

KARY KARY Kernel-Based ARchitecture for safetY-critical cONtrol

A Tool for Real-Time Assessment Through Fault Injection in IEEE 802.15.4 Networks

Rui Pedro Caldeira, Jeferson L. R. Souza, José Rufino



Wireless networks increasingly used:

- Size, Weight and Power requirements make them a suitable replacement for a wired network;
- Current standards have been designed



towards real-time operation.

However, they are fragile:

• Electromagnetic interferences have the ability to impair communications.

Thus, it is important to:

• Observe the real-time operation in the presence of errors.

Monitor:

- Capture all frames, including corrupted ones;
- Frames are sent to the analyser as well as written to a CSV file.

Stress:

Manual parameterisation or use of embedded





pre-defined scenarios;

- Injection of noise or MAC symbols;
- Injection may be triggered by specific traffic patterns;

Analyse:

 Report creation by using the CSV file format (Frame Delivery Rate, Frame Error Rate, Energy consumption, etc...).

Network Monitoring Unit (NMU):

- Captures network traffic.
- Fault Injection Unit (FIU):
 - Injects noise/symbols to the channel.

Wireshark Translator:

File Edit View Go Capture Analyze	Statistics Telephony Tools Internals IEE	802.15.4 Tools Help				
🖲 🖲 🖉 📕 🙇 🗈 🗎 🗙 d	3 □ < > ୬ ㅈ ⊻ 🔳 📑 🛛	9 🖸 🖿 🔛	🗹 🍢 🔅 🛛 ?			
Filter:	Expression Clear	Apply Save				
No. Time Source	Destination Protoc	Length Info				
1783 113.2318890(0x0000	IEEE 8	2.15.4 32 Beac	on, Src: 0x0000			
1784 113.2418750(0x0000	IEEE 8	2.15.4 32 Beac	on, Src: 0x0000			
1785 113.3128460(0x0000	IEEE 8	2.15.4 32 Beac	on, Src: 0x0000			
1786 113.4158420(0x0000	IEEE 8	2.15.4 32 Beac	on, Src: 0x0000		DIRE	
1787 113.5378750(0x0000	IEEE 8	2.15.4 32 Beac	on, Src: 0x0000			
1788 113.6608520(0x0000	IEEE 8	2.15.4 32 Beac	on, Src: 0x0000			
1789 113.7838510(0x0000	IEEE 8	2.15.4 32 Beac	on, Src: 0x0000			
1790 113.9068570(0x0000	IEEE 8	2.15.4 32 Beac	on, Src: 0x0000			PEB23
1791 114.0298410(0x0000	IEEE 8	2.15.4 32 Beac	on, Src: 0x0000			
1792 114.1528990(0x0000	IEEE 8	2.15.4 32 Beac	on, Src: 0x0000			
1793 114.2118340(0x0000	_IEEE 8	2.15.4 14 Faul	t Injection, Src: 0x00	900		Committee and the
1794 114.2138360(IEEE 8	2.15.4 3 Ack[Malformed Packet]			
1795 114.2238350(bb:5c:eb:bb:bb:	bb:20:6c 74:41:00:00:37:66:cc:3b [EEE 8	2.15.4 32 Beac	on, Dst: 74:41:0000:37	7:66cc:3b, Src: bb:5c:ebbb:bb:b	bb20:6c[Mal	
1796 114.2448390(Broadcast	IEEE 8	2.15.4 14 Faul	t Injection, Src: Broa	adcast		
1797 114.2948610(0x0000	LEEE 8	2.15.4 32 Beac	on, Src: 0x0000			
1798 114.3048450(0x0000	LEEE 8	2.15.4 32 Beac	on, Src: 0x0000			
1799 114.3148520(0x0000	LEEE 8	2.15.4 32 Beac	on, Src: 0x0000		I - Matter	
1800 114.3258410(0x0000	LEEE 8	2.15.4 32 Beac	on, Src: 0x0000			a a first and and
1801 114.3988890(0x0000	LEEE 8	2.15.4 32 Beac	on, Src: 0x0000			
1802 114.5218810(0x0000	LEEE 8	2.15.4 32 Beac	on, Src: 0x0000			**************
1803 114.6438460(0x0000	IEEE 8	2.15.4 32 Beac	on, Src: 0x0000			C111111111111
1804 114.7673530(0x0000	LEEE 8	2.15.4 32 Beac	on, Src: 0x0000			2
1805 114.8907180(0x0000	EEE 8	2.15.4 32 Beac	on, Src: 0x0000			and a second sec
Frame 1780: 3 bytes on wire (24 b)	its), 3 bytes captured (24 bits) n inte	rface 0				
0000 ap bb cc		333				Contract of the Contract of th





 Captures frames and writes the CSV file while forwarding data to Wireshark.

Hardware Integration Interface:

• Integrates the NMU and the FIU.

Extended Wireshark:

Command and control functions.

IEEE 802.15.4	14 Fault Injection, Src: 0x0000
IEEE 802.15.4	3 Ack[Malformed Packet]
IEEE 802.15.4	32 Beacon, Dst: 74:41:0000:37:66cc:3b, Src: bb:5c:ebbb:bb:bb20:6c[Mal
IEEE 802.15.4	14 Fault Injection, Src: Broadcast

This work was partially supported by the European Unions' Seventh Programme for research, technological development and demonstration, through project KARYON, under grant agreement No. 288195

