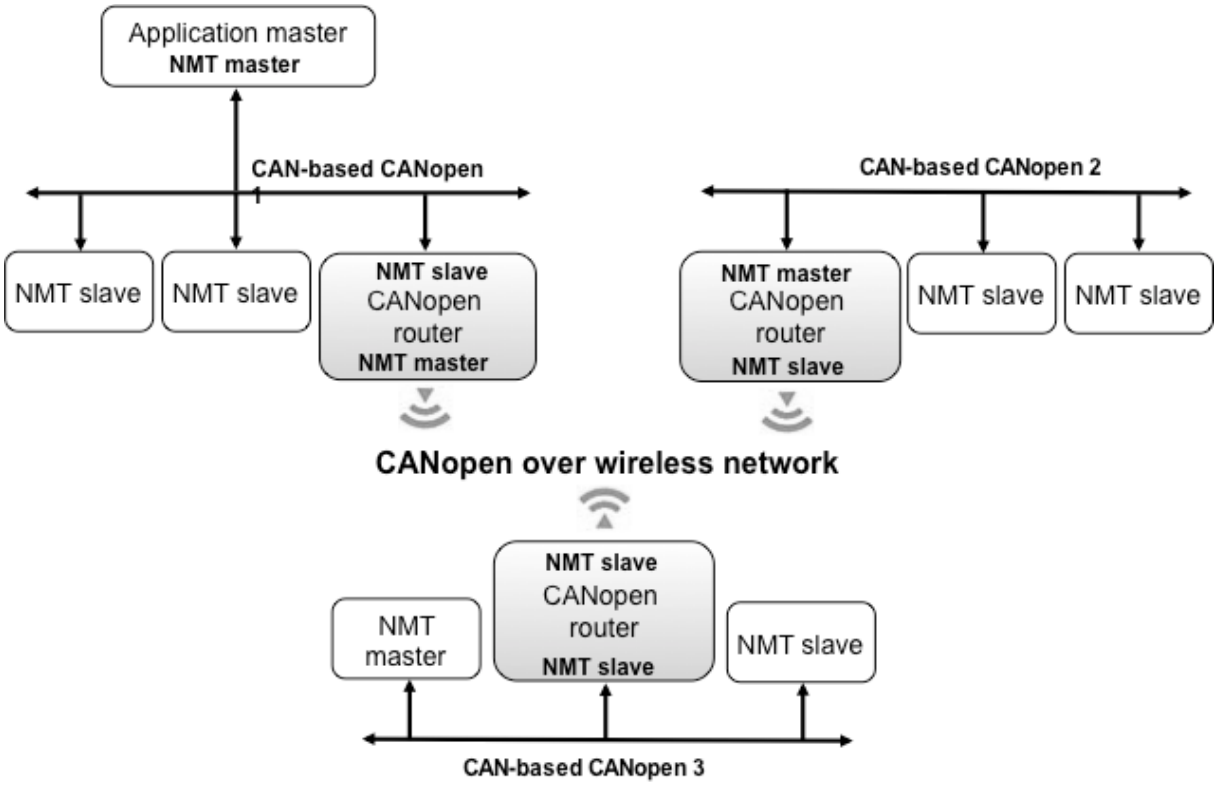

Figure 6 – Block diagram of a use case 6 example

The CANopen router/bridge connected to the CANopen network 1 and the application master implement the services and protocols as specified in /CiA302-7/. The wireless network is regarded as a sub-layered network of the CANopen network 1. The other two CANopen networks are sub-layered to the wireless network with CANopen application layer. All outer/bridges are compliant to /CiA302-7/.

4.8 Use case 7: CANopen transparent wireless segment

This use case is a simplified version of use case 5. Figure 7 shows a single CANopen network with three segments; two are CAN-based, which are interconnecting by a wireless network segment. The linking devices are CAN bridges, transmitting the CAN messages transparently via the wireless network. Logically, it is one CANopen network, but data consistency is not guaranteed by means of the wireless network data link layer.

NOTE PDO and EMCY communication needs to be confirmed on the application level.

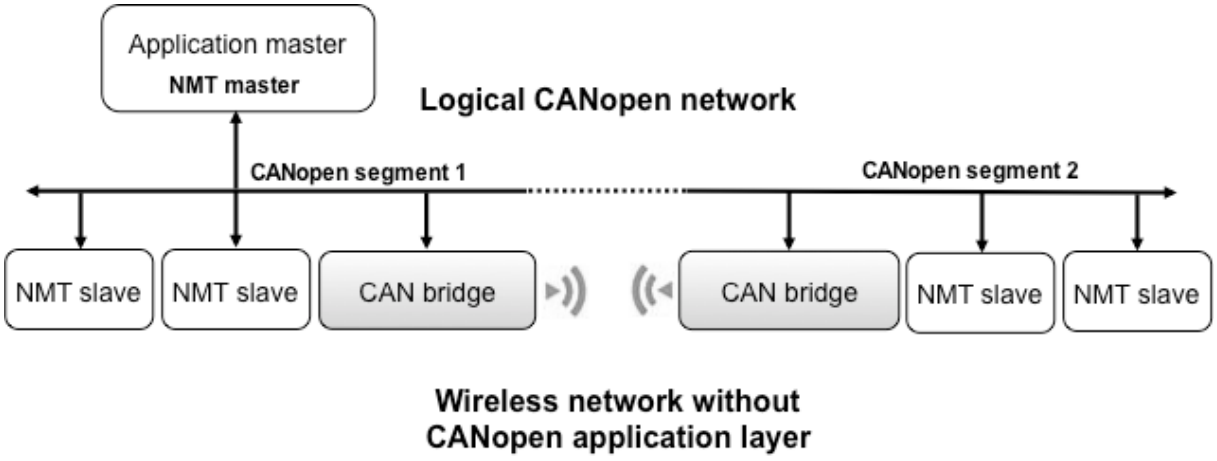

Figure 7 – Wireless link between two CANopen segments

The CAN bridge (with two or multiple network ports) devices is an infrastructure element, which is CANopen transparent as the wireless network is. It is not a CANopen device; it just forwards the COBs and tunnels them through the wireless network. The tunnelling mechanism is described in the /CiA315/ for different wireless network technologies.

4.9 Use case 8: Configurable CANopen transparent wireless segments

This use case is a version of use case 5. Figure 78 shows a CANopen network with five segments; three are CAN-based, which are interconnecting by two wireless network segments. The linking devices are CAN bridges/switches, transmitting the CAN messages transparently via the wireless networks. In this use case the communication between the CAN-based segments ensued via CAN switch. The transmission of CAN messages by CANopen segments may ensue to no segment, to a certain segment, to certain multi-segments or to all segments. It depends on the configuration of the CAN switch. Logically, it is one CANopen network, but data consistency is not guaranteed by means of the wireless network data link layer.

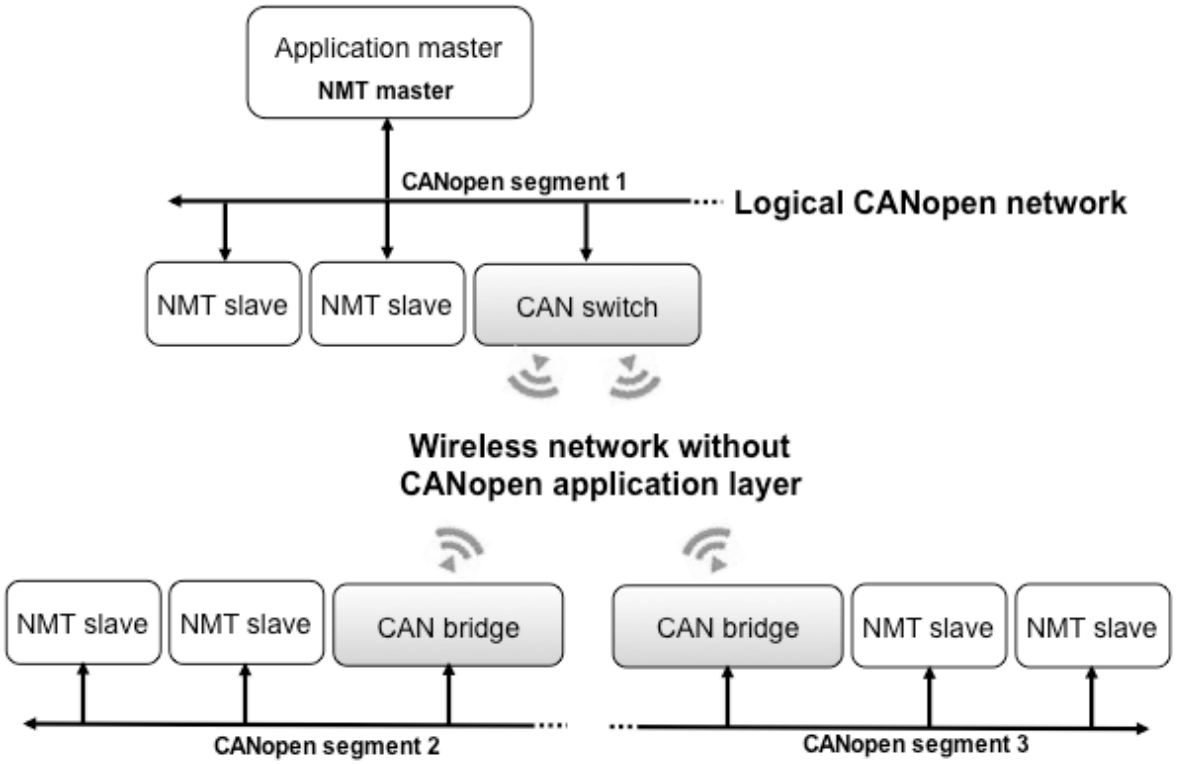

Figure 8 – Wireless link between three CANopen segments

The CAN switch (with three or multiple network ports) device is an infrastructure element, which is CANopen transparent as the wireless network is. It is not a CANopen device; it just forwards the COBs and tunnels them through the wireless network. The tunnelling mechanism is described in the /CiA315/ for different wireless network technologies.

