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Internet-Draft                                       SnT/Univ. of Luxembourg
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                                                           November 18, 2013

           Terminology in IPv6 over the TSCH mode of IEEE 802.15.4e
                     draft-ietf-6tisch-terminology-00

Abstract

   6TiSCH proposes an architecture for an IPv6 multilink subnet that is
   composed of a high speed powered backbone and a number of
   IEEE802.15.4e TSCH wireless networks attached and synchronized by
   backbone routers.  This document extends existing terminology
   documents available for Low-power and Lossy Networks to provide
   additional terminology elements.

Requirements Language

   The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT",
   "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and
   "OPTIONAL" in this document are to be interpreted as described in RFC
   2119 [RFC2119].

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1.  Introduction

   A new breed of Time Sensitive Networks is being developed to enable
   traffic that is highly sensitive to jitter and quite sensitive to
   latency.  Such traffic is not limited to voice and video, but also
   includes command and control operations such as in industrial
   automation or in-vehicle sensors and actuators.

   At IEEE802.1, the "Audio/Video Task Group", was renamed TSN for Time
   Sensitive Networking.  The IEEE802.15.4 Medium Access Control (MAC)
   has evolved with IEEE802.15.4e which provides in particular the Time
   Slotted Channel Hopping (TSCH) mode for industrial-type applications.
   Both provide deterministic capabilities to the point that a packet
   that pertains to a certain flow crosses the network from node to node
   following a very precise schedule, like a train leaves intermediate

stations at precise times along its path.

This document provides additional terminology elements to cover terms
that are new to the context of TSCH wireless networks and other
deterministic networks.

## 2. Terminology

The draft extends [I-D.ietf-roll-terminology] and use terms from RFC
6550 [RFC6550] and RFC 6552 [RFC6552], which are all included here by
reference.

The draft does not reuse terms from IEEE802.15.4e such as "path" or
"link" which bear a meaning that is quite different from classical
IETF parlance.

This document adds the following terms:

6TiSCH:       IPv6 over the Timeslotted Channel Hopping (TSCH) mode of
              IEEE 802.15.4e. It defines a set of IETF sublayers and
              protocols (in particular, for setting up a schedule with
              a centralized or distributed approach, managing the
              resource allocation), as well as the architecture to bind
              them together, for use in IPv6 TSCH based networks.

6F:           IPv6 Forwarding.  One of the three forwarding model
              supported by 6TiSCH.  Packets are routed at layer 3,
              where QoS and RED operations are expected to prioritize
              flows with differentiated services.

6top:         6top is the adaptation layer between TSCH and upper
              layers like 6LoWPAN and RPL.  It is defined in
              [I-D.draft-wang-6tsch-6top].

6top Data Convey Model:  Model describing how the 6top adaptation
              layer feeds the data flow coming from upper layers into
              TSCH.  It is composed by an I-MUX module, a MUX module, a
              set of priority queues, and a PDU (Payload Data Unit).

ASN:          Absolute Slot Number, the timeslot counter, incremented
              by one at each timeslot.  It is wide enough to not roll
              over in practice.  See

[I-D.watteyne-6tsch-tsch-lln-context].

   Blacklist:    Set of frequencies which should not be used for
                 communication.

   BBR:          Backbone Router.  In the 6TiSCH architecture, it is an
                 LBR and also a NEAR.  It performs ND proxy operations
                 between registered devices and classical ND devices that
                 are located over the backbone.

   Bundle:       A group of equivalent scheduled cells, i.e. cells
                 identified by different [slotOffset, channelOffset],

                 which are scheduled for a same purpose, with the same
                 neighbor, with the same flags, and the same slotframe.
                 The size of the bundle refers to the number of cells it
                 contains.  Given the length of the slotframe, the size of
                 the bundle translates directly into bandwidth, either
                 logical, or physical.

   Cell:         A single element in the TSCH sloframe, identified by a
                 slotOffset value, a channelOffset value, a slotframe_ID
                 and Hopping_Sequence_ID.  A cell can be scheduled or
                 unscheduled.  During an unscheduled cell, the node does
                 not communicate.  When a cell is scheduled, it is
                 assigned a MAC-layer slotframe identifier, a neighbor MAC
                 address (which can be the broadcast address), and one or
                 more of the following flags: TX, RX, shared,
                 timeskeeping, hard.  A broadcast cell is an alias for "a
                 scheduled cell with neighbor address the broadcast
                 address".

   ChannelOffset: Identifies a row in the TSCH slotframe.  The number
                 of available channelOffsets is equal to the number of
                 available frequencies.  The channelOffset translates into
                 a frequency when the communication takes place, resulting
                 in channel hopping, as detailed in
                 [I-D.watteyne-6tsch-tsch-lln-context].

   Communication Paradigm:  It is Associated with the Information Model
                 [RFC3444] of the state that is exchanged, and indicates:
                 the location of that state (e.g., centralized vs.

distributed, RESTful, etc.), the numbers of parties
(e.g., P2P vs. P2MP) and the relationship between parties
(e.g., master/slave vs. peers) at a high level of
protocol abstraction.  Layer 5 client/server REST is a
typical communication paradigm, but industrial protocols
also use publish/subscribe which is P2MP and source/sink
which is MP2MP and primarily used for alarms and alerts
at the application layer.  At layer 3, basic flooding,
P2P synchronization and path-marking (RSVP-like) are
commonly used paradigms, whereas at layer 2, master/slave
polling and peer-to-peer forwarding are classical
examples.

Dedicated Cell:  A cell that is reserved for a given node to transmit
to a specific neighbor.

Distributed cell reservation:  A reservation of a cell done by one or
more in-network entities (typically a connection
endpoint).

Distributed track reservation:  A reservation of a track done by one
or more in-network entities (typically a connection
endpoint).

EB:          Enhanced Beacon frame used by an advertising node to
announce the presence of the network.  It contains
information about the timeslot length, the current ASN
value, the slotframes and timeslots the beaconing mote is
listening on, and a 1-byte join priority (i.e., number of
hops separating the node sending the EB, and the PAN
coordinator).

FF:          6LoWPAN Fragment Forwarding.  It is one of the three
forwarding model supported by 6TiSCH.  The 6LoWPAN
Fragment is used as a label for switching at the 6LoWPAN
sublayer, as defined in
[I-D.thubert-roll-forwarding-frags].

GMPLS:       Generalized Multi-Protocol Label Switching, a 2.5 layer
service that is used to forward packets based on the
concept of generalized labels.

Hard Cell:   A scheduled cell that is locked, i.e., it cannot be moved
             by 6top in the schedule.  See
             [I-D.draft-wang-6tsch-6top].

Hopping Sequence:   Sequence of frequencies, identified by a
             Hopping_Sequence_ID, used for channel hopping, when
             translating the channel offset value into a frequency
             (i.e., PHY channel).  See
             [I-D.watteyne-6tsch-tsch-lln-context].

IE:          Information Elements, a list of Type-Length-Value
             containers placed at the end of the MAC header, used to
             pass data between layers or devices.  A small number of
             types are defined by TSCH, but a range of types is
             available for extensions, and thus, is exploitable by
             6TiSCH.  See [I-D.watteyne-6tsch-tsch-lln-context].

I-MUX module:  Inverse-Multiplexer, a classifier that receives
             6LoWPAN frames and places them into priority queues.

Interaction Model:  It is a particular way of implementing a
             communication paradigm.  Defined at a lower level of
             abstraction, it includes protocol-specific details such
             as a particular method (e.g., a REST GET) and a Data
             Model for the state to be exchanged.

KMP:         Key Managment Protocol.

LBR:         LLN Border Router.  It is an LLN device, usually powered,
             that acts as a Border Router to the outside within the
             6TiSCH architecture.

Link:        A communication facility or medium over which nodes can
             communicate at the link layer, i.e., the layer
             immediately below IP.  Thus, the IETF parlance for the
             term "Link" is adopted, as opposed to the incompatible
             IEEE802.15.4e terminology.  In the context of the 6TiSCH
             architecture, which applies to Low Power Lossy Networks
             (LLNs), an IPv6 subnet is usually not congruent to a
             single link and techniques such as IPv6 Neighbor
             Discovery Proxying and Routing Over LLNs are required to

achieve reachability within the multilink subnet.  A link
is distinct from a track.  In fact, link local addresses
are not expected to be used over a track for end to end
communication.  Finally, from the Layer 3 perspective
(where the inner complexities of TSCH operations are
hidden to enable classical IP routing and Forwarding), a
single radio interface may be seen as a number of Links
with different capabilities for unicast or multicast
services.

Logical Cell:  A cell that corresponds to granted bandwidth but is
only lazily associated to a physical cell, based on
usage.

MAC:          Medium Access Control.

MUX module: Multiplexer, the entity that dequeues frames from
priority queues and associates them to a cell for
transmission.

NEAR:         Energy Aware Default Router, as defined in
[I-D.chakrabarti-nordmark-6man-efficient-nd].

NME:          Network Management Entity, the entity in the network
managing cells and other device resources.  It may
cooperate with the PCE.  It interacts with LLN nodes
through the backbone router.

PANA:         Protocol for carrying Authentication for Network Access,
as defined in [RFC5191] . It is the protocol used in the
6TiSCH architecture for handling authentication during
the join process.

PCE:          Path Computation Element, the entity in the network which
is responsible for building and maintaining the TSCH
schedule, when centralized scheduling is used.

PCE cell reservation:  The reservation of a cell done by the PCE.

PCE track reservation:  The reservation of a track done by the PCE.

QoS:         Quality of Service.

       SA:          Security Association.

       Shared Cell:  A cell that is used by more than one transmitter nodes
                     at the same time and on the same channelOffset.  Only
                     cells with TX flag can be marked as "shared".  A backoff
                     algorithm is used to resolve contention.

       SlotOffset:  Identifies a column in the TSCH schedule, i.e., the
                    number of timeslots since the beginning of the current
                    iteration of the slotframe.

       Slotframe:   A MAC-level abstraction that is internal to the node and
                    contains a series of timeslots of equal length and
                    priority.  It is characterized by a slotframe_ID, and a
                    slotframe_size.  Multiple slotframes can coexist in a
                    node's schedule, i.e., a node can have multiple
                    activities scheduled in different slotframes, based on
                    the priority of its packets/traffic flows.  The timeslots
                    in the Slotframe are indexed by the SlotOffset; the first
                    timeslot is at SlotOffset 0.

       Soft Cell:   A scheduled cell that is not locked, i.e., it may be
                    moved in the schedule within a same slotframe by 6top, as
                    described in [I-D.draft-wang-6tsch-6top].

       TF:          Track Forwarding.  It is the simplest and fastest
                    forwarding model supported by 6TiSCH.  It is a G-MPLS-
                    like forwarding model.  The input cell characterises the
                    flow and indicates the output cell.

       Timeslot:    A basic communication unit in TSCH which allows a
                    transmitter node to send a frame to a receiver neighbor,
                    and that receiver neighbor to optionally send back an
                    acknowledgment.  The length of the timeslot determines
                    the maximum size of the frame that can be exchanged.

   Time Source Neighbor:  A neighbor a node uses as its time reference,

and to which it needs to keep its clock synchronized.  A
node can have one or more time source neighbors.

Track:       A determined sequence of cells along a multi-hop path.
             It is typically the result of a reservation.  The node
             that initializes the process for establishing a track is
             the owner of the track.  The latter assigns a unique
             identifier to the track, called TrackID.

TrackID:     Unique identifier of a track, assigned by the owner of
             the track.

TSCH:        Time Slotted Channel Hopping, a medium access mode of the
             [IEEE802154e] standard which uses time synchronization to
             achieve ultra low-power operation and channel hopping to
             enable high reliability.

TSCH Schedule:  A matrix of cells, each cell indexed by a slotOffset
             and a channelOffset.  The slotframe size (the "width" of
             the matrix) is the number of timeslots it contains.  The
             number of channelOffset values (the "height" of the
             matrix) is equal to the number of available frequencies.
             The TSCH schedule contains all the scheduled cells from
             all slotframes and is sufficient to qualify the
             communication in the TSCH network.

## 3.  IANA Considerations

   This specification does not require IANA action.

## 4.  Security Considerations

   This specification is not found to introduce new security threat.

## 5.  Acknowledgements

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