AmICA – A Flexible, Compact, Easy-to-Program and Low-Power WSN Platform

Sebastian Wille[1], Norbert Wehn[1], Ivan Martinovic[2], Simon Kunz[3], and Peter Göhner[3]

[1] Microelectronic Systems Design Research Group, Uni. of Kaiserslautern, Germany
{wille,wehn}@eit.uni-kl.de

[2] Distributed Computer Systems, University of Kaiserslautern, Germany
martinovic@informatik.uni-kl.de

[3] Institute of Industrial Automation and Software Eng., Uni. of Stuttgart, Germany
{simon.kunz,peter.goehner}@ias.uni-stuttgart.de

Abstract. In this paper, we present *AmICA*: a flexible, compact, easy-to-program, and low-power WSN platform. Developed from scratch and including a node, a basic communication protocol, and a debugging toolkit, it assists in a user-friendly rapid application development. Our analysis shows that *AmICA* nodes are 67% smaller than BTnodes, have five times more sensors than Mica2Dot and consume 72% less energy than the state-of-the-art TelosB mote in sleep mode.

Keywords: Wireless Sensor Networks, WSN Platform Design, Real-world application, AmICA Node.

The key requirements for a WSN node are flexibility, usability, compactness, high integration of sensors, high transmission range, and power-efficiency. By follwing these requirements as our main design objectives, we developed AmICA nodes. The *AmICA nodes* can be equipped with up to five sensors and two actors (see Fig. 2), have a transmission range up to 280m LOS, are as small as a coin (see Fig. 1) and consume only 1.6µA in sleep mode. More technical details and a comparison to state-of-the-art platforms are depicted in Table 1. Our flexible software stack together with free accessible compilers, and the flexible radio module enable rapid application development and open up a wide usage of the *AmICA platform*. A debugging toolkit (see Fig. 1) allows amongst others to record communication packets, scans for nodes, and re-configure and -program them wireless. Additionally, a new basic communication protocol called *AmICA node protocol* can be used for any single-hop short-distance network.

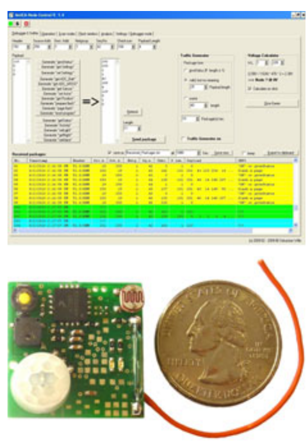

Fig. 1. Debugger toolkit (above), and *AmICA node* and a $0.25 coin (below)

P. Sénac, M. Ott, and A. Seneviratne (Eds.): MobiQuitous 2010, LNICST 73, pp. 381–382, 2012.

A real-world Ambient Assisted Living (AAL) application running since 18 month evaluates the use of *AmICA* for a low duty-cycle application, where power-efficiency belongs to the most important application constraints. A real-world, high duty-cycle sport application exploits the in-network-processing capabilities, the small footprint, and the hardware robustness of the nodes.

Circuit diagrams, C libraries, software, protocol definitions and the debugger toolkit can be downloaded at www.amica-system.com as well as an elaborate technical report ([4]). Some assembled nodes can be provided on request.

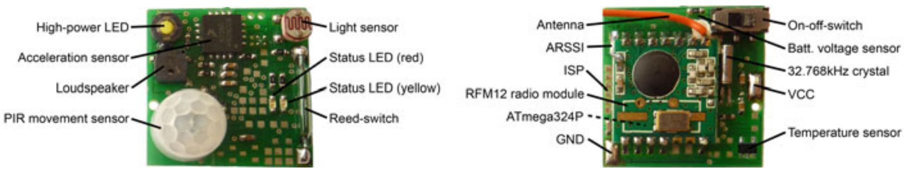

Fig. 2. Fully equipped *AmICA node*; top (left) and bottom (right) view

Table 1. Comparison between Mica2Dot ([1]), TelosB ([3]), BTnode ([2]) and *AmICA node*. [1]v1.1: 0.9-4.4/3.3-5.5V; [2]7 byte header, 4 byte payload per packet @ 3V

	Mica2Dot	TelosB 2420CA	BTnode rev3	*AmICA 1.0*
Size	ø25x6mm	65x31x6mm	58x33x7mm	25x25x6mm
Flash/RAM	128KB/4KB	48KB/10KB	128KB/64KB	128KB/16KB
Sensors/actors	1/1 (on-board)	4/3 (on-board)	0/4 (on-board)	5/4 (on-board)
Freq. / Mod.	Sub-GHz FSK	2.4GHz OQPSK	Sub-GHz FSK	Sub-GHz FSK
Data rate	0.6-76.8kbps	250kbps	0.6-76.8kbps	0.6-115.2kbps
Link budget	112dBm (max.)	94dBm (max.)	112dBm (max.)	114dBm (max.)
Input voltage	2.7-3.3V	1.8-3.3V	0.5-4.4/3.6-5.0V	2.6-3.6V[1]
Only RTC	48µW	15.3µW	9000µW	4.2µW
MCU active	24mW	5.4mW	36mW	17.1mW
+ radio tx	81mW@5dBm	58.5mW@0dBm	93mW@5dBm	85.5mW@5dBm
+ radio rx	30mW	74.4mW	75mW	55.5mW
E/bit [µJ]	2.42 @ 38.4k	0.23 @ 250k	2.42 @ 38.4k	0.74 @ 115.2k
ø E/30 pck./hr.[2]	62.1µW	18.5µW	9020.2µW	16.2µW
w. 2x2000mAh	up to 45 month	up to 150 month	up to 0.3 month	up to 171 month

References

1. UC Berkeley. Mica2Dot platform (2002), `http://tinyos.net/scoop/special/hardware`
2. Beutel, J., Dyer, M., Hinz, M., Meier, L., Ringwald, M.: Next-generation prototyping of sensor networks. In: SenSys 2004: Proceedings of the 2nd International Conference on Embedded Networked Sensor Systems, pp. 291–292. ACM, New York (2004)
3. Polastre, J., Szewczyk, R., Culler, D.: Telos: enabling ultra-low power wireless research, pp. 364–369 (April 2005)
4. Wille, S., Wehn, N., Martinovic, I., Kunz, S., Goehner, P.: Amica - design and implementation of a exible, compact, easy-to-program and low-power wsn platform. Technical report (October 2010), `http://ems.eit.uni-kl.de/uploads/tx_uniklwehn/AmICATechReport2010.pdf`