PoDL – OEM requirements

Contributors

Thomas Hogenmüller, Bosch

Kirsten Matheus, BMW

Stephane Korzin, Renault

Stefan Buntz, Daimler

Supporters

- Mike Gardner, Molex
- Sasha Babenko, Molex
- Mehmet Tazebay, Broadcom
- Thomas Suermann, NxP
- Helge Zinner, Continental
- Ahmed Harrar, PSA
- Todd Herman, CommScope
- Thomas Müller, Rosenberger

overview

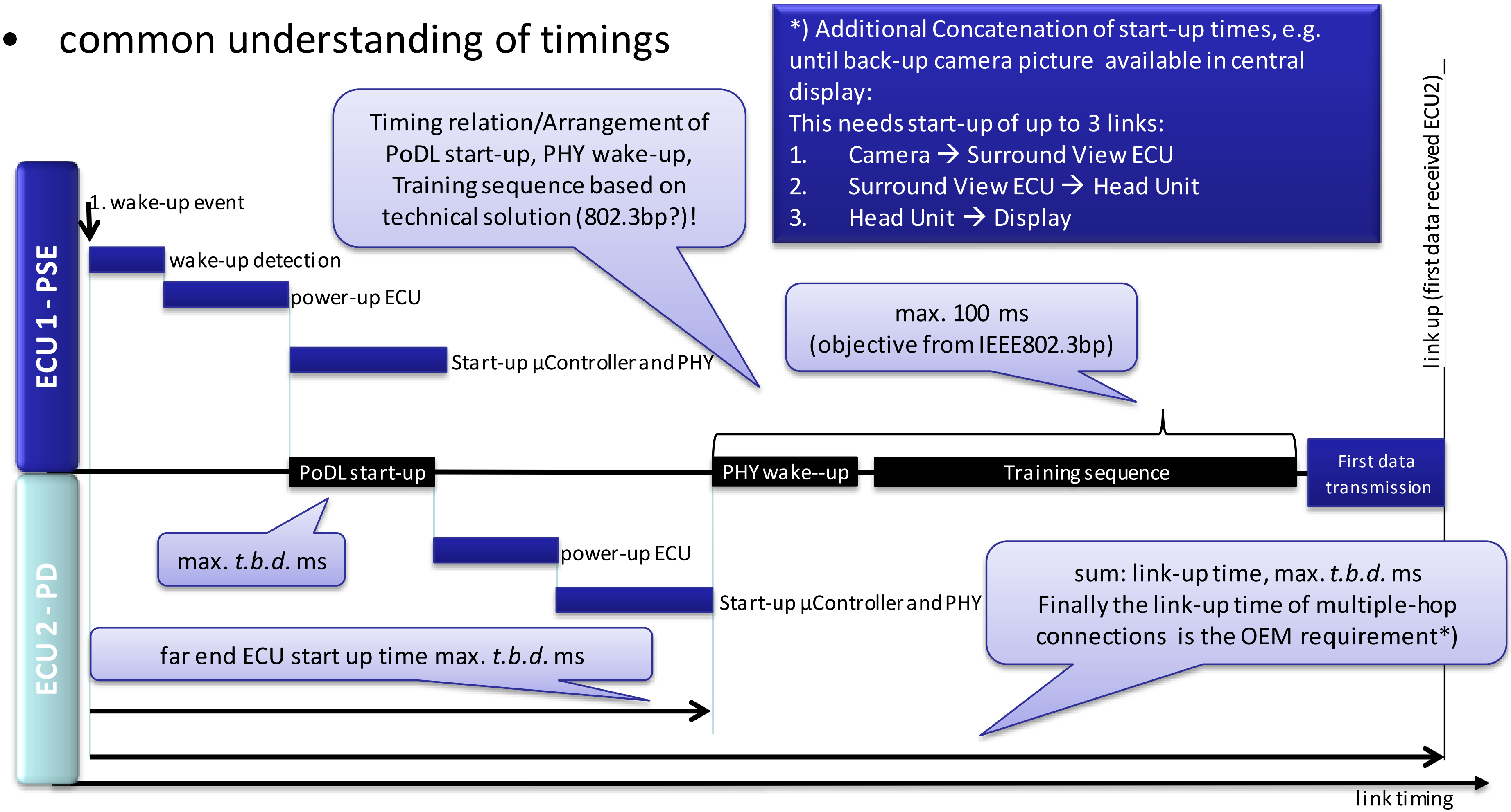
- possible applications
- start-up time: definitions and requirements for a PoDL-link
- power classes: proposal for PowerClasses
- further requirements

possible applications

- cameras
- displays
- other remote sensors
  (e.g. tuner, ultrasonic sensor array in the bumper or radar systems)
- high power sensors (e.g. cameras including image processing like stereo multi purpose camera)
- complete external sensor/actuator ECUs
  (e.g. door-ECU, complete mirror or overhead control unit)

start-up of PoDL-powered IEEE802.3bp link

- common understanding of timings

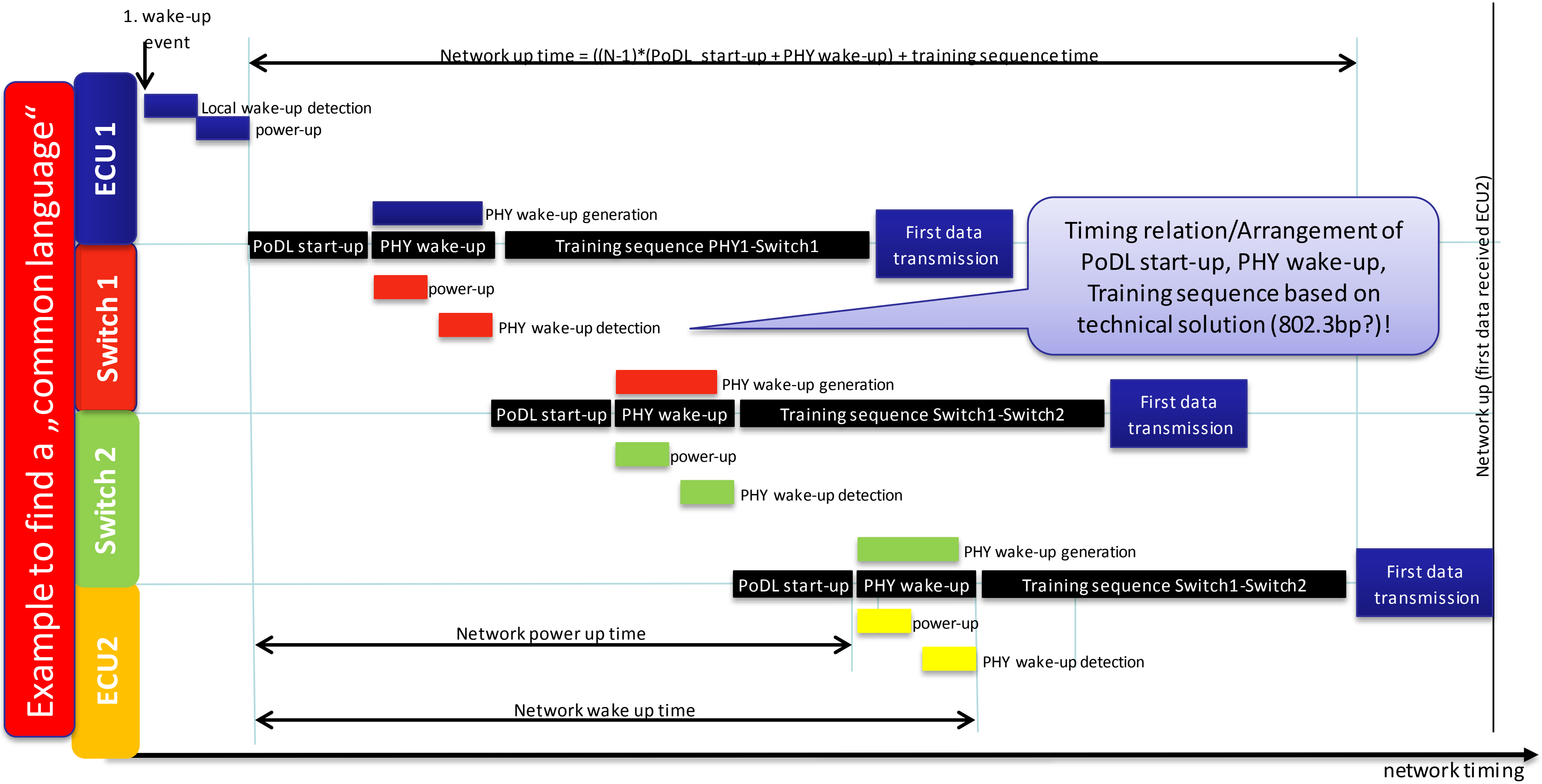


start-up timing requirements

- Until a complete network is powered up, we should have time of a less then **100ms** to start-up the power (after this the data links have to start up)
- For networks with e.g. 5 hops, this would lead to a PoDL start up time of 20ms per link, if links are powered up successively.
- If the network needs a dedicated wake-up process (after PoDL power-up and bevor training sequence), this should also be included within this **100ms** for the complete network. For a 5-hop network, which in cooperates PoDL and PHY wake-up, this could lead e.g. to 10ms PoDL start-up and 10ms PHY start-up per link , if links are powered up successively.
  → timing has to be coordinated with 802.3bp
  (For OEMs the complete time to start-up network/system is finally relevant, see following two slides to find a „common language“)
- To allow these numbers (or even faster) we expect the need of „fixed“ power classes to allow fast start up – Plug‘n‘Play won‘t be able to be that fast?

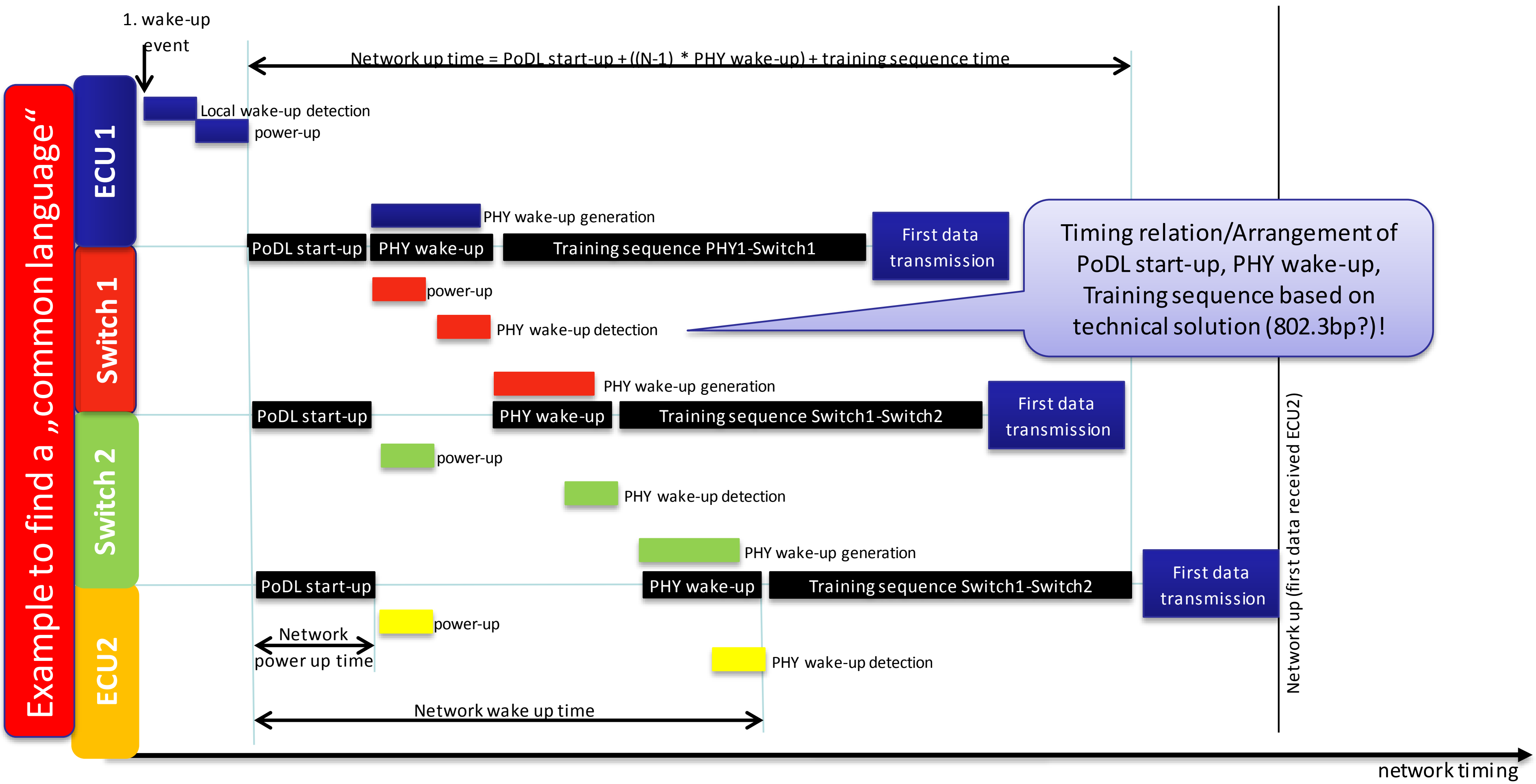
power-up, wake-up and link-up process

- Example: Start-up of of a 3-hop network (a network with N=4 nodes, example), if links are powered up successively



power-up, wake-up and link-up process

- Example: Start-up of of a 3-hop network (a network with N=4 nodes, example), if PoDL links are powered up parallel (see later)



power classes

- OEMs have „designed networks“:
  They know the power consumption of every PD-ECU very well!
  They also know exactly what maximum power a PSE-ECU has to deliver!

- The need of cost optimization does not allow to design every PSE-ECU to the maximum PoDL specified power, but only to the maximum needed power
  → To find a optimum between P‘n‘P PoDL and individual power supply design PoDL has to provide multiple standardized power classes to design the supply network

- To allow the OEM to design his network in an optimized manner, the power classes (later on shown) should be individual for powered device (PD), coupling network (CN) and power sourcing equipment (PSE)

power classes - proposal for definition

- Below an example of how power classes could be defined is shown:
  - 5V, 12V and (maybe) 48V are the typical voltage levels (12V e.g. means 6V…18V according to OEM supply voltage specifications, e.g. MBN LV 124)
  - Definition is individual for PSE / CN /PD to allow network design for OEMS
  - VI is a Plug'n'Play class, which should be compatible with the fixed power classes
  - Focus is the maximum available power and appropriate scaling possibilities
- Maybe some of the power classes (e.g. 5V,1A and 12V,1A) are not worth to distinguish?
  → feedback from component suppliers necessary
- The following tables should be seen as an proposal, however details can be discussed

Definition of Power Classes (example)

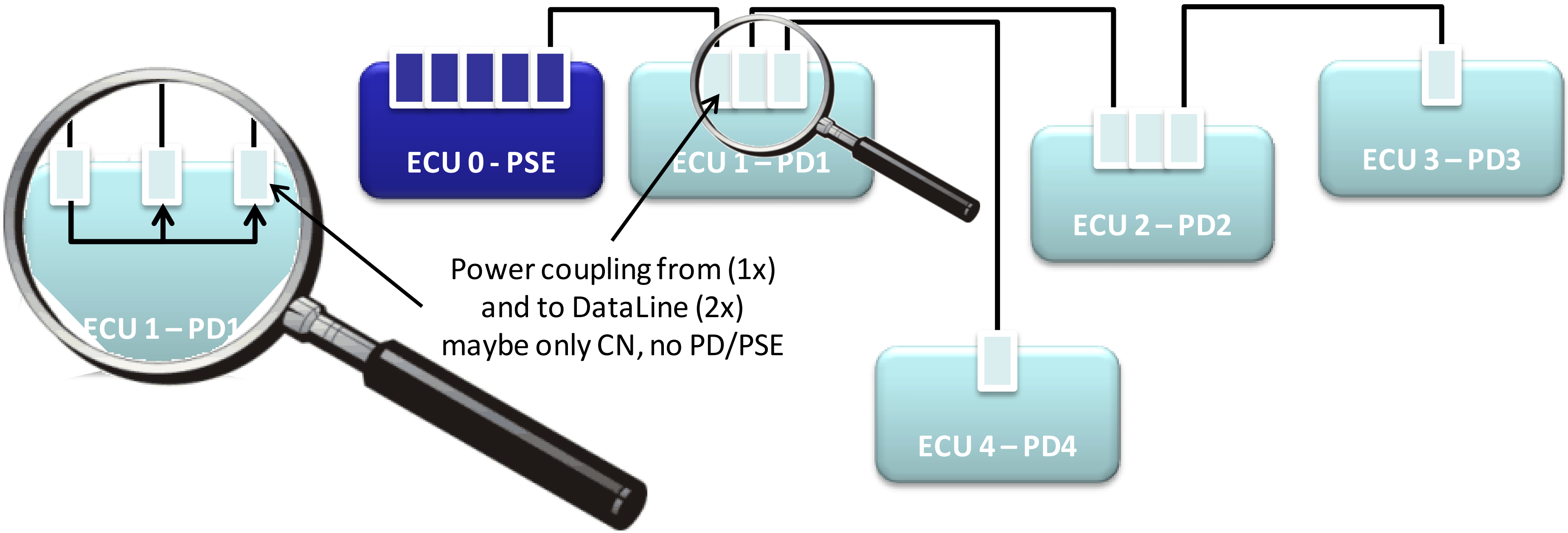
PSE chip						
PowerClass	min input voltage [V]	max. input voltage [V]	output voltage [V]	max output current [A]	max. power [W]	input robustnes requirements
I (5V)	*t.b.d.*	*t.b.d.*	e.g. 7	0,5	2	maybe less stringent
I (12V)	*t.b.d.*	*t.b.d.*	12	0,5	2	hard (Vbat)
II (5V)	*t.b.d.*	*t.b.d.*	e.g. 7	1	5	maybe less stringent
II (12V)	*t.b.d.*	*t.b.d.*	12	1	5	hard (Vbat)
III (12V)	*t.b.d.*	*t.b.d.*	12	2	10	hard (Vbat)
IV (12V)	*t.b.d.*	*t.b.d.*	12	5	25	hard (Vbat)
IV (48V)	*t.b.d.*	*t.b.d.*	48	5	25	hard (Vbat)
V (12V)	*t.b.d.*	*t.b.d.*	12	10	60	hard (Vbat)
V (48V)	*t.b.d.*	*t.b.d.*	48	10	60	hard (Vbat)
VI	*t.b.d.*	*t.b.d.*	48	10	60	hard (Vbat)

Coupling Network			
PowerClass	max. Voltage [V]	max. Current [A]	max. Power [W]
I (5V)	7	0,5	2
I (12V)	18	0,5	2
II (5V)	7	1	5
II (12V)	18	1	5
III (12V)	18	2	10
IV (12V)	18	5	25
IV (48V)	60	5	25
V (12V)	18	10	60
V (48V)	60	10	60
VI	60	10	60

PD chip					
PowerClass	min input voltage [V]	max. input voltage [V]	output voltage [V]	max output current [V]	max output power [V]
I (5V)	5	7	5	0,5	2
I (12V)	5	18	12	0,5	2
II (5V)	5	7	5	1	5
II (12V)	5	18	12	1	5
III (12V)	5	18	12	2	10
IV (12V)	5	18	12	5	25
IV (48V)	5	60	48	5	25
V (12V)	5	18	12	10	60
V (48V)	5	60	48	10	60
VI	5	60	5/12/60	10	60

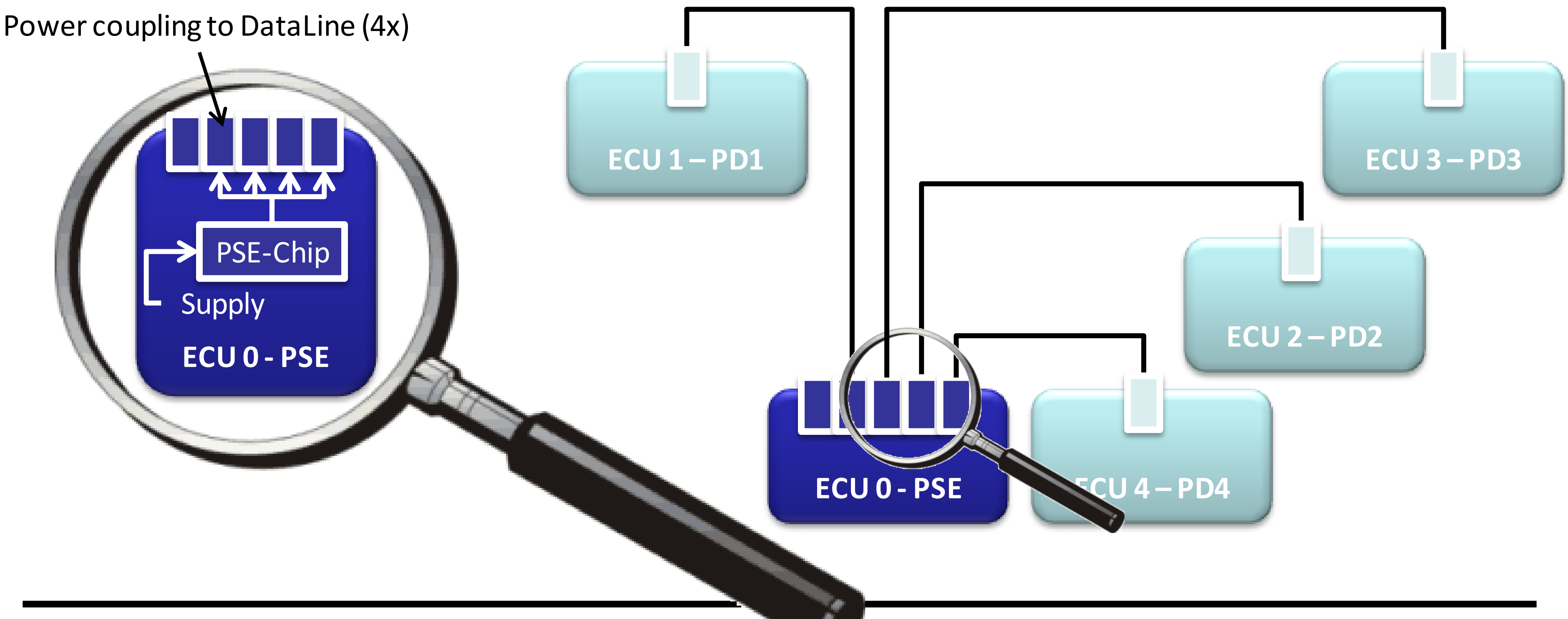
possible further requirements

- **PoDL daisy chaining:**
  more than one PD in a network/daisy chain configuration!
  Remark: OEM knows max. network topology and power requirement, so PSE can be chosen accordingly (e.g. PowerClass IV(12V) PSE can source 5 PowerClass II(12V) ECUs with appropriate power coupling).



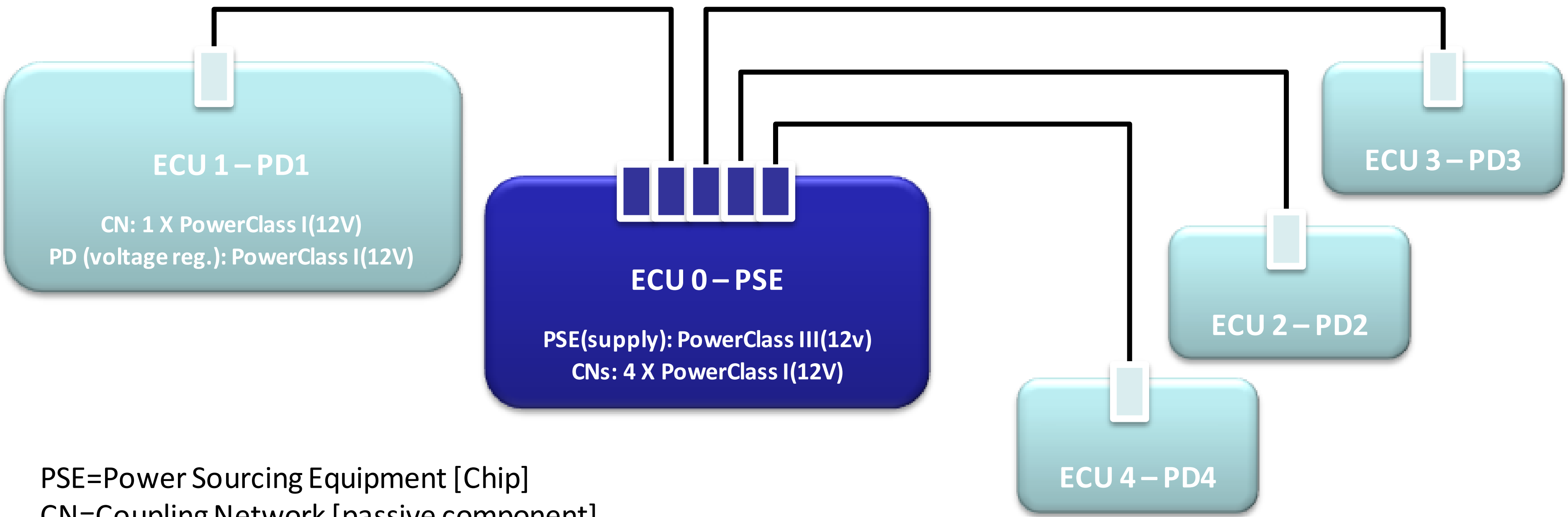
possible further requirements

- **Parallel PD sourcing** from one PSE!
  Remark: OEM knows max. network topology and power requirement, so PSE can be chosen accordingly



separate Classification of individual components in a network

- Due to individual design each system, every component of a designed network can be of a different PowerClass:



PSE=Power Sourcing Equipment [Chip]
CN=Coupling Network [passive component]
PD=Powered Device [voltage regulator]

further requirements/remarks

- No influence on data link (clear…)
- Maximum PoDL segment length should be 15m
- Well defined fault detection and error handling:
  e.g. Switch off and signaling to PSE Microcontroller
- robust to cabling failures (pin swap, short to GND, Vbat, …)
- Voltage droop over DataLine is acceptable (e.g. PSE=7V, PD=5V)
- …

MBN LV124/148 – max/min voltages

12V net – MBN LV124

type	duration	maximum voltage
under-voltage	-	**6V**/8V/9V *)
over-voltage	Long-term (>60s)	16V/**26V** **)
transient over-voltage	Short-term (300ms)	**27V**

*) depending on function (e.g. availability during engine start)
**) 16V=maximum operating voltage, 26V=jump-start (starting from a 24V truck battery)

48V net – MBN LV148

type	duration	maximum voltage
under-voltage	-	**24V**/36V
over-voltage	Long-term (>60s)	54V (60V?)
transient over-voltage	Short-term (100ms)	**70V**