IEEE 802.3dg 100BASE-T1L: Downshift: Part 2

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Background

- Concepts previously presented in https://www.ieee802.org/3/dg/public/May_2022/jones_3dg_01_08172022.pdf
- Learn from "Downshift" widely deployed with 802.3bz as defined in NBASE-T Alliance specification.
  - Enable link partners to choose a lower rate than Highest Common Denominator (HCD) when the link is too noisy for HCD
  - White paper at https://archive.nbaset.ethernetalliance.org/wp-content/uploads/2017/05/NBASET-Downshift-WP-1217.pdf
  - Specification in section 2.11 of https://ethernetalliance.org/wp-content/uploads/2024/05/NBASE-T-PHY-Spec-rev-2.3_final_Copyright.pdf.
  - Redrawn state machine in backup slide.

Downshift Overview

1. Auto-negotiation(AN) selects HCD speed.
2. Link training for selected speed.
3. If training fails repeatedly, remove the HCD rate from the AN advertisement and restart AN.
4. Functions correctly if supported on only one of the link partners.

Downshift Behavior with 802.3bz
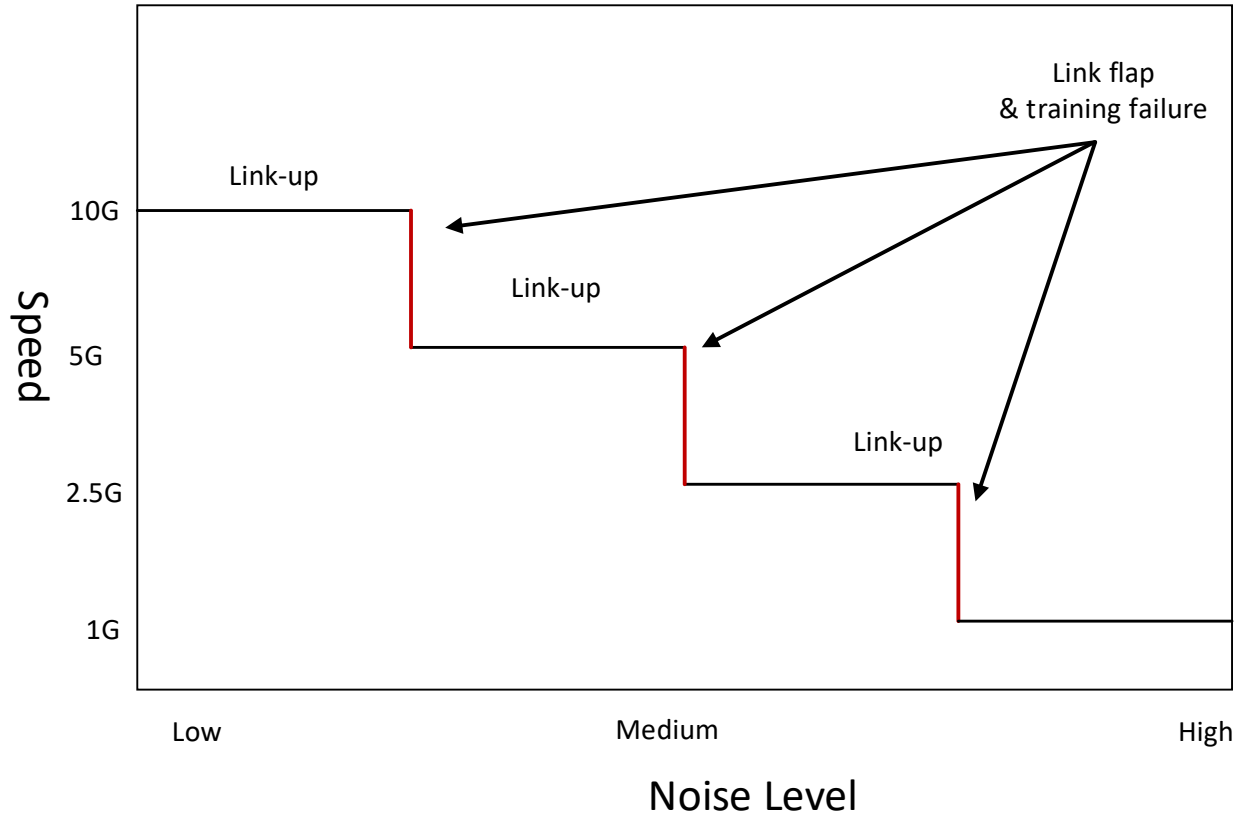
Downshift and >10Mb/s SPE

- The BASE-T1L PHYs are intended to be used in noisy environments.

- Link segment specifications for 100BASE-T1L are more stringent than 10BASE-T1L.

- Downshift enables communication when the Auto-Negotiation Highest Common Denominator(HCD) speed is not reliable, and a common slower speed exists.

- P802.3dg should specify a Downshift capability to improve user experience.

BASE-T1L Downshift Flow Chart
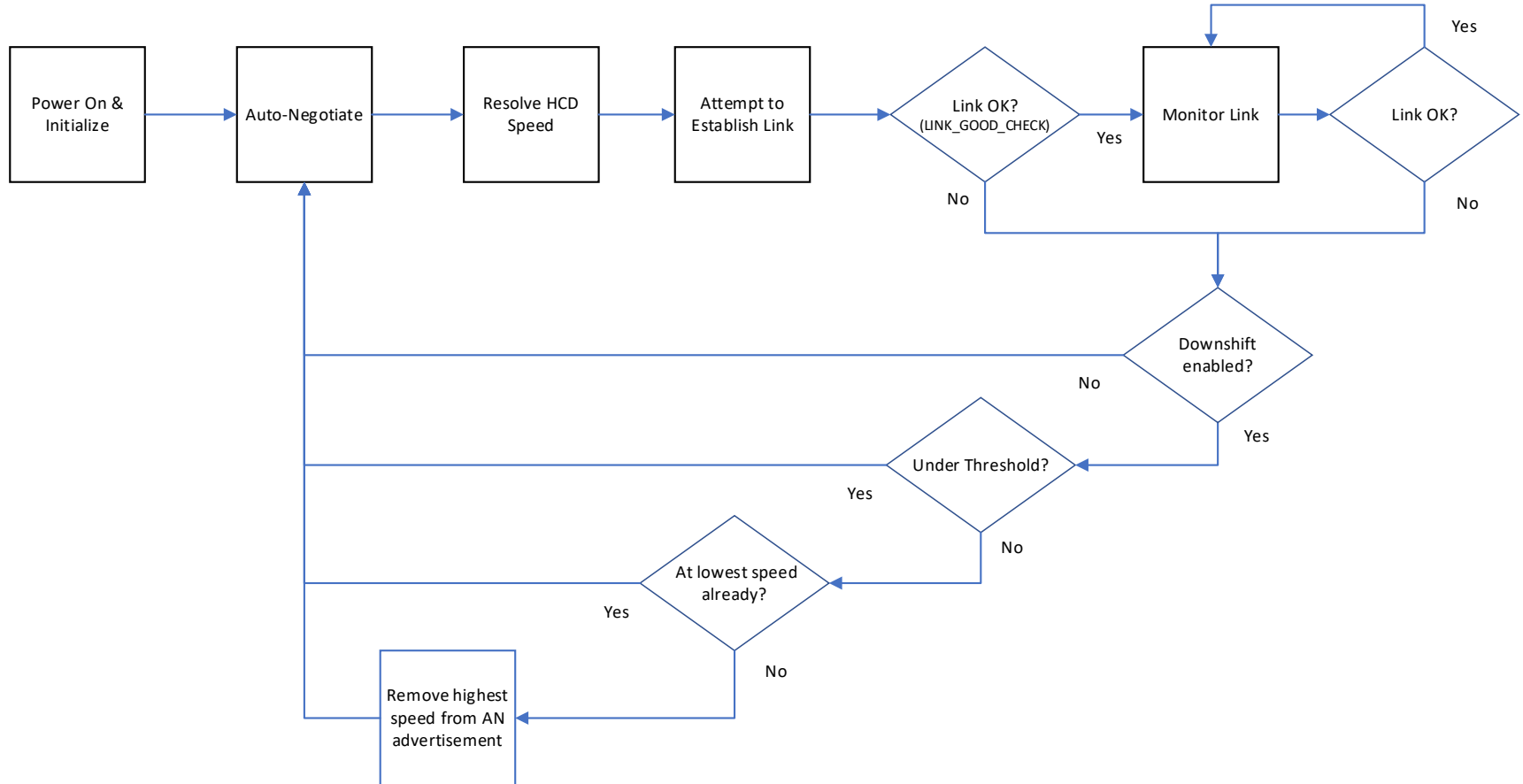
Variables/constants

Name	What	Type	Access	Default
downshift_supported	Is Downshift supported?	boolean	r/o	--
downshift_enabled	Is Downshift enabled?	boolean	r/w	yes
downshift_no_energy_reset	Reset advertised speeds if no energy detected on link.	boolean	r/w	yes
downshift_training_threshold	Training cycles allowed to establish link before downshift.	uint8	r/w	TBD
downshift_training_count	Number of training attempts to establish link	uint8	r/o	--

Adding it to the draft

- ## Where should it go?
  - informative annex, normative annex, 100BASE-T1L PHY clause?
  - I think it becomes a normative annex.
- ## General or Specific
  - I think the techniques are broadly useful (consider it's use with 802.3bz), and we should write the text so it can be used with other BASE-T/T1 PHYs.
  - I think we can make it "compatible" with existing implementations in the 802.3bz world and get that function into 802.3 so we don't have to point to the NBASE-T spec anymore.

Conclusion

- NBASE-T Downshift has been widely implemented and deployed in commercial products implementing 802.3bz.

- 10BASE-T1L, 100BASE-T1L and future BASE-T1Ls:

  - live in harsh noise environments.

  - can use existing installed cabling.

  - will not always be connected to the "right cabling".

- P802.3dg should specify a similar capability to improve user experience.

Consensus
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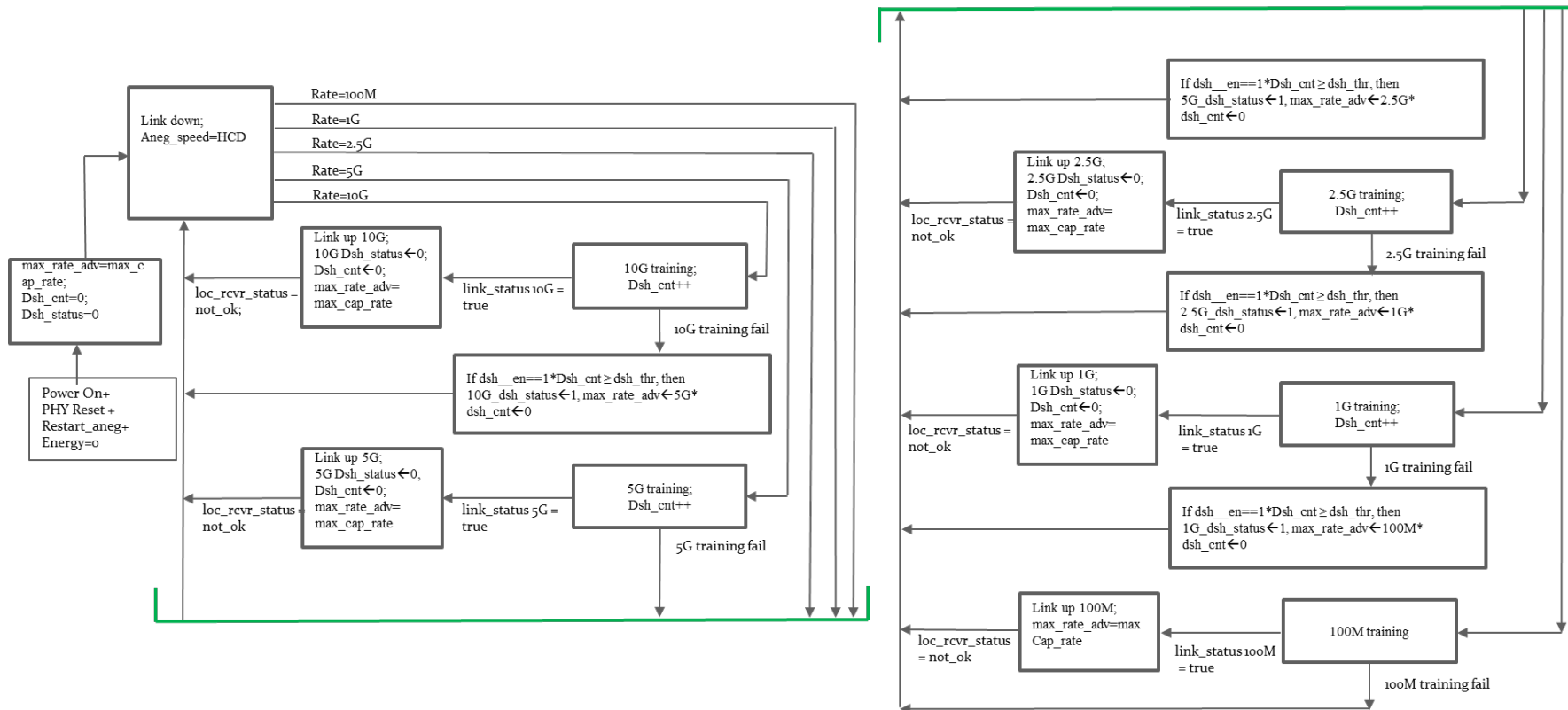
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Backup

NBASE-T Downshift State Machine

Link down;
Aneg_speed=HCD

Rate=100M
Rate=1G
Rate=2.5G
Rate=5G
Rate=10G

max_rate_adv=max_cap_rate;
Dsh_cnt=0;
Dsh_status=0

Power On+
PHY Reset +
Restart_aneg+
Energy=0

Link up 10G;
10G Dsh_status←0;
Dsh_cnt←0;
max_rate_adv=
max_cap_rate

loc_rcvr_status =
not_ok;

10G training;
Dsh_cnt++

link_status 10G =
true

10G training fail

If dsh__en==1*Dsh_cnt ≥ dsh_thr, then
10G_dsh_status←1, max_rate_adv←5G*
dsh_cnt←0

Link up 5G;
5G Dsh_status←0;
Dsh_cnt←0;
max_rate_adv=
max_cap_rate

loc_rcvr_status =
not_ok

5G training;
Dsh_cnt++

link_status 5G =
true

5G training fail

If dsh__en==1*Dsh_cnt ≥ dsh_thr, then
5G_dsh_status←1, max_rate_adv←2.5G*
dsh_cnt←0

Link up 2.5G;
2.5G Dsh_status←0;
Dsh_cnt←0;
max_rate_adv=
max_cap_rate

loc_rcvr_status =
not_ok

2.5G training;
Dsh_cnt++

link_status 2.5G
= true

2.5G training fail

If dsh__en==1*Dsh_cnt ≥ dsh_thr, then
2.5G_dsh_status←1, max_rate_adv←1G*
dsh_cnt←0

Link up 1G;
1G Dsh_status←0;
Dsh_cnt←0;
max_rate_adv=
max_cap_rate

loc_rcvr_status =
not_ok

1G training;
Dsh_cnt++

link_status 1G
= true

1G training fail

If dsh__en==1*Dsh_cnt ≥ dsh_thr, then
1G_dsh_status←1, max_rate_adv←100M*
dsh_cnt←0

Link up 100M;
max_rate_adv=max
Cap_rate

loc_rcvr_status
= not_ok

100M training

link_status 100M
= true

100M training fail

Note: Redrawn from internal documents

Thanks!