Project	IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>	
Title	**Spectrum management options for GRIDMAN – Smart Grid applications**	
Date Submitted	2010-01-08	
Source(s)	Eldad Zeira InterDigital Communications LLC	Voice: E-mail: Eldad.zeira@interdigital.com *<http://standards.ieee.org/faqs/affiliationFAQ.html>
Re:	Call for Contributions in C802.16gman-09/0001	
Abstract	This contribution presents Spectrum management options for GRIDMAN – Smart Grid applications and proposes modifications to draft PAR in IEEE 802.16-09/0068r2	
Purpose	To be discussed and agreed by SG – GRIDMAN for inclusion in draft PAR presented to WG for approval	
Notice	*This document does not represent the agreed views of the IEEE 802.16 Working Group or any of its subgroups.* It represents only the views of the participants listed in the "Source(s)" field above. It is offered as a basis for discussion. It is not binding on the contributor(s), who reserve(s) the right to add, amend or withdraw material contained herein.	
Release	The contributor grants a free, irrevocable license to the IEEE to incorporate material contained in this contribution, and any modifications thereof, in the creation of an IEEE Standards publication; to copyright in the IEEE's name any IEEE Standards publication even though it may include portions of this contribution; and at the IEEE's sole discretion to permit others to reproduce in whole or in part the resulting IEEE Standards publication. The contributor also acknowledges and accepts that this contribution may be made public by IEEE 802.16.	
Patent Policy	The contributor is familiar with the IEEE-SA Patent Policy and Procedures: <http://standards.ieee.org/guides/bylaws/sect6-7.html#6> and <http://standards.ieee.org/guides/opman/sect6.html#6.3>. Further information is located at <http://standards.ieee.org/board/pat/pat-material.html> and <http://standards.ieee.org/board/pat>.	

Spectrum management options for GRIDMAN

– Smart Grid applications

Eldad Zeira
InterDigital Communications LLC

Introduction

In [2] we have introduced two approaches to Smart Grid network architecture, namely the homogenous and heterogeneous networks. We have proposed that out of all IEEE-802 standards, 802.16 devices are uniquely suitable for high data rate long range applications and therefore for the home to POP (point of presence) communication link. In-home communication could also be done using 802.16 devices which leads to a homogenous network. Alternatively other RATs could be deployed which leads to heterogeneous networks using a combined Home Area Network (HAN) and Metropolitan Area Network (MAN).

We have also shown that both infrastructure and operating cost to deploy Smart Grid needs to be minimized, which leads to the need to minimize both equipment / deployment and spectrum choices for Smart Grid.

Another requirement for Smart Grid is for high network reliability. This requirement stems from the fact that the same communication network will be used for real time load monitoring and balancing. Failure to balance load, when needed, could result in large scale blackouts. This trend is even stronger if energy peak production capacity is reduced (as a result of having the Smart Grid communication in the first place). Thus both cost and reliability govern spectrum choices for the Smart Grid.

Spectrum could be licensed, unlicensed or lightly licensed. In order to use licensed spectrum, utility companies will have to either lease it from the national regulators or pay existing operators per use. Both alternatives are expensive. Unlicensed spectrum is free, and therefore very crowded. Due to its unlicensed nature, no performance guarantee can be given. A reasonable cost – performance compromise is the lightly licensed spectrum, where different users of the spectrum avoid interfering with each other via a combination of sensing and an open data base of communication devices, possibly accessed through a remote server. When operating in heterogeneous network, both networks can be then deployed in lightly licensed spectrum.

The draft PAR in [1] already recognizes this fact in its proposed scope which calls for operation in “licensed, unlicensed and lightly licensed spectrum bands”.

Networks deployed in lightly licensed spectrum generally compete for spectrum resources and have little or no incentive to cooperate beyond formal requirements. Not so for HAN and MAN for Smart Grid which will likely be managed by the same entity, provide the same functionality and can benefit from joint control of spectrum usage (spectrum sharing).

Joint control of spectrum usage provides several benefits:

1) Ability to operate in single band
2) Ability to assign the right spectrum to the right network, e.g. HAN could be adjacent to TV stations
3) Reuse of spectrum (between HAN and HAN / MAN networks) to increase spectral efficiency
4) Guarantee of end to end QoS

Specific techniques for spectrum sharing are best left to the technical discussion stage after PAR approval. They could include, among other techniques, measurements, band selection and on / off / power control or their combination. The network as a whole could share information and decisions via a remote server or controller. See fig. 1 for example.

Text Proposal

Propose to modify draft PAR in 80216-09_0068r2 as follows: (Blue – new text)

5.2 Scope of Proposed Standard:

This amendment specifies OFDMA PHY, MAC and management interfaces enhancements to IEEE Standard 802.16 for operation with increased robustness in degraded infrastructure. This amendment will support path redundancy, Mobile Base Station, Low Duty Ratio, as well as operation in licensed, unlicensed and lightly licensed spectrum bands below 6GHz with means and mechanisms to share spectrum use with other RATs .

References

[1] Draft PAR 80216-09_0068r2
[2] Network Architecture options for GRIDMAN – Smart Grid applications – C80216gman-10/0002

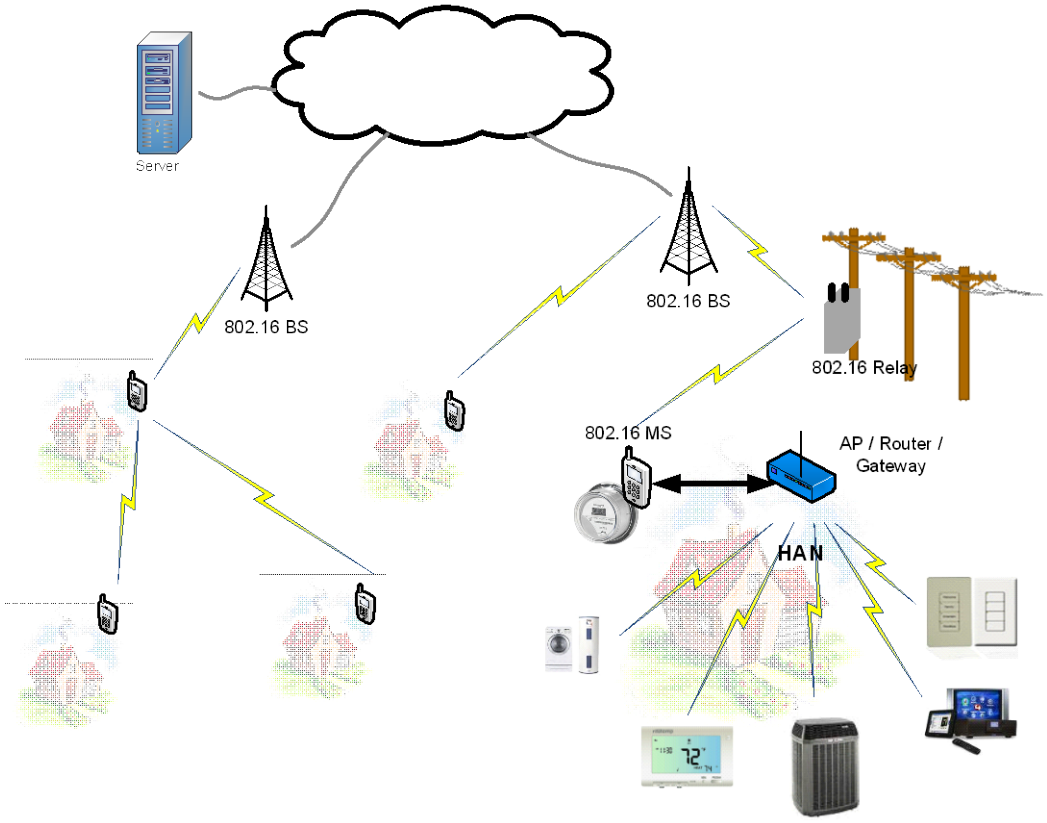

Figure 1: Spectrum sharing architecture