Comparison between TG3 Functional Requirements Document and TG1 proposed MAC

Prepared by TG3 (2000-09-14)

- **Comments in black**

Responses by TG1 (2000-09-14) included

- **Green means that TG1 MAC can support this now or it is easy to support**
- **Yellow means that TG1 has questions regarding these requirements**
- **Purple means that this is misinformation on behalf of TG3 regarding TG1**
- **Blue is a general response**

Contents

- Essential FRD differences
- Expected difference in behavior
- TG1 MAC disadvantages from TG3 perspective

TG1, TG3 FRD

- TG1: Document IEEE 802.16.s-99/00r1
- TG3: Document IEEE 802.16.3-00/02r3, including modifications at Session #9

- “MAY” requirements not discussed here

Essential FRD differences - 1

	TG1	TG3
Services	**Legacy telephony** **Audio/Video Multicast** **ATM** **IP**	**IP** **Bridged LAN** **Packet based voice**
Connection-less?	**Supports all kind of such traffic**	**Mandatory**
Peak data rate (order of mag.)	**155Mb/s**	**Capable of scaling beyond 10Mb/s**
Maximum delay	**5ms**	**20-40ms**

Essential FRD differences - 2

	TG1	TG3
Classes of Services	**ATM classification:** **CBR (SDH/PDH)** **VBR (VoIP, video)** **ABR(variable BW)** **UBR(best effort)**	**IETF DiffServ classification:** **EF(VoIP,video)** **AF(ISP service differentiation)** **BES(best effort)**
Typical channel width	**25MHz***	**3-3.5MHz**
Cell max. radius	**3km***	**50km**
ARQ	**N.A.**	**YES**

* - resulting from other considerations

Expected differences in the behavior of the TG1 and TG3 systems – 1

Why	TG1	TG3
Traffic characteristics	**Large traffic pipes, always carrying data, quasi-static character**	**Mostly dynamic, small pipes, random demand**
Legacy vs. IP	**Low delay is required (1ms frames)**	**More flexible, less critical delay requirements**
Bridged LAN	**-**	**Requires 802.1d addressing for bridge support**
High vs. low data rate	**Low transmission time per packet**	**Variable transmission time, more than 1ms for long IP packets**

Expected differences in the behavior of the TG1 and TG3 systems - 2

Why	TG1	TG3
Cell size range	**Short contention period**	**Variable, longer, contention period**
Variable length IP datagrams support	**Segmentation may be used**	**Segmentation is less spectral efficient**
ARQ	**Down-link only** **Hard to introduce in up-stream due to the "policy rules"**	**Should be supported in both directions**
ATM vs. IP QoS classification	**Hard, 1ms, framing** **TG1"policy rules"**	**Flexible framing**

TG1 MAC LIMITATIONS

(from TG3 perspective)

TG1 MAC is PHY dependent

- The MAC is adapted for the QAM modulation
  - Mini-slot is defined in number of QAM symbols
    - defined in Physical Slots that are defined for each PHY separately.
  - The header is transmitted in QAM 4
    - transmitted in a “well known” burst profile. (PHY specific)
  - The equalizer parameters are for QAM
    - Currently does not exist, but can be added if needed.

The MAC is adapted for the QAM modulation (continued)

- Adaptive modulation support is defined for QAM
  - in burst types; not tied to any specific modulation and/or coding schemes.
- PHY burst parameters (modulation type, FEC parameters)????
  - code space exists for expansion to define additional burst parameters. (253 remaining)

1 ms frame duration

- Too short for IP variable packet length support
  - 1.7ms for 3.5MHz, 2bit/s/Hz, 1500bytes frame
- Too short to accommodate the contention period, with 50km distance
- Too short to accommodate delay for 50km (150us)
  - 32 different frame lengths may **now** be specified for each PHY.

Fixed framing

- Fixed framing is problematic with IP traffic
  - Long frames = long delay
    - QoS problems
    - TCP/IP throughput problems
  - Short frames = short delays
    - Require fragmentation
    - Spectral efficiency problems
  - Flexibility is a requirement for TG3
- **Frameless Mode Exists!**

No fast BW allocation

- Many CPE units with random data demand require fast BW allocation, as opposed to small number of users using legacy connection oriented services
- Slow (pseudo-static) and centralized BW allocation mechanism: request followed by allocation
- The piggy-back request is limited to 256bytes

- *Contention based data transfer can be easily added.*

No Acknowledge frames

- ARQ require fast variable BW allocation, which is against the TG1 up-link “policy rules”
- *What is the issue?*

VoIP VAD support

- BW requests are permitted only with unicasts - actually will not take any advantage of silence periods

- *currently supported*

VoIP VAD support

- Not suitable for relatively long compression intervals, demanding fast BW allocation for efficient support (a loss of packet will be perceived)

- *directly supported by UGS-AD*

Multicast and LAN-to-LAN bridging support?

- Addressing mode: based on connection_ID of the final destination, not on the MAC address
- *CID is local to the air interface; the final destination is specified at a higher layer.*

- No mechanism to allocate a LAN address to a connection_ID
- *will be supported through the convergence layer which has not yet been written. Call for contribution is being drafted.*

Multicast and LAN-to-LAN bridging support?

- Makes the bridge implementation non-standard and difficult *(please clarify)*
- Will the “spanning tree” algorithm work?
  - *Yes, this is above the MAC and so will be addressed in the Ethernet convergence layer. (Common Requirement)*
- Introduces significantly delays in bridge
  - *please clarify*
- Lowers IP performance
  - *please clarify*

No data polling mechanism
(Is supported)

- Data polling needs no apriori knowledge of BW requirements
- Most suitable when combined with IP traffic shaping
- Most suitable for VoIP when VAD is enabled
- Most suitable for external VoIP GW
- Most suitable to support ARQ
- Most suitable to support “Expedited Forwarding” and “Assured forwarding”