LonWorks

LON (Local Operating Network) LonWorks® on detsentraliseeritud seadmete ja tarkvara platvorm:

- võrgu protokoll LonTalk® on väljatöötatud Echelon firma pool ja jõudnud standardiks: ANSI/(EIA)CEA709.1, IEEE 1493-L, CEA-852, ...
  - ISO/IEC/EN 14908:2006,2014 Control Network Protocol (CNP) - LonTalk
- spets.mikroprotsessor – Neuron chip (mitmed tootjad)
- transiiverid erinevatele võrgumeediatele
- Oli OpenLNS (LON Network Services) Network Operating System – võrguteenuste infrastruktuur (client-server, DB, managm.tools, +PlugIns)
  - nüüd **IzoT Net Server** https://www.arigo-software.de/en/shop/network-tool.html
- Interneti ühendused(UI) läbi Web services (XML SOAP calls, OPC, dde, LonMark profiles)

Koostalitlusvõime tagab LonMark® International sertifitseerimine

Platvormi ülesehitus on niipalju universaalne, et kasutatakse lisaks arukate hoonetele veel ka tööstuslikus automaatikas ja transpordivahendite juhtimises.

https://edgesupport.diasemi.com/

Renesas(2021 Dialog Semiconductor(2020 Adesto (2018 Echelon)))

LON seadmete kasutamine

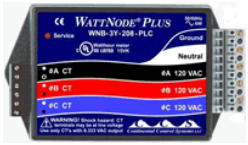
Üle 900 (2015.a.) certified interoperable products (seadmete AB suurem:1300)
Installitud üle 500 000 projekti (Eestis nt EÜP, KUMU, Saku SH, Lennuj, TTÜ, EE, CCPlaza, VV jm)
lonmark.org/connection/case
Installeeritud üle 110 miljoni seadme (35 milj. smart meters)
Ligi 400 OEM arendaja ja üle 700 sertifikaadiga profi. (**vorguvara.ee**[2] **tml.ee**[3])
Online training and test
LonMark Authorized Training & (**ecomatic.ee** **merx.ee**)
Testing Centres euroopas 11 tk.

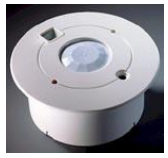
https://www.lonmark.org/technology/certification/

LonMark Task Groups ;

PML, TML

BAS (Sheduling, Alarming, Logging, Calendar)
HVAC (Pump, Therm., AHU, VAV, ...)
Home, **Utility** / **Energy** (metering),
Fire/Smoke, Safety
Security , Access, Monitoring
Services, Automated Food Service
Lighting, Refridgeration,
Sunblinds, Wheather,
Industrial, Transportation, Elevators ,
Connectivity





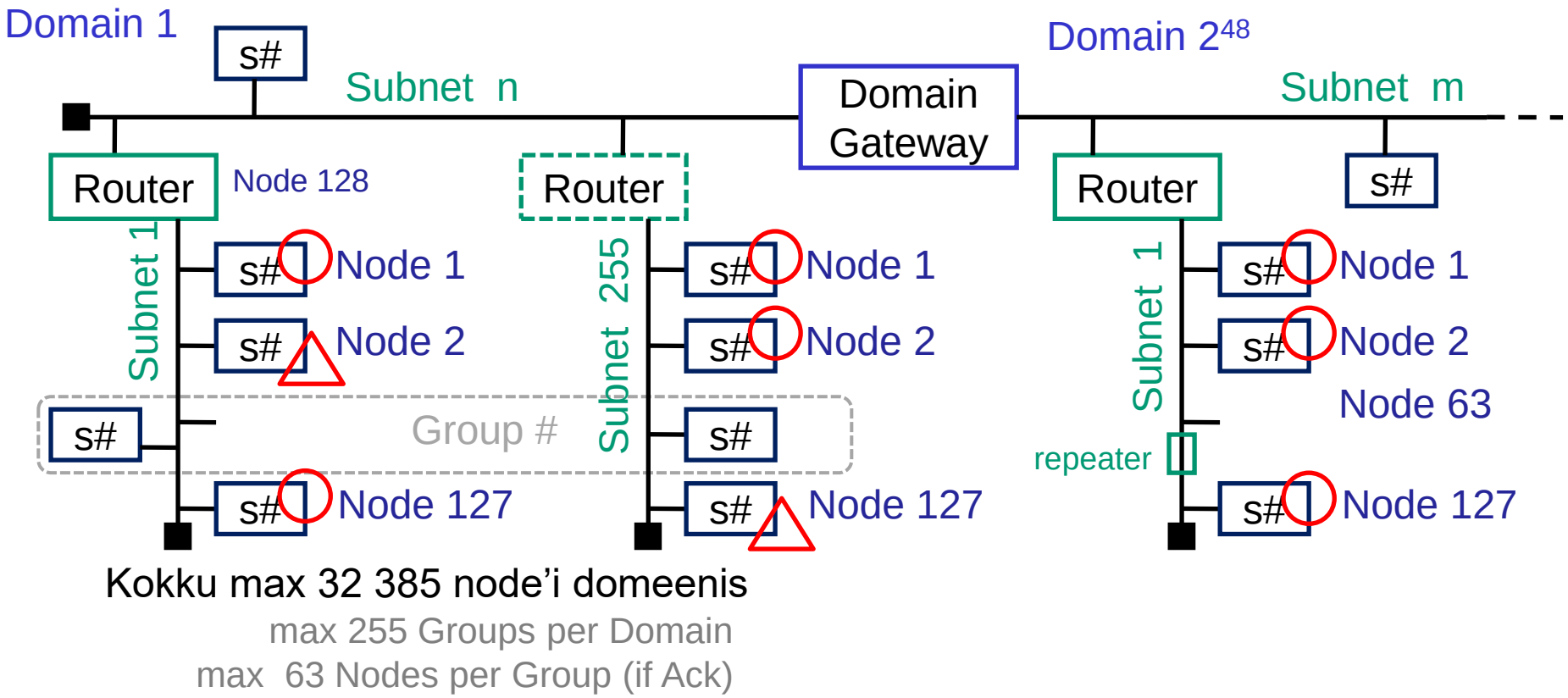
https://youtu.be/mrqC_GiLKAc?t=30s

Tänavavalgustuse juhtimine (üle PL)

Profile Updates: **Outdoor Streetlighting**, **Renewables**, ..

LonWorks for Smart Grid,2.0

LonWorks adresseerimine (EIA-709)



Kokku max 32 385 node'i domeenis

max 255 Groups per Domain

max 63 Nodes per Group (if Ack)

Unicast - sõnum ühele konkreetsele (Neuron ID s# | Subnet#/Node#)

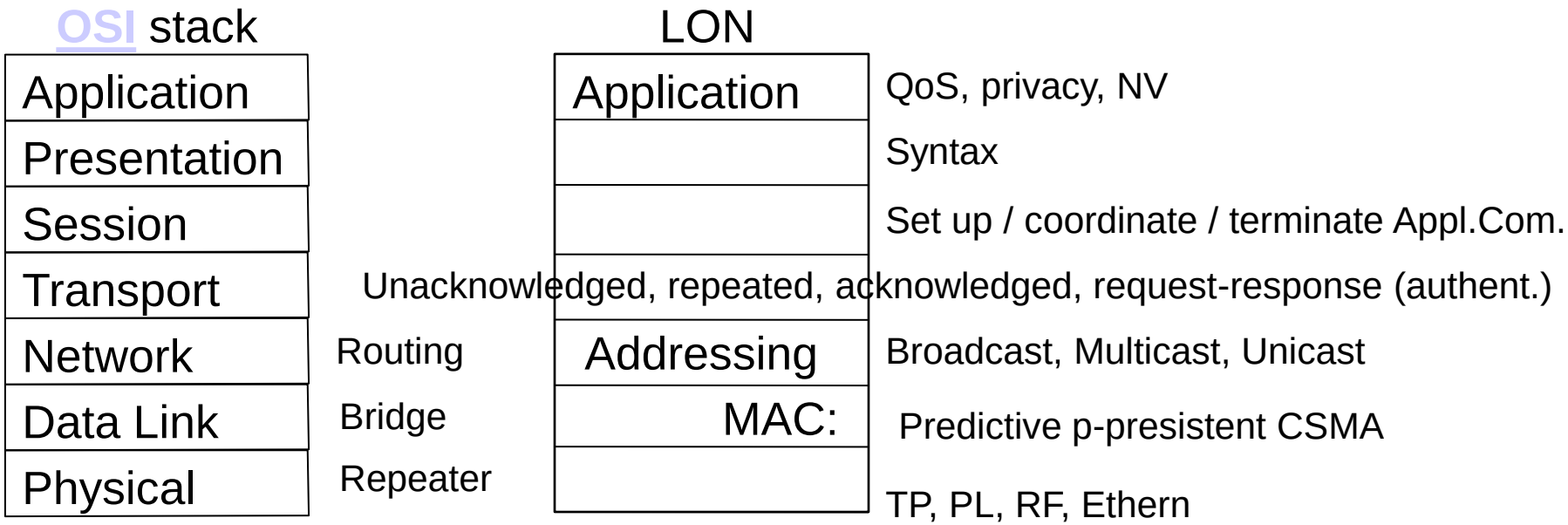
Multicast – sõnum mitmele (Group #) või kõigile alamvõrgus (Subnet#)

Broadcast – sõnum kõigile domeenis (Domain#)

Lisaks tavalisele liinile lubatud ka vaba topoloogia (täht, ring). Kasutades repiitereid, ruutereid ja lüüse ning terminaatoreid tuleb tagada võrgu õige koormus ja saatevigade esinemise vähesus. (*Network diagnostics built-in*)

LON com kihid

Spetsifikatsioon täidab kõik ISO OSI mudeli kihid.



P2P-arhitektuur, sõnumite kättetoimetamise kinnitused ja määratus, autentimine, seadmete kaughaldus (konf., programmi laadimine, start/stop jm). Seade ei pea võrgu topoloogiat teadma ja saab suhelda ("*field level interoperability*") .

Rakenduste liidestamiseks (*binding*) on **NV**'s - *network variables* (in / out). Lisaks on sõlmede vaheliseks suhtluseks otsesed info sõnumid.

LonMark Higher Level Standard Services; Scheduling, Alarming, Trending, Overrides, Energy Demand Response, ..

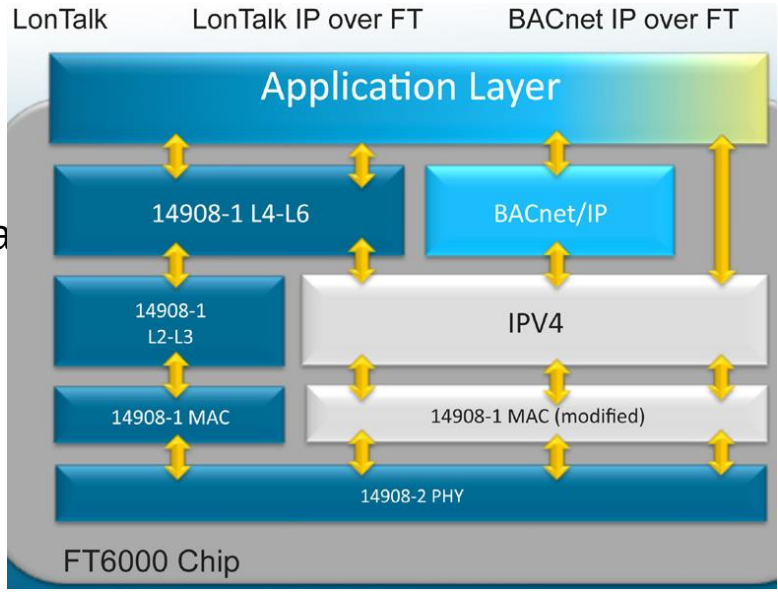
Neuron

Neuron mikrokontroller (uus 6000 seeria) realiseerib LonTalk protokolli ja jooksutab rakendus-programmi, mis suhtleb läbi I/O ploki andurite ja täituritega. Kahe mikroskeemiga komplekt kõrgema jõudluse jaoks.

Echeloni litsensi alusel tootjaid oli varem vaid Motorola, Toshiba ja Cypress, nüüd rohkem. (LON protokolli pinu on realiseeritud ka muudel chipidel nt koos ARM MCU-ga)

Neuron® 6050 *& Smart Transceivers*

Neuroni mikroskeemis tegeles kahe alumise kihiga(meediale juurdepääs) spets protsessor, üks 3-6 kihiga (Network CPU)
ja üks rakenduskihiga (seal jookseb seadme tootja a
(+ 1 katkestustega al. 5000 seeriast)
Paralleelsete protsesside jooksutamiseks
Neuronis kasutati paralleelse programmeerimise keelt Neuron-C.



Arendusvahendid: https://www.dialog-semiconductor.com/products/communications

Arendajate võrguhaldustööriistad ja infrastruktuuri vahendid.

IzoT NodeBuilder - arenduskeskkond, lisaks veel protokolli analüsaator,

Free SDK http://iecdocs.diasemi.com/display/DrftIzot/IzoT+SDK+Software+Download

FT 6050 EVK maketi ja softiga = 1040€

Free SDK **izot-sdk-2**

enables developers to build communicating devices for the **Industrial Internet of Things**. And to build a Web application server for IzoT networks that connects the IzoT devices to Web clients with an easy-to-use RESTful API.

source code for a LonTalk/IP protocol stack for devices based on 32-bit or 64-bit processors;
source code for a server stack with RESTful API for rapid Web page and enterprise software development;
Includes new IzoT Vision JavaScript library for faster custom Web page development (new for IzoT SDK 2);
Supports devices that communicate on Ethernet (LonTalk/IP-EN) and Wi-Fi (LonTalk/IP-Wi-Fi) media;
Supports communication with an IzoT Router, providing compatibility with LonTalk/IP devices on free topology (FT) twisted pair channels (LonTalk/IP-FT). it is possible to use the free software solution called “IzoT™ sdk2” for the LON part, in association with a **BACnet**™ protocol stack.
Supports complex controllers with support for up to 32,767 address table entries and 32,767 simultaneous transactions
Compatible with **Raspberry Pi** with Raspbian Linux and BeagleBone Black with Debian Linux; may be ported to other processors and operating systems
Ready-to-run images available for the **Raspberry Pi** and BeagleBone Black providing a quick start for the IzoT SDK; source archive available for porting to other platforms supporting your choice of host and operating system
Standard Edition available for Free Download

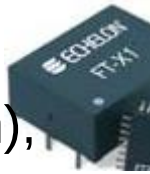
https://youtu.be/YpK5rJolcVI

In minutes you’ll be able to:

- Evaluate Echelon’s free topology twisted pair or power line based LonWorks application development and the benefits of LonWorks control networking
- Write applications using our example control networking application source code
- Experience the ease of developing devices that don’t require installation tools such as home appliances
- Demonstrate the benefits of the ISO/EN 14908-1 Control Network Protocol

LON Võrgumeediad

Transiiverid erinevatele võrgumeediatele:



- twisted pair **TP|FT*-10**; 78kbps(<2700m, bus), ***/XF*** 1.25Mbps(<130m),
  LPT***** – toide siini kaudu (<2200m, CAT5 < *400m)
- power line **PL*-20**; 5.4kbps,
  spread spectrum 100-450kHz, narrow band 125-140kHz bpsk),

- radio frequency (RF, 433.0-472.1MHz EU, fsk),

infrared (IR), RS-485, coaxial cable(CX) and fiber optics(FO;1.25Mbps),

- EIA-**852 IP** (*Tunneling* läbi stand. Etherneti ruuterite)

ISO/EN 14908-4; IP-852 CNP over IP
EN 14908-7; IP-70,100 Gen. IPv6 UDP#2541
EN 14908-8; HD-PLC
https://youtu.be/LbLKZTodA-g

LON BCU
= Transceiver +
+ Neuron, memory
+ Service LED
+ Service button
+10-pin application module interface
(EIB compatible)

*FT – Free Topology (subn < 500m, < 64 nodes)

LonWorks protocol – LonTalk kaader (*frame*)

TP andmeside kaadri formaat

Data Link kihilt

Reciever Bit sync.

Priority, # packets

48 bit Neuron(ID) *physical* aadress | *logical* aadress

1 ... 228 bytes

Cyclic Redun-dancy Check

Code Viola-tion

IV Serv. Type ID, (1 byt)
V Session Hdr. (2 byt, NV selector)
VI Present. Hdr. (2 byt)

↑ OSI kiht (*Layer*)

https://www.lonmark.org/webinars/recording/

LON seadmete koostalitlusvõime

Interoperability through LonMark International (2003) certification (more than 300 members).
–Vendors test their products using Web-based LonMark Certification Tool.
–LonMark checks the product documentation including XIF files
–There is still room for proprietary (vendor specific) extensions

LonMark® (http://www.lonmark.org) –Is the trademark and symbol of certification of the LonMark Interoperability Association (since 1994)

•Interoperability guidelines (1-6 Layers, App. Layer)

https://www.lonmark.org/technology/technology/

Task Groups define standard functional profile templates (**SFPT**s)[158]
+ standard network variable types (**SNVT**s)[225] *“snivvets”*
+ standard configuration property types (**SCPT**s)[409]

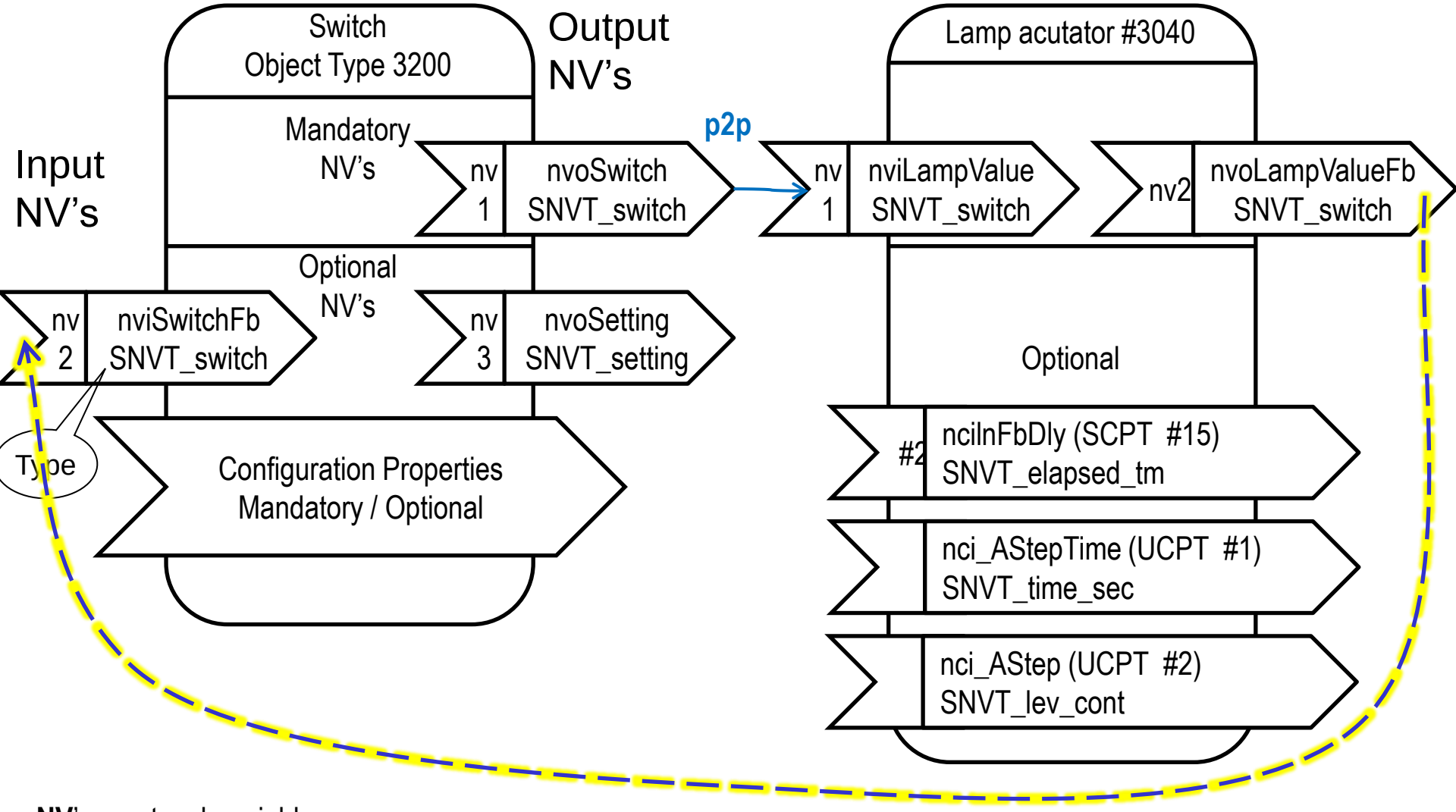
https://www.lonmark.org/technology/technical-resources/resource-files/

Tootjale jäetud vabadus määrata lisaks ka mittestandardseid tüüpe (*User-defined* **U**NVT, **U**CPT), mis lubab erinevusi ☹

Igal SNVTüübil on suurys (bytes), väärtuse vahemik (ülem-/alampiir), täpsus ja ühik (SI)

LON Standard Functional Profile Templates (SFPTs)

Nt. Lüliti ja lülitava täituri SFP



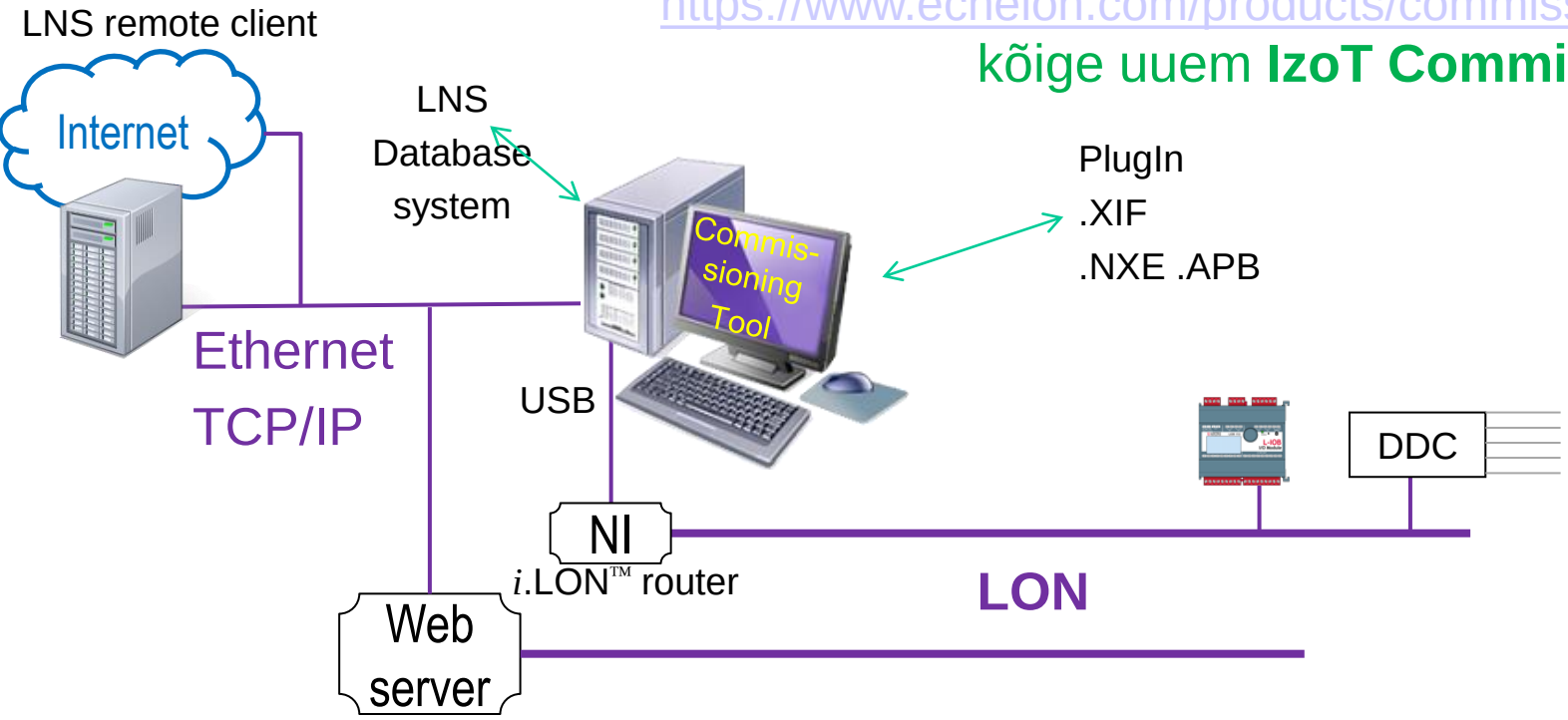
NV's – network variables

LON seadistamine

Varem kasutatavaim oli Echelon LonMaker Integration Tool, aga mitmetel tootjatel on oma vahendid üle võrgu seadistamiseks

https://www.echelon.com/products/commissioning-tool/izot

kõige uuem **IzoT Commissioning Tool**



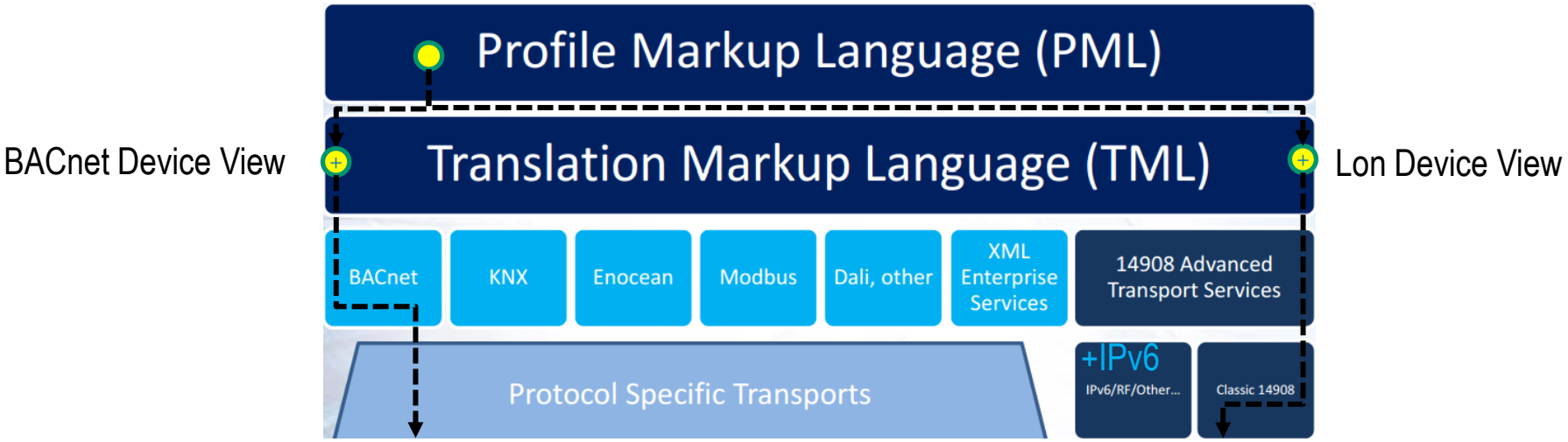
Seadmete tootja annab kaasa konkreetse mudeli FP (rakenduse), NV-d ja CP(malli) standardkirjeldused nt XIF, NXE või APB failina. LM2.0 kogu kirjeldus PLM/TML definitsioonis. Konkreetsed seaded laetakse LNS vahendusel ja seostamine tehakse integreerimise tööriista abil.

LonMark 2.0

Interoperability Platform

Advanced Transport Services
Profile Markup Language (PML) – XML abstract def, +subsystems profiles
Translation Markup Language (TML) – translates (maps) Profile Objects to industry protocol specific details; coding rules, addresses

Profile Advocacy Program – educ. value device profiles
Grid Connected Buildings – OpenADR, load cntr
System Integrator Program (2010 ...
Training Programs (2006 ..., new



DALI - Digital Addressable Lighting Interface

www.dali-alliance.org

2014. DALI **2** (eelnevaga ühilduv)
Spetsiifiliselt valgustuse juhtimise jaoks (avatud standard IEC 62386, EN)

Koostöövõime sertifitseeritud testimine (ka tarkvaraga) >2300

Kuni 64+64 seadet (ballast, trafo, andur, lüliti jm) ühes segmendis ja lüüsidega mitu võrku koos. Iga seade adresseeritav. Staatuse tagasiside. Liini, tähe ja sega topoloogia. Juhtmevaba laiendus.

256 valgusviljakuse taset, tulevane ühilduvus ohutussüsteemide valgustusega, väljundi balansseerimine LED-de jaoks.
Lüüsidega seotav ka teiste hoone andmesidevõrkudega.
D4i™ *enables DALI for intelligent, IoT-ready luminaires*.

Original DALI loop can contain up to 64 individually addressable devices. Additionally, each device can be a member of 16/32 possible groups. Devices can store lighting levels for power-on, system failure and 16 scene values, plus fading times. There are also immediate commands (without store functionality) and commands for status feedback (such as lamp status). Assignment of addresses, group membership and scene values is possible via the bus. Loops can be up to **300 m** long, with free topology. The data rate is 2400 bps using a master–slave-based, asynchronous protocol. Since biphase coding is used, the net data rate is 1200 bps. A message cycle consists of the master sending a request (in-channel) consisting of the 7-bit slave address (1 bit is used for selecting between individual and group addresses) and a 9-bit command. A slave (ballast) may then return an 8-bit value (out-channel), and the cycle starts over.

M-Bus (meter-bus) http://www.m-bus.com

Kaugloetavate mõõdikute jaoks.

EU standard EN 13757-2,3,4

Integreeritav teiste hoone võrkudega, lüüsid IP võrkudesse.

Alamseadmete toide liinil.

Individuaalselt adresseeritavad vee-, gaasi-, sooja-, elektriarvestid, klapid ja täiturid ka.

Keerupaar liini topoloogiaga + juhtmevaba.

Includes support for advanced functionality like multiple tariffs. A segment can contain up to 250 devices and cover a maximum distance of 1000m (multiple segments are possible). In the master-to-slave direction, data is transmitted using voltage modulation, while in the reverse direction, current modulation signalling is used.

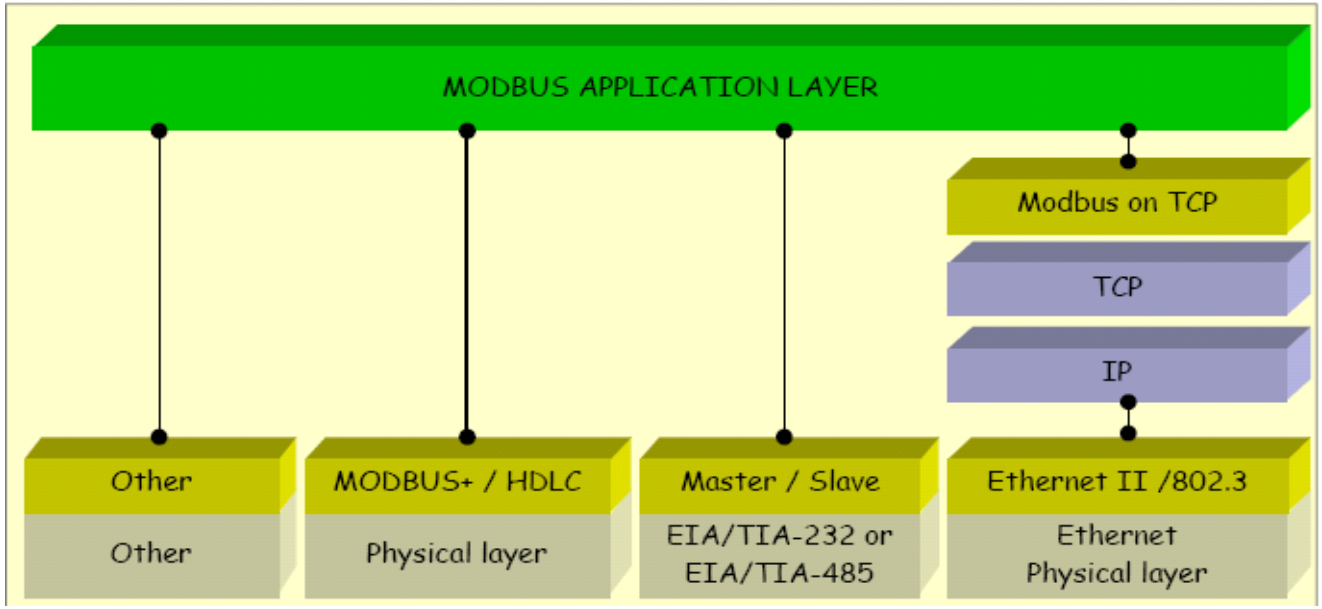
The bottom two layers of **KNX RF** were defined jointly with the wireless meter readout standard EN 13757-4:2005.

ValueInField counter value unit and resolution (+M-bus Address) enconding used in KNX.

Wireless M-Bus 868 MHz with a max speed from 4.8 kb/s to 100 kb/s. Meters start periodically the send.

Modbus

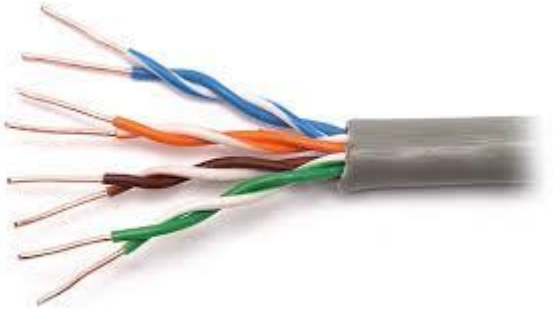
Hoonetes jahutusseadmete, katelde, ventseadmete juhtimisel. (+HMI)



Modbus-IDA,
http://www.modbus.org
Litsensivaba (open protocol 2004),

Master-slave (client-server),
(247 slaves)
19200 bps, Ethernet, IP

Võrgumeediate võrdlus



	TUGEVAD OM-d	NÕRGAD OM-d
TP	Kõrge töökindlus. Madal materjalide hind. Lihtoskustega kaabeldajad.	Madal...keskmine instal. hind.
PL	Kõrge töökindlus (v.a X10). Madal materjalide hind. Olemasoleva juhtmestiku peal.	Teatud seadmete paigaldamine nõuab elektriku pädevusega paigaldajat.
FO	Kõrge töökindlus ja DA kiirus Tundetu elektrihäiretele.	Suur materjalide hind. Instal. hind võib olla väga suur ja vajab oskustöölisi.
RF	Juhtmestamist pole vaja. Madal...keskmine materjalide hind.	Piiratud levik läbi mitmete seinte ja vahelagede. Installi hind sõltub asukohast. Võib vajada repiitereid. Töökindlus sõltub muuude segavate raadiosag. seadmetest. Patareide vahetus.
IR	Juhtmestamist pole vaja. Madal materjalide hind.	Väike tegevusraadius. Ei levi läbi takistuste. Töökindlus sõltub asukohast ja on mõjutatud teiste infrapuna allikatest (flouresent, ...)