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| Project | **IEEE 802.16 Broadband Wireless Access Working Group <http://ieee802.org/16>** |
| Title | **Proposal for Allocation of IEEE 802.16 Operator ID** |
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| Re: | IEEE 802.16-06/047 (“Report and Call for Comments on Registration Authority Issues”) |
| Abstract | This contribution proposes a set of basic principles, specific formats, and procedural details for the allocation of IEEE 802.16 Operator IDs by the IEEE Registration Authority. |
| Purpose | Information to be incorporated in a tutorial and other documentation to be prepared by the IEEE 802.16 Working Group for inclusion on the IEEE Registration Authority web site. |
| Notice |  |
| Release |  |
| Patent Policy and Procedures |  |

# Proposal for Allocation of IEEE 802.16 Operator ID

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## Considerations

As a result of discussions on the issue of IEEE 802.16 Operator ID at the July 2006 meeting of the IEEE Registration Authority Committee (RAC), as stimulated by a letter (IEEE 802.16-06/016r3) from the IEEE 802.16 Working Group, the RAC agreed to assume responsibility for establishing a registration authority for the allocation of IEEE 802.16 Operator Identifiers , as defined in IEEE Std 802.16. The RAC indicated its openness to allocate this resource in accordance with the needs of interested parties, and it offered the IEEE 802.16 WG the opportunity to further refine its proposal (IEEE 802.16-06/035) on the allocation process. Subsequently, the IEEE 802.16 Working Group documented the status of the issue and called for relevant comments in IEEE 802.16-06/047. It is the purpose of this contribution to respond to IEEE 802.16-06/047 with a proposal reflecting consensus on this allocation that has been reached by a number of organizations. The submitters request that the IEEE 802.16 WG use these recommendations as the basis of its communications with the RAC on this matter.

## Potential use cases for IEEE 802.16 and implied requirements for Operator ID (OID)

We perceive three potential use cases that may each suggest a specific derivation of the Operator ID (OID):

1. A public network may have a number of 802.16 compliant base stations, located in one or more countries, that may cooperatively interoperate with other such public networks using radio interfaces operating according to IEEE Std 802.16. In this case, the operator will require a globally unique OID and will require the assignment of one from the number space controlled by the IEEE Registration Authority.
2. A public network may have a number of 802.16 compliant base stations that may cooperatively interoperate with networks using non-802.16 (e.g., GSM-based) technology. In these cases, the operator may seek an 802.16 OID that is the same as (or is a direct, known, representation of) the operator or network ID used for the non-802.16 network. Specifically, many cellular networks make use of the Mobile Country Code – Mobile Network Code (MCC-MNC) format specified by ITU E.212 [1] for network identification. We believe it would be useful to provide a procedure for such operators to derive a unique IEEE 802.16 Operator ID based on the unique E.212 assignment. This option would also accommodate any need (e.g., one based on regional regulations) to use an OID that is derived from an allocation made by a regional allocation authority and indicative of a particular region or country of operation.
3. Private networks may operate 802.16 compliant systems but will not offer public service and may utilize a small number of base stations. In such cases, the network operator (which may be, for example, a residential user or a small enterprise) may not demand a unique assignment and may find the Operator ID assignment process onerous; furthermore, the operator may be tolerant of the possibility that the Operator ID is non-unique. In this case, a large pool of public OIDs from which private users could choose would maximize the deployment potential for such systems by saving the cost and effort involved in applying for a globally unique ID.

## Procedure for Assigning Operator ID

Based on these requirements, we propose that the IEEE Registration Authority specify three procedures for allocation of the IEEE 802.16 Operator ID:

## 1) Allocation directly by IEEE Registration Authority

a) The IEEE Registration Authority should support a procedure for allocating Operator IDs based on an application process. The application form should request relevant information, including the number of unique OIDs required; multiple contiguous OIDs should be allowed to accommodate operator needs, but the RAC should place an upper limit on the number of OIDs that may be requested at one time in order to to conserve the resource.

b) We recommended OIDs be allocated only in the range from:
0000 0000 0000 0000 0000 0001 [hex: 1; decimal: 1] through
0011 1111 1111 1111 1111 1111 [hex: 3FFFFF; decimal: 4194303].

(Note: spaces within 24-bit numbers in this document are only for clarity of presentation.)

c) Pre-reservation of specific numbers or number ranges is not required.

## 2) Based on unique ITU E.212 assignment under the ITU International Numbering Resource

a) We recommend that the IEEE Registration Authority support, and specify on the web site, a specific procedure for computing an IEEE 802.16 Operator ID from a specifically allocated unique assignment of the Mobile Country Code (MCC) and Mobile Network Code (MNC) per ITU E.212 [1].

b) The IEEE Registration Authority should specify that this procedure is acceptable only for operators who have been expressly allocated an appropriate MNC, and only within the specified MCC region under the appropriate national authority, according to the E.212 process <http://www.itu.int/ITU-T/inr/forms/mnc.html>.

c) The MCC-MNC is encoded into an IEEE 802.16 Operator ID as follows:

i) The OID shall begin with the bits “1111”

ii) The next 10 bits are a binary representation of the 3 digit decimal number comprising the MCC; e.g. MNC 234 is represented as 0011101010.

iii) The final 10 bits are a binary representation of the 3 digit decimal number comprising the MNC; e.g. MNC 573 is represented as 1000111101.

iv) 2-digit MNCs are encoded as if they are prefixed with zero to create a 3-digit number. This encoding will be unambiguous because no MCC supports both 2- & 3-digit MNCs, per the E.212 requirement [2] that “For a specific shared MCC, the length of all MNCs within that MCC shall be the same.” For example, MNC 38 is encoded as 0000100110; MNC 99 is encoded as 0001100011.

v) Examples:
The E.212 MCC-MNC pair 310-185 would be encoded 1111 0100110110 0010111001.
The E.212 MCC-MNC pair 234-02 would be encoded 1111 0011101010 0000000010.

d) We propose that the IEEE Registration Authority assume no responsibility for any actions regarding these E-212-derived OIDs, except to specify the algorithm. It should not maintain a registry of numbers calculated according to this process, not should it accept responsibility for arbitrating any disputes. It should however, specify that the procedure is to be used only with MCC-MNC pairs that have been properly allocated according to ITU E.212.

e) Note that OIDs representing such MCC-MNC pairs would fall in the range from
1111 0000000000 0000000000 [hex: F00000; decimal: 15728640] through
1111 1111100111 1111100111 [hex: FF9FE7; decimal: 16752615].

### 3) Operator ID selected for private network use from a pool of publicly-available Operator IDs

a) We recommend that a public OID pool be assigned in the otherwise-vacant range above the highest possible encoding of an E.212 identifier. In other words, the public OID pool should range from:

111111111001111111101000 [hex: FF9FE8; decimal: 16752616] through

111111111111111111111111 [hex: FFFFFF; decimal: 16777215].

This provides a pool of 24,600 public Operator IDs.

b) The IEEE Registration Authority should make it clear that these numbers are not globally unique and must therefore be used only in systems not providing public service.

c) To facilitate this, the IEEE Registration Authority could provide a "pick a number" facility that provides a random number in this range on request. To simplify entry of this number to the equipment, it should be provided in binary, hex, & decimal formats.

d) We propose that the IEEE Registration Authority recommend that an equipment vendor supplying 802.16 base stations for private use pre-populate the OID with a number randomly selected from the public OID pool. The Registration Authority, however, should remind vendors of the requirement that, per subclause 6.3.2.3.2 of IEEE Std 802.16, the entire Base Station ID (which includes the Operator ID) shall be programmable. This will ensure that private users with multiple 802.16 base stations can program all of the Operator IDs to match.

e) It should be noted that, using an exponential approximation (e.g., as described at <http://en.wikipedia.org/wiki/Birthday_paradox>), there is a 10% probability of duplication of number selection if 72 numbers are selected at random from a range of 24,600, a 50% probability if 185 numbers are selected, and a 99% probability with 476 numbers. Considering numbers representing likely usage scenarios (i.e. co-channel base stations within interference range), for 10 selections there is a 0.18% probability of duplication, and 1% probability is exceeded at 23 selections.

## Reservation of unused numbering space

It is recommended that the remaining range of OID space not described above, namely:

0100 0000 0000 0000 0000 0000 [hex: 400000; decimal: 4194304] through

1110 1111 1111 1111 1111 1111 [hex: EFFFFF; decimal: 15728639],

be specifically reserved by the IEEE Registration for future uses to be determined. This reserved range contains some 11,534,336 values, representing 11/16 of the 24-bit space.

## Table of proposed allocations

See Annex.

## References

[1] ITU-T Recommendation E.212 (05/2004, including Erratum 1 [10 /2004]), "The international identification plan for mobile terminals and mobile users," May 2004 <http://www.itu.int/rec/T-REC-E.212/en>.

### Annex: Table of proposed allocations

Note: Refer to text for details.

| Status | Binary | Hex | Decimal | Notes |
|---|---|---|---|---|
| Unused | 000000000000000000000000 | 000000 | 0 | 25% of the 24-bit space (all numbers beginning with bits "00") is allocated for IEEE-assignable OIDs, except 0, which is excluded. This provides 4194303 ($2^{22}$-1) OIDs. |
| First IEEE-assignable OID | 000000000000000000000001 | 000001 | 1 | |
| Last IEEE-assignable OID | 001111111111111111111111 | 3FFFFF | 4194303 | |
| First reserved OID | 010000000000000000000000 | 400000 | 4194304 | Reserved for future use. Includes all numbers beginning with bits "01", "10", and "11" except those beginning with "1111". In all, 11,534,336 numbers (11/16 of the space) are reserved. |
| Last reserved OID | 111011111111111111111111 | EFFFFF | 15728639 | |
| First E.212-based OID | 111100000000000000000000 | F00000 | 15728640 | All E.212-derived OIDs begin with bits "1111". The next 10 bits represent the three-digit MCC; the next 10 bits represent the MNC. |
| Last E.212-based OID | 111111111001111111100111 | FF9FE7 | 16752615 | |
| First public OID | 111111111001111111101000 | FF9FE8 | 16752616 | The 24,600 largest numbers in the space, all starting with "1111", are reserved for the public OID pool. |
| Last public OID | 111111111111111111111111 | FFFFFF | 16777215 | |