

5 Criteria- P802.22.1, Revision to IEEE Std. 802.22.1-2010

1. Broad Market Potential

a) Broad sets of applicability

The proposed revision will enable an advanced beaconing technology that will open up many new frequency bands for spectrum sharing while protecting primary users of the band including radars, commercial federal/defense communications, space to earth satellite receivers, wireless microphones etc.

b) Multiple vendors and numerous users

This revision will enable spectrum sharing between federal and commercial users while providing protection to many primary users of the band including radars, commercial federal/defense communications, space to earth satellite receivers wireless microphones etc. The new features of the revision are expected to bring new equipment vendors.

c) Balanced costs (LAN versus attached stations)

It is expected that the new features of the revision can be implemented with reasonable cost resulting in overall better value.

2. Compatibility

The revision will be compatible with IEEE 802 family of standards, specifically 802 overview and architecture, 802.1 including 802.1D and 802.1Q.

3. Distinct Identity

a) Substantially different from other IEEE 802 standards

There is no other IEEE 802 standard or project, for advanced beaconing that is currently being used for spectrum sharing between commercial and federal users. This revision will allow that.

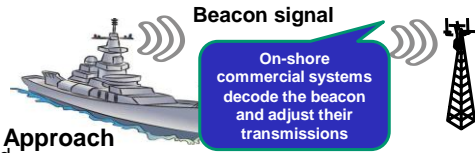
As an example, this standard will enable spectrum sharing with federal radar systems as shown in the slides below.

Spectrum sharing with radar using IEEE 802.22.1 Beacons Standard – Enables spectrum sharing in the 3550 – 3650 MHz Bands

To Create NATIONWIDE availability of the 3550-3650 MHz Band using IEEE 802.22.1 advanced beaconing approach

Current Plan: The current plan is the use of exclusion zones to protect U.S. Navy coastal operations and other Department of Defense test and training areas. This means that major part of the US population will not be able to use these bands.

Alternatives: However, there may be some other approaches which will make 100 MHz of spectrum available nation-wide, and especially in the coastal areas where significant US population resides.



Approach

Use of Advanced Beaconing Approach: Neither spectrum sensing or database driven approaches are suitable for this type of spectrum sharing. However, *advanced beaconing approaches, such as the one developed in the IEEE Standard 802.22.1 for spectrum sharing between the primary signals and incumbent signals may be used* for the 3550-3650 band.



Background

3550 – 3650 MHz Band: One of the portions of the spectrum identified to achieve the goal of freeing up 500MHz of spectrum, is the 3550-3650 MHz where maritime radars have been deployed.

Deployment Strategy

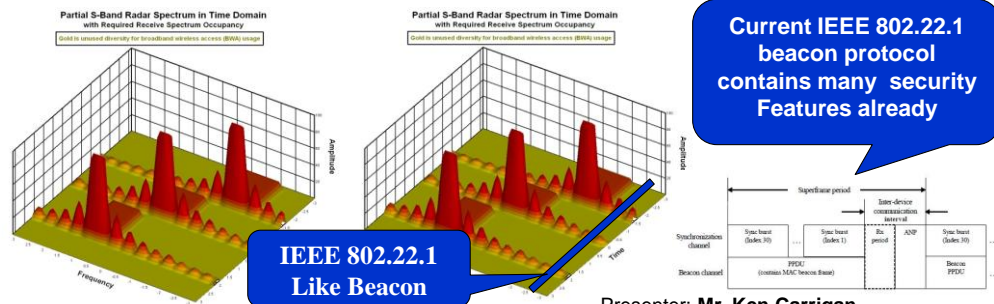
Regulators have realized that beaconing is a viable option for spectrum sharing. *The IEEE 802.22.1-2010™ standard has been completed and can be revised to add protection of radars and satellite earth stations* **Approved for Public Release Distribution Unlimited**

Submission

Spectrum sharing with radar using IEEE 802.22.1 Beacons Standard

How will it Work: The designed beacon will contain *Peace Time* temporal patterns of the radars (e. g. PW, PRI), which when combined with some universal time clock such as GPS can help commercial communications systems to use the empty time slots for their operation.

During *Emergency Scenarios*, the beacon will send Urgent Co-existence request, to ask all the commercial systems to shut down immediately. Security features for such beacons are very important. IEEE Std, 802.22.1-2010™ has incorporated many such security mechanisms that may be applied to the 3550-3650 band relatively readily.



Presenter: **Dr. Apurva N. Mody**,
Submission mody@ieee.org, +1-404-819-0314

Presenter: **Mr. Ken Carrigan**,
ken@carrigan.com

b) One unique solution per problem (not two solutions to a problem)

Spectrum sharing between federal and commercial users utilizing advanced beaconing approaches is currently not being considered by any other wireless standards or project.

c) Easy for the document reader to select the relevant specification

Yes, since the proposed standard will produce a revision to the IEEE std. 802.22.1-2010.

4. Technical Feasibility**a) Demonstrated system feasibility**

Beacons have been reliably used in many different forms since more than 90 years and deployed for protection of many different types of systems that exist today.

IEEE Std. 802.22.1-2010 beacon was designed for the purposes of protecting Part 74 device systems (e. g. wireless microphones) in the Television Bands. Extensive studies were conducted and a beaconing approach was found to be feasible, robust and reliable by a wide variety of participating organizations including the chipset vendors, TV Broadcasters etc.

IEEE 802.22.1-2010 uses direct sequence spread spectrum (DSSS) technology that has been widely adopted in many standards based products for more than a decade. The DSSS PHY and TDMA based MAC technologies have been widely deployed and hence are feasible.

b) Proven technology, reasonable testing

Beacons have been reliably used in many different forms since more than 90 years and deployed for protection of many different types of systems that exist today.

IEEE 802.22.1-2010 uses direct sequence spread spectrum (DSSS) which is a proven technology that has been widely adopted in many standards based products for more than a decade and it has been reasonably tested. The cost factors to implement DSSS and TDMA based MAC are well known today.

c) Confidence in reliability

IEEE Std. 802.22.1-2010 beacon was designed for the purposes of protecting Part 74 device systems (e. g. wireless microphones) in the Television VHF / UHF Bands. Extensive studies were conducted and a beaconing approach was found to be feasible, robust and reliable by the TV Broadcasters to protect their own systems. Although, the regulators decided to provide protection to licensed wireless microphones via a database service they did consider beaconing to be a viable and a reliable approach.

d) Coexistence of 802 wireless standards specifying devices for unlicensed operation

This revision supports mechanisms to enable coexistence with other 802 systems in the same band. A coexistence assurance document will be produced by the WG as a part of the WG balloting process.

5. Economic Feasibility

a) Known cost factors, reliable data

IEEE 802.22.1-2010 uses direct sequence spread spectrum (DSSS) technology that has been widely adopted in many standards based products for more than a decade. The cost factors to implement DSSS and TDMA based MAC are well known today.

b) Reasonable cost for performance

The IEEE 802.22.1 systems are designed to serve as beacon transmitter and receivers. These beacon transmitters and receivers are expected to be inexpensive. Also, since each these beacons are detectable at a low Signal to Noise Ratio (SNR) (e. g. IEEE Std. 802.22.1-2010 based beacon can be detected at -114 dBm) it is likely to support operation over a large area. Hence the cost of deployment over a large area is likely to be reasonable.

c) Consideration of installation costs

Installation costs will be those of the IEEE 802.22-2011 base standard and are expected to be reasonable.