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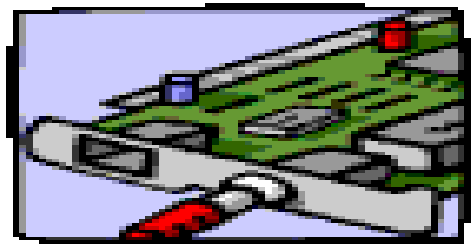

Bluetooth

Előadó:
Kajdocsi László

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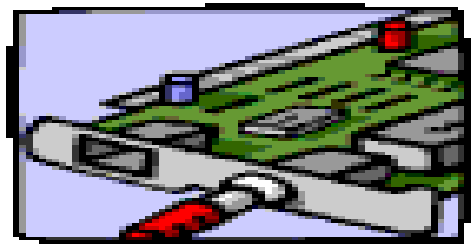
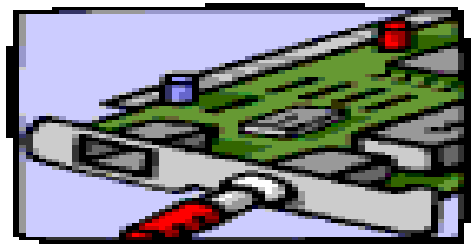
Bluetooth kialakulása



- 1994 L. M. Ericsson társaság
- Megalakul a SIG (Special Interest Group) – Ericsson, IBM, Nokia, Intel és Toshiba
- Elkezdődik a „Bluetooth” projekt, névadója II. Harald Blaatand viking király
- 1999 július: kiadták a Bluetooth 1.0-t
- 2004: Bluetooth 2.0
- 2009: Bluetooth 3.0
- 2010: Bluetooth 4.0 -> 2013: Bluetooth 4.1 -> 2014: Bluetooth 4.2

Jelenlegi Bluetooth szabványok



- Bluetooth Classic
- Bluetooth Low Energy

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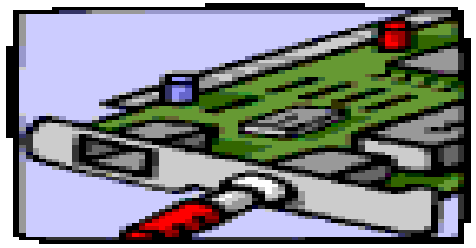
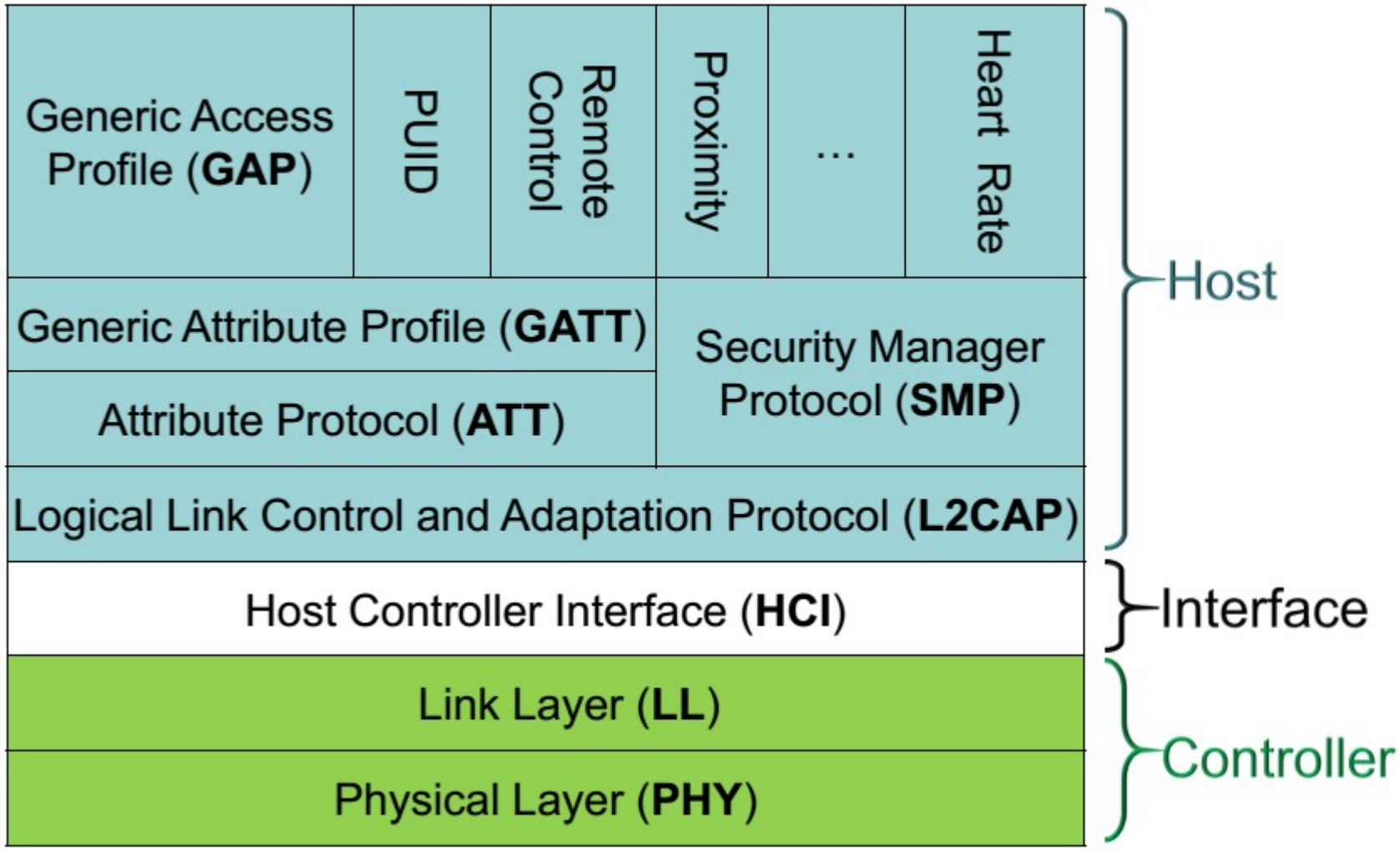
Protokoll architektúra (LE)





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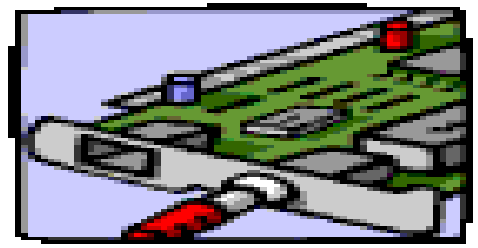
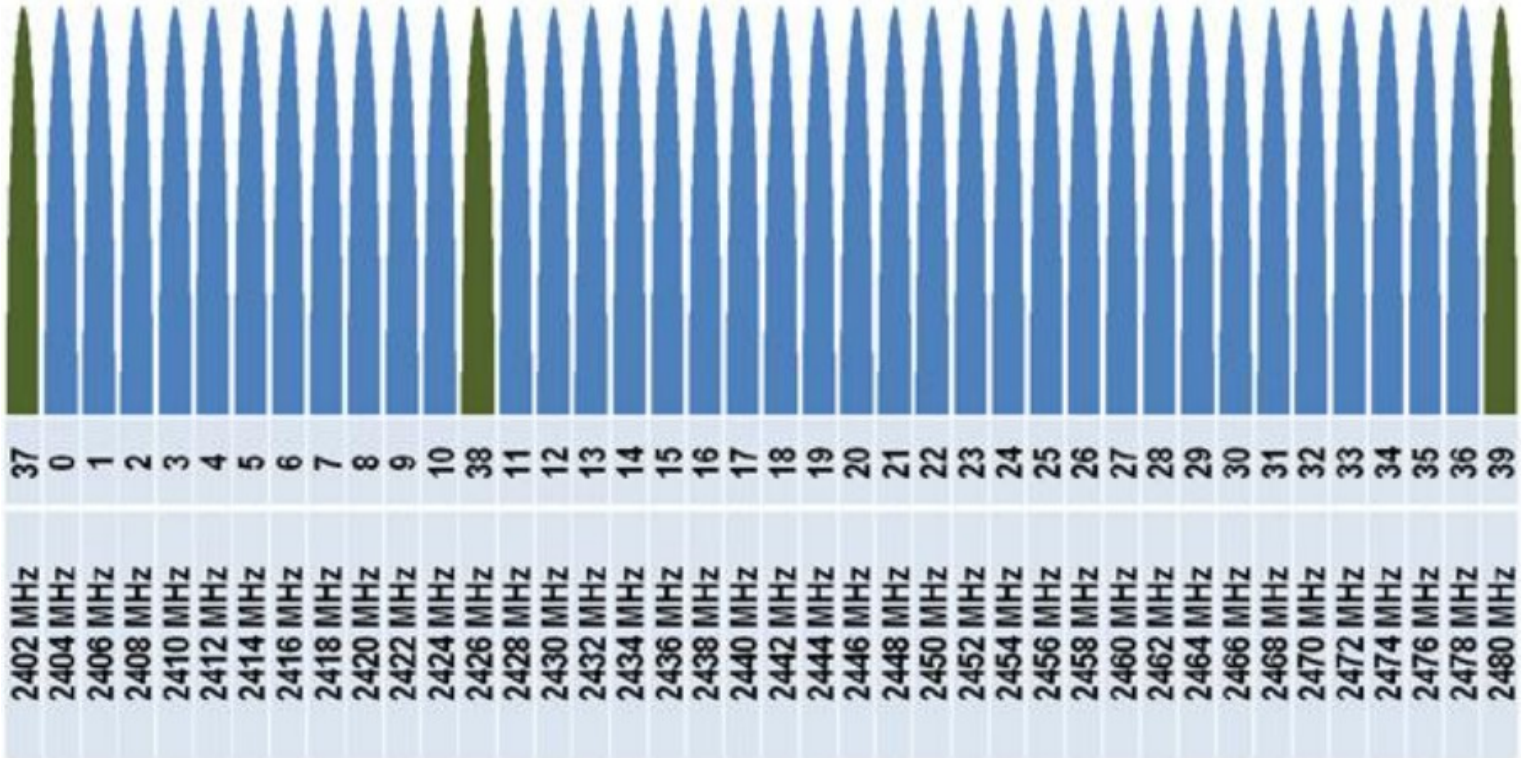
Csatornakiosztás



- Classic
  - 79db 1MHz-es csatorna
  - 2.4GHz-es ISM sáv
- Low Energy
  - 40db 2MHz-es csatorna
  - 2.4GHz-es ISM sáv
  - 3 hirdető csatorna
  - 37 adatátviteli csatorna



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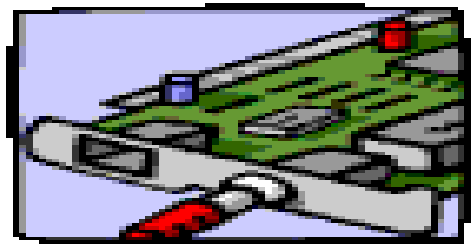
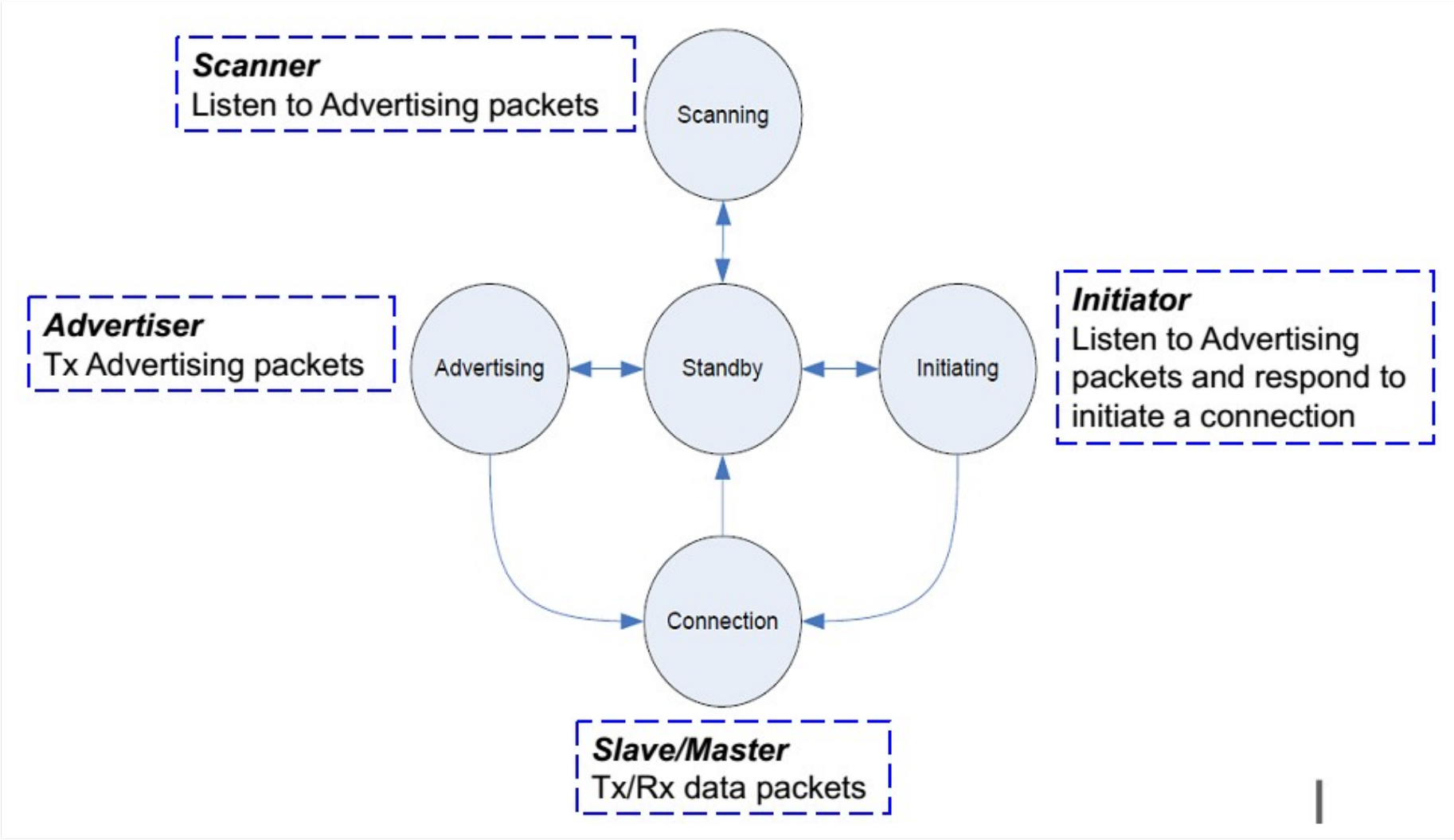
Link Layer: állapotgép





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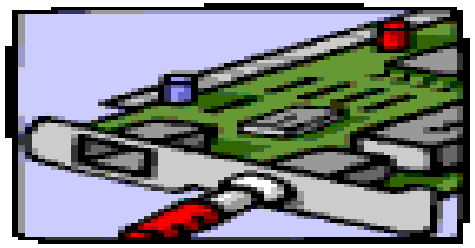
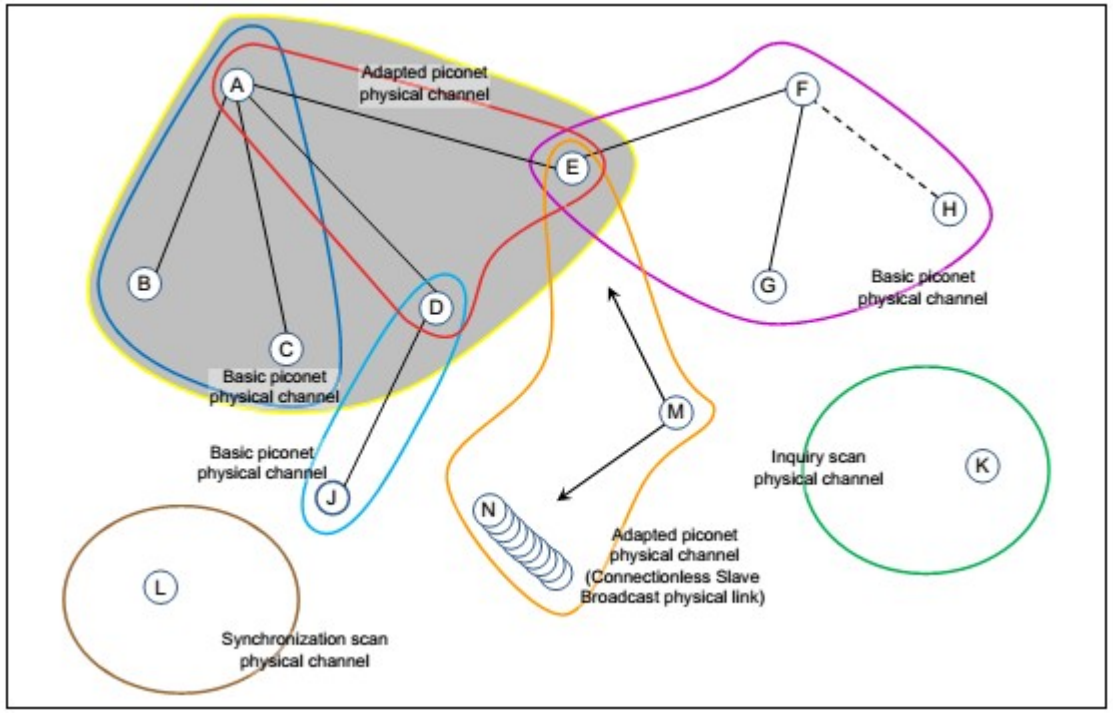
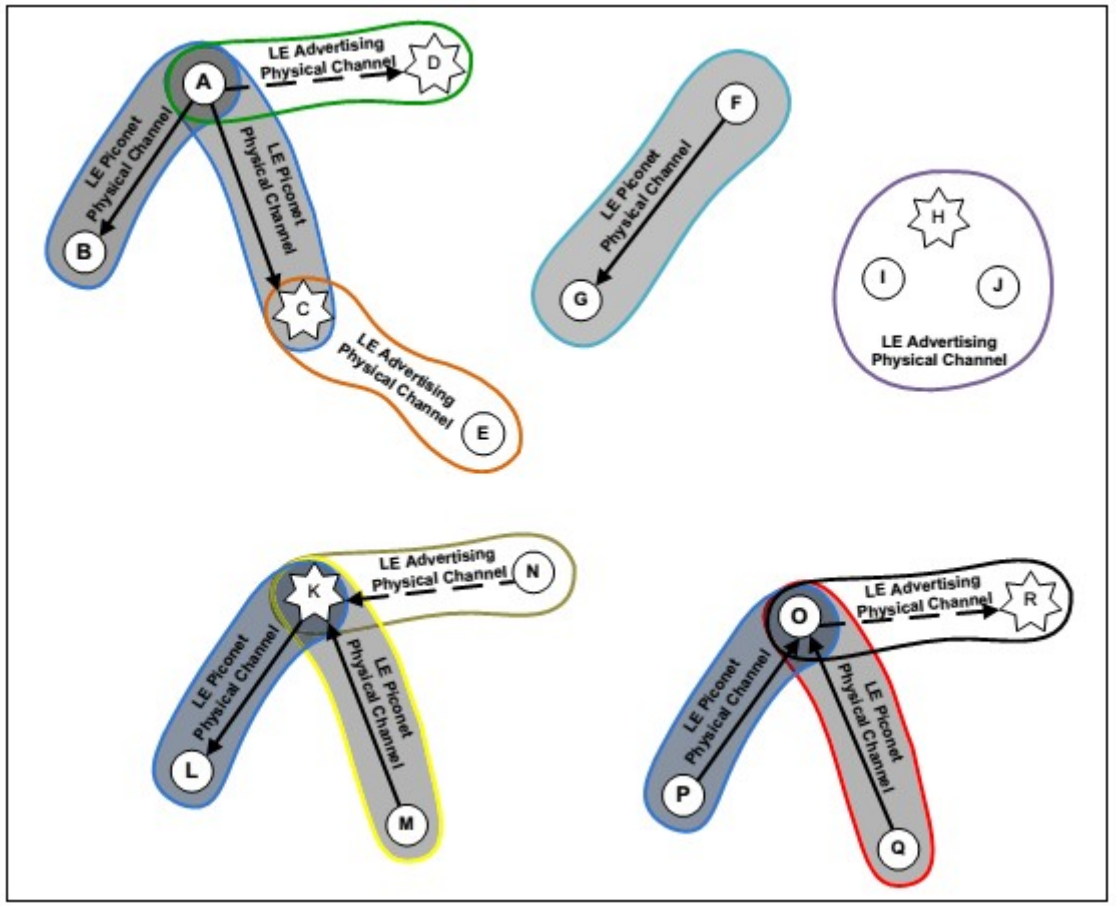
Topológia: PICONET



Classic



Low Energy



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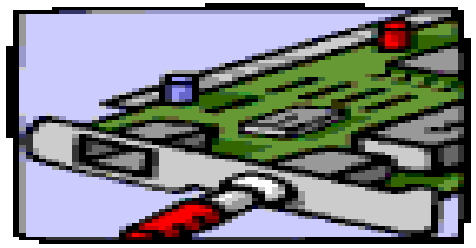
PICONET



- 1 Master
- 7 Slave (aktív)
- 255 Slave (várakozó)

Összekötött pikohálózatok: SZÓRT HÁLÓZAT (SCATTER)

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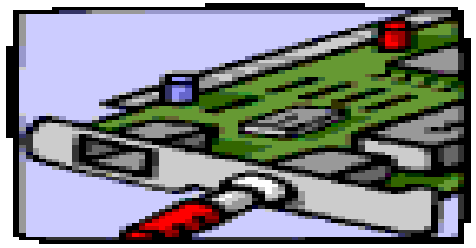
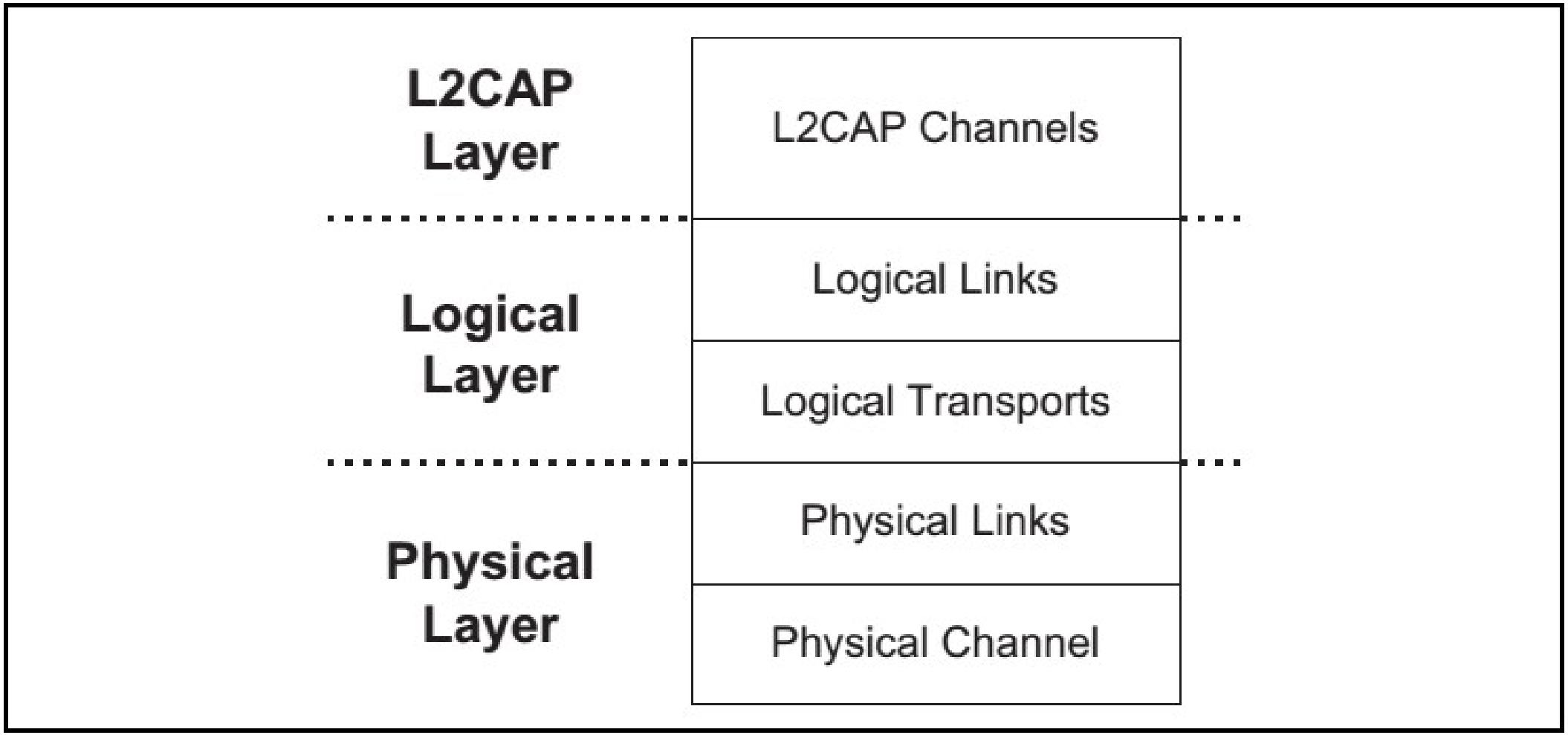
Adatátviteli architektúra





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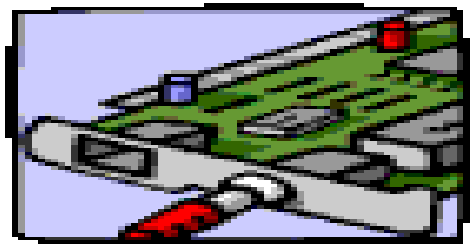
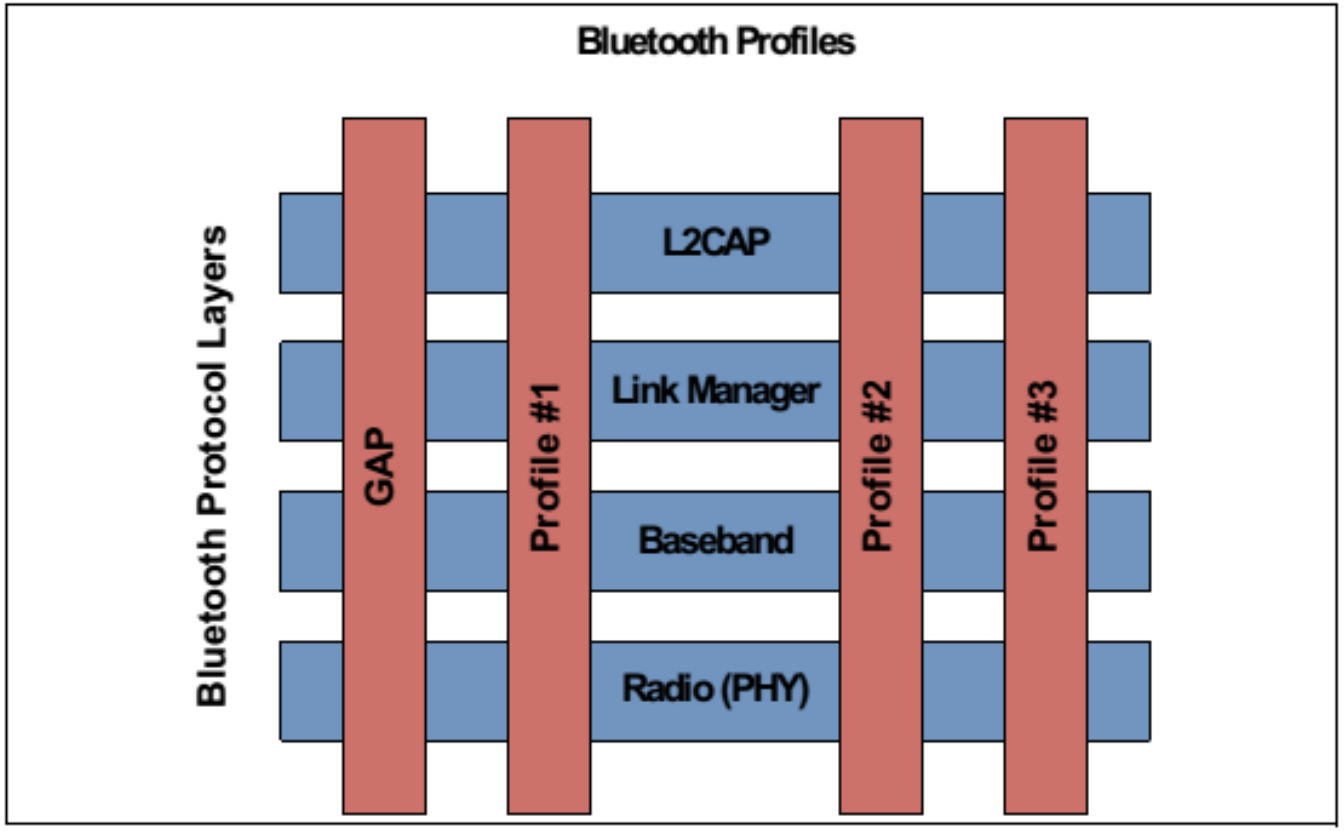
Alkalmazásszintű architektúra



Bluetooth profilok



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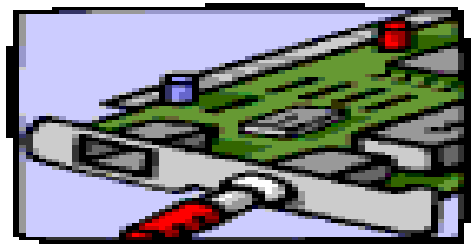
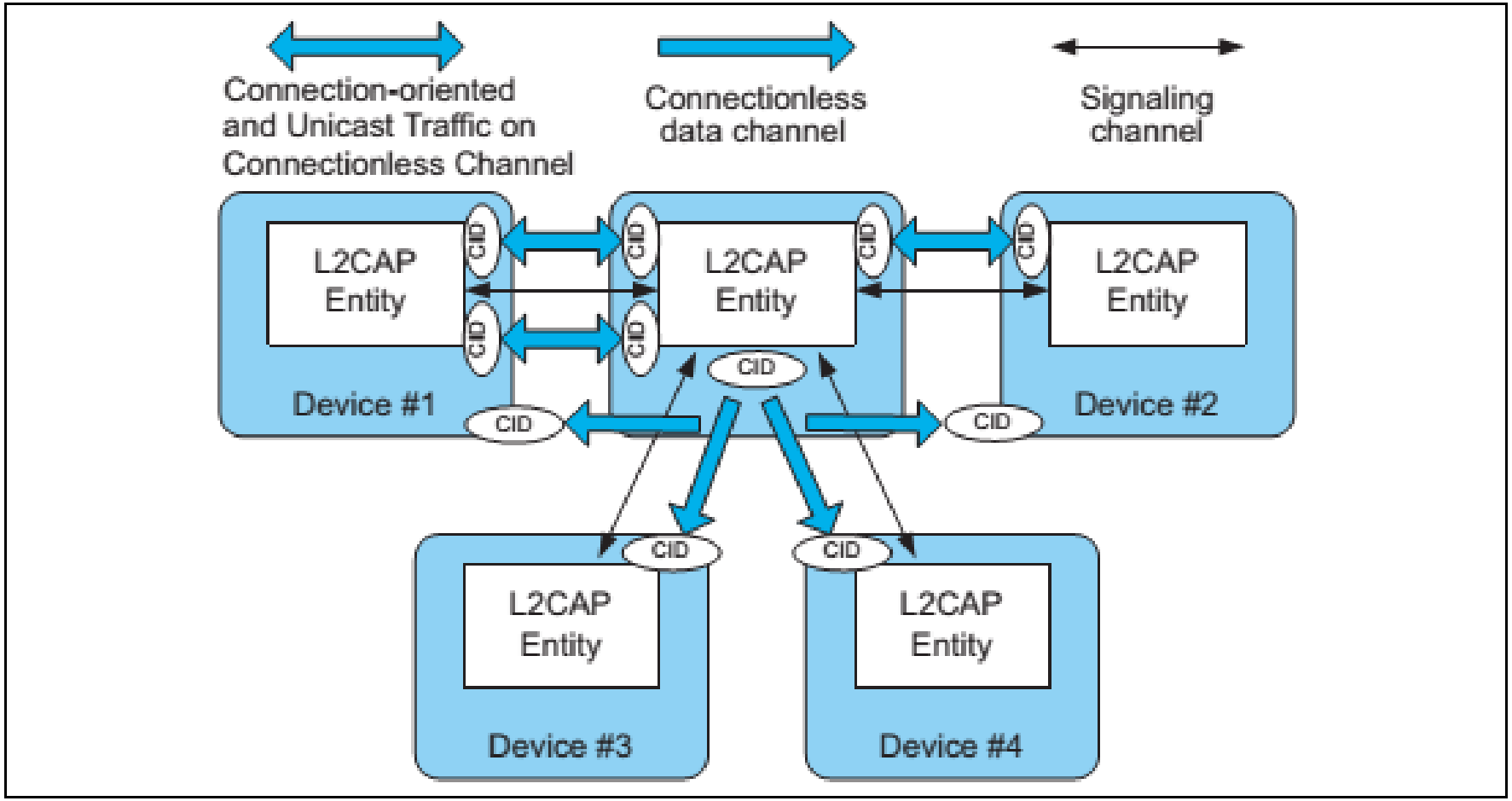
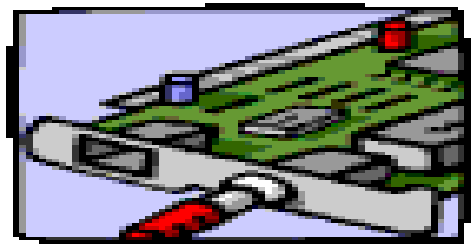
HOST - L2CAP



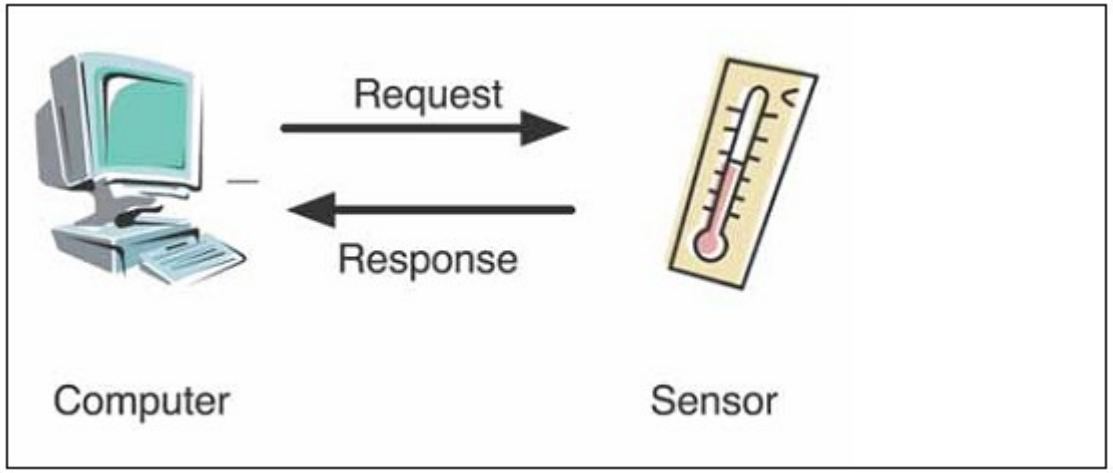
Csatornák közötti kommunikációt segíti

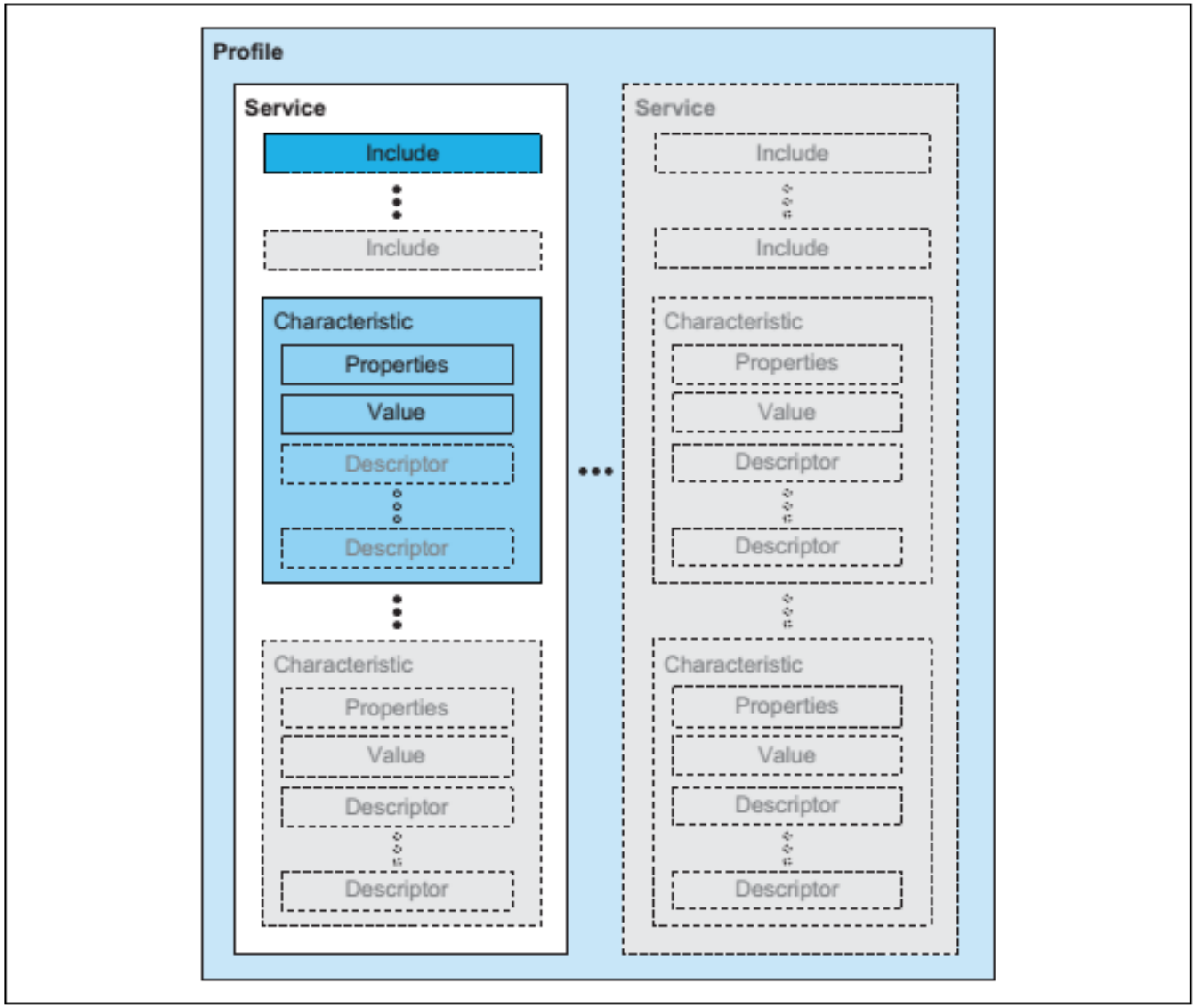


HOST – GATT

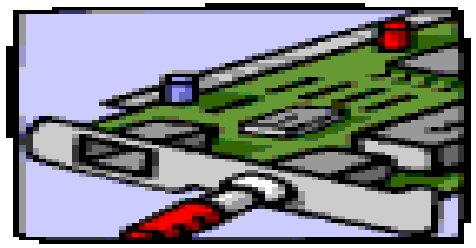


- Szerver
- Kliens

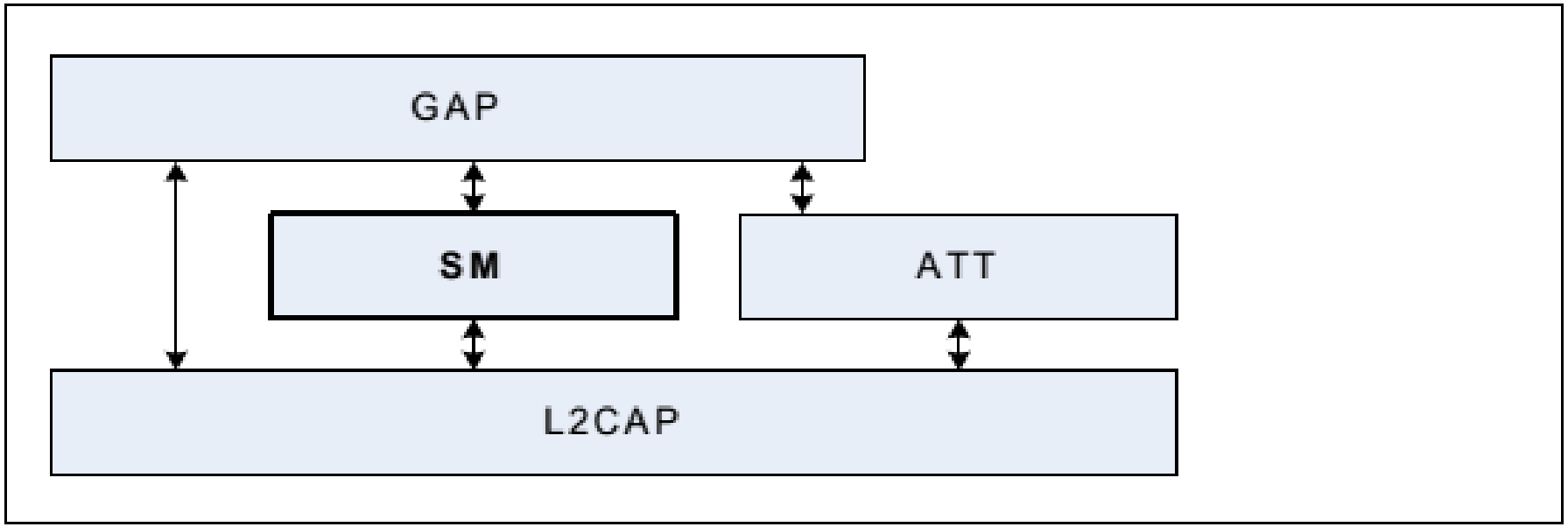




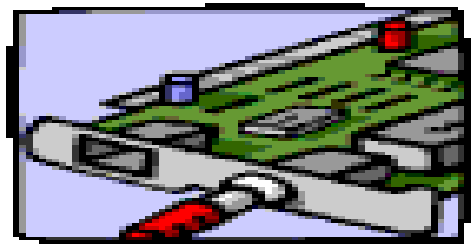
HOST – SM (LE)



- Párosítás
- Kulcs kiosztás



Párosítás és authentikáció (LE)

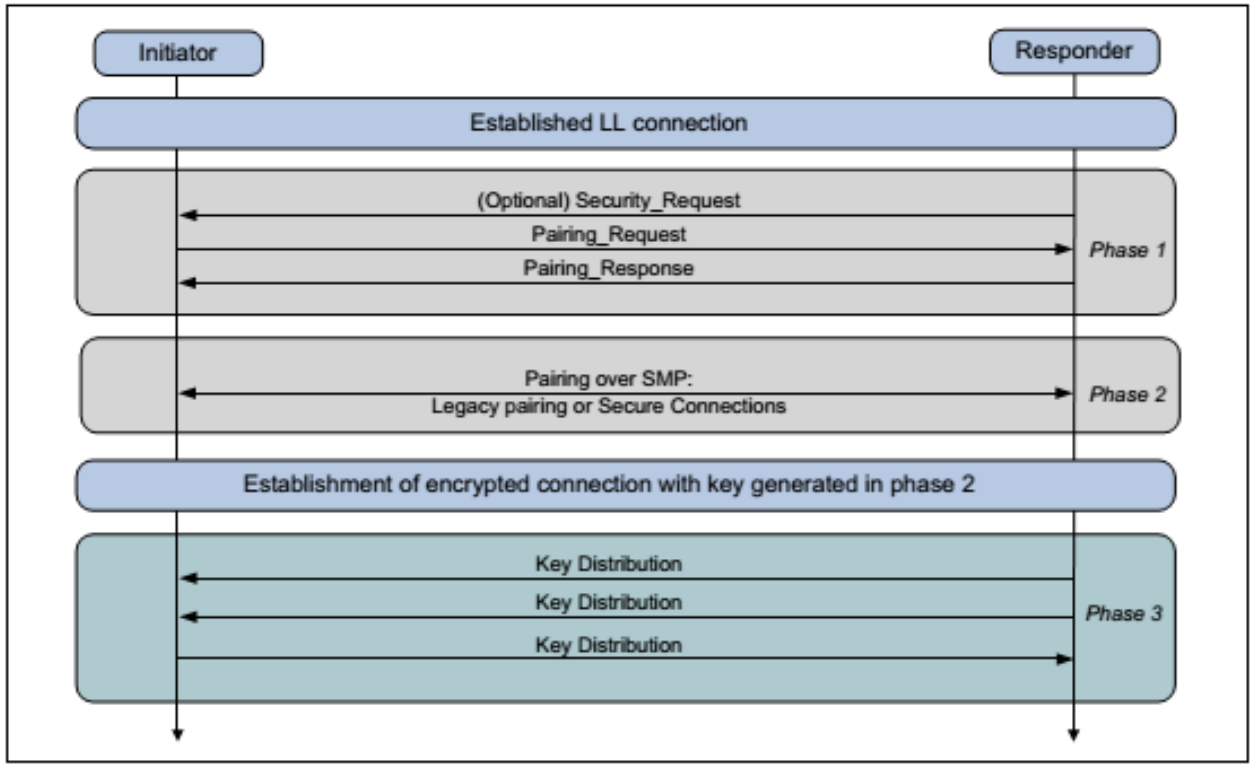


Fázisok:

- Párosítási tulajdonságok cseréje
- STK generálás / LTK generálás
- Transport Specific Key kiosztása

Authentikációs módszerek:

- Just Works
- Numeric Comparison
- Passkey entry
- Out of Band



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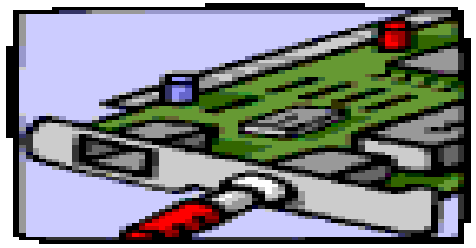
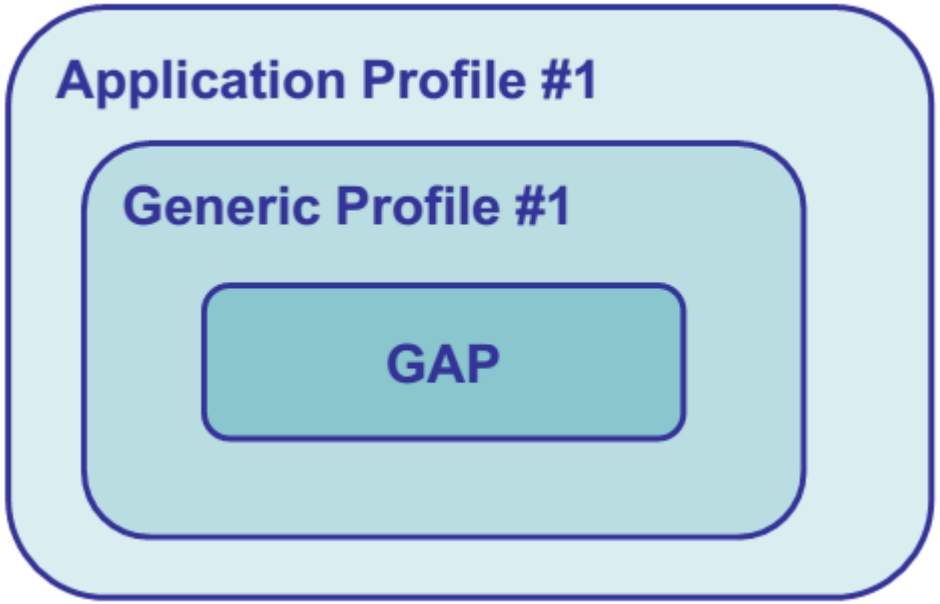
HOST – GAP



Classic:

egy szerepkör
(BR/EDR GAP)



Low Energy:

broadcaster
observer
peripheral
central

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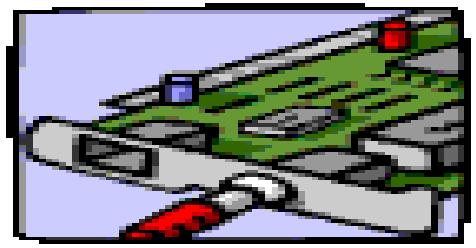
BLE: működési módok



Broadcast Mode and Observation procedure
Broadcast mode
Observation procedure

Discovery modes and procedures
Non-Discoverable mode
Limited Discoverable mode
General Discoverable mode
Limited Discovery procedure
General Discovery procedure
Name Discovery procedure

Connection Modes and Procedures
Non-connectable mode
Directed connectable mode
Undirected connectable mode
Auto connection establish-ment procedure
General connection estab-lishment procedure
Selective connection estab-lishment procedure
Direct connection establish-ment procedure
Connection parameter update procedure
Terminate connection proce-dure

Bonding
Non-Bondable mode
Bondable mode
Bonding procedure

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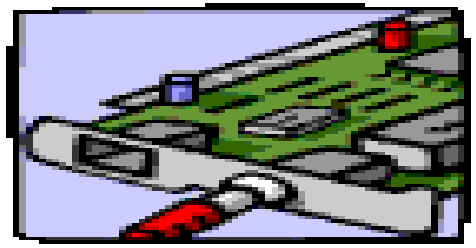
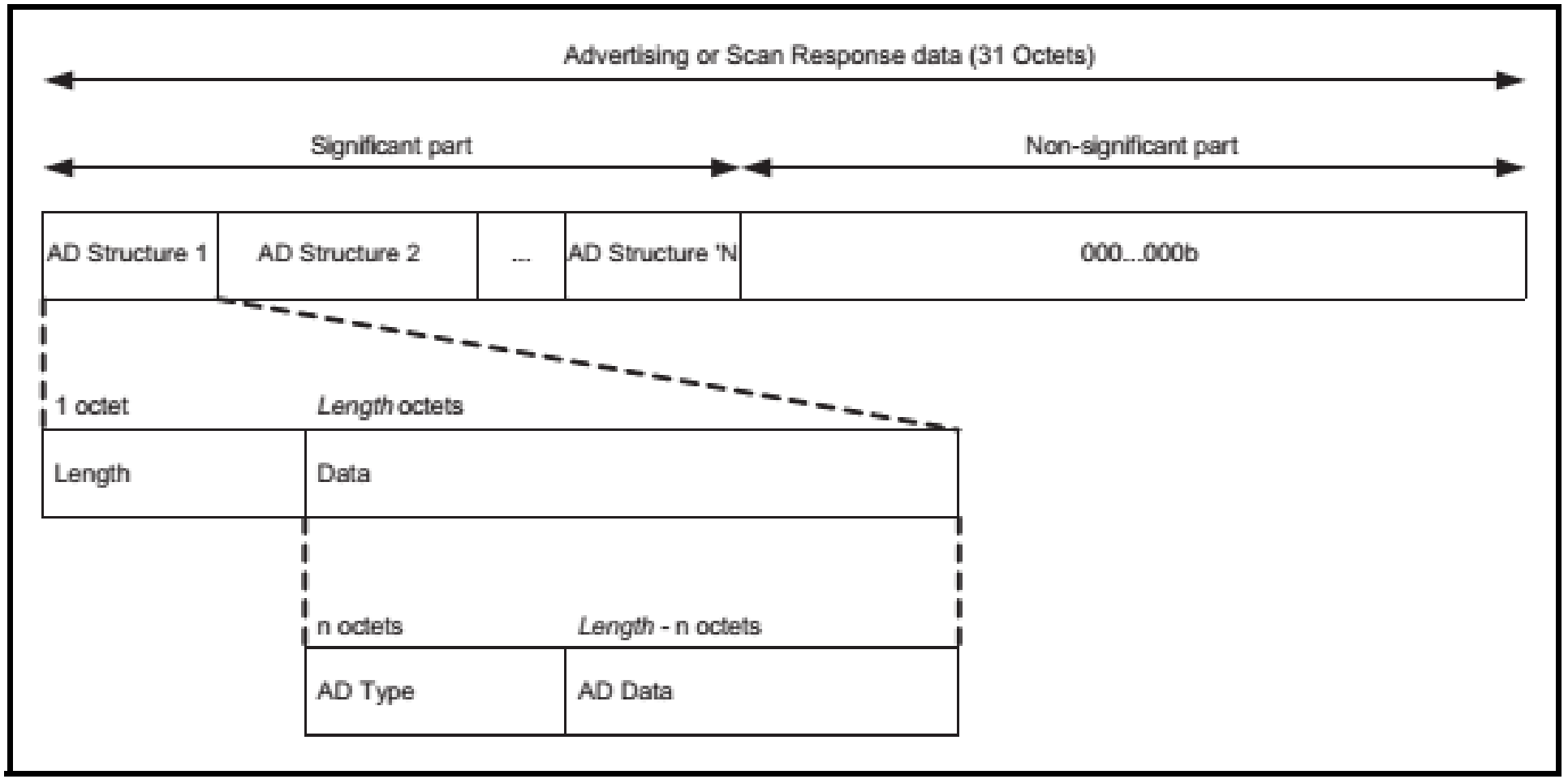
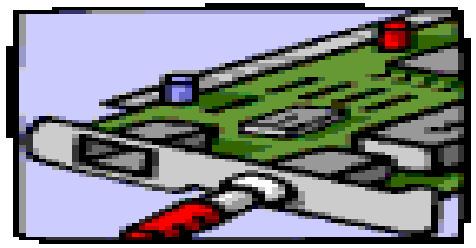
Hirdetés és pásztázás visszajelzés





Csomag (PDU) formátumok



PDU típusok:

- Adat (Data)
- Hirdetés (Advertising)

Változó méretű PDU

- min. 80bit – max. 376bit

Változó adatátviteli intervallum

- 80µs – 0.3ms

Preamble	Access Address	PDU Header	PDU Payload	CRC
1 byte	4 bytes	2 bytes	variable (0 – 37 bytes)	3 bytes

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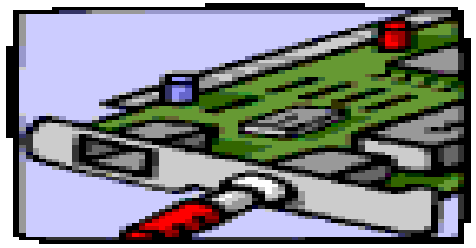
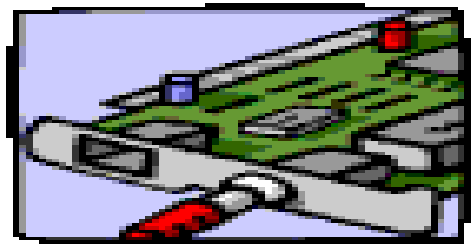
Technikai összehasonlítás



Technical Specification	Classic Bluetooth technology	Bluetooth low energy technology
Distance/Range	100 m (330 ft)	50 m (160 ft)
Over the air data rate	1-3 Mbit/s	1 Mbit/s
Application throughput	0.7-2.1 Mbit/s	0.27 Mbit/s
Active slaves	7	Not defined; implementation dependent
Security	56/128-bit and application layer user defined	128-bit AES with Counter Mode CBC-MAC and application layer user defined
Robustness	Adaptive fast frequency hopping, FEC, fast ACK	Adaptive frequency hopping, Lazy Acknowledgement, 24-bit CRC, 32-bit Message Integrity Check
Latency (from a non connected state)	Typically 100 ms	6 ms
Total time to send data (det.battery life)	100 ms	3 ms[citation needed], <3 ms[56]
Voice capable	Yes	No
Network topology	Scatternet	Star-bus
Power consumption	1 as the reference	0.01 to 0.5 (depending on use case)
Peak current consumption	<30 mA	<20 mA
Service discovery	Yes	Yes
Profile concept	Yes	Yes
Primary use cases	Mobile phones, gaming, headsets, stereo audio streaming, automotive, PCs, security, proximity, healthcare, sports & fitness, etc.	Mobile phones, gaming, PCs, watches, sports and fitness, healthcare, security & proximity, automotive, home electronics, automation, Industrial, etc.

Felhasználási területek



- autóipar
- sport és fitness
- egészség
- szórakozás
- okos otthon
- biztonság
- média
- IoT

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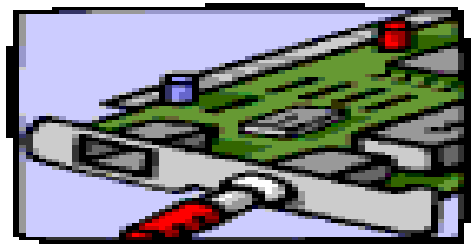

Autóipar

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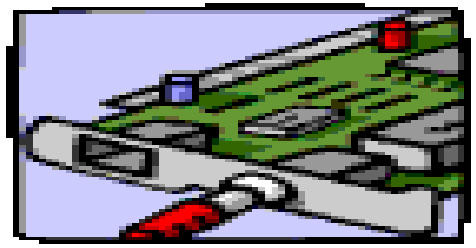
Sport és fitness



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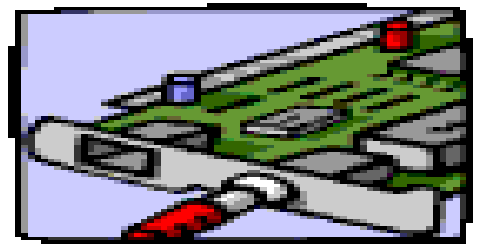

Egészség

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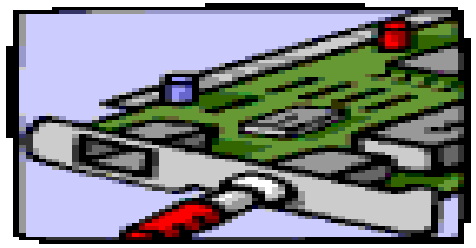
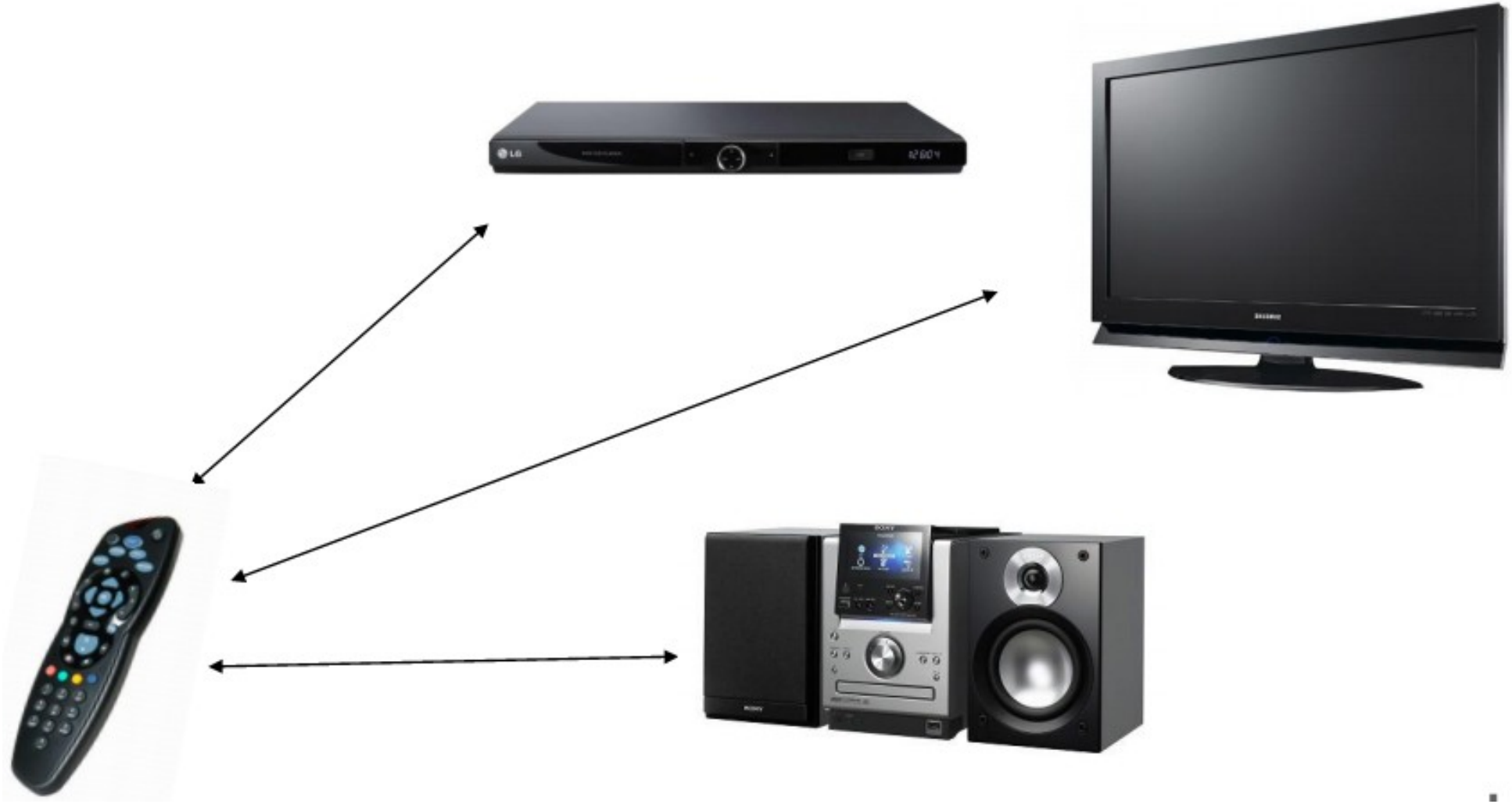
Szórakozás





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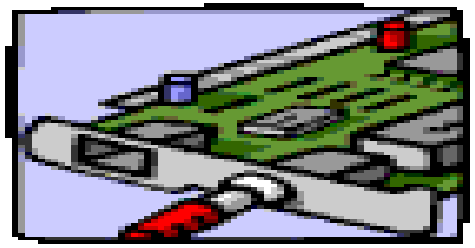
Okos otthon



ome automation

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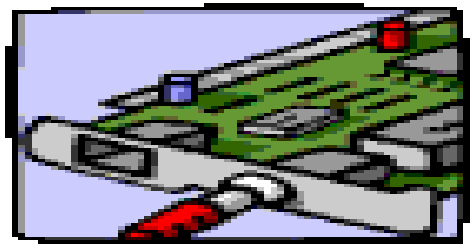
Biztonság



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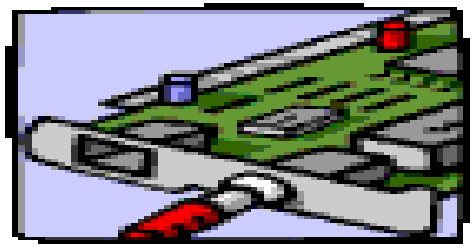
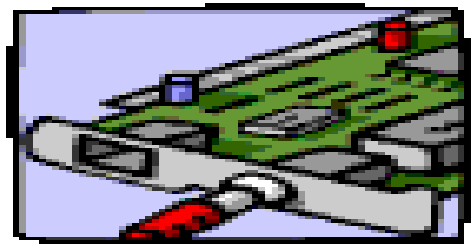
Internet of Things



Bluetooth 5



- 2x sebesség
- 4x hatótáv
- 8x több adat
- Nagyobb létjogosultság

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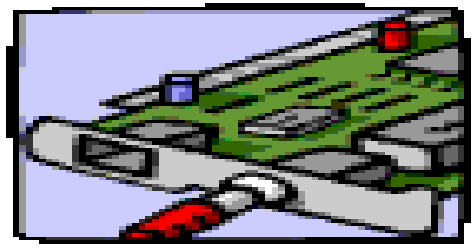
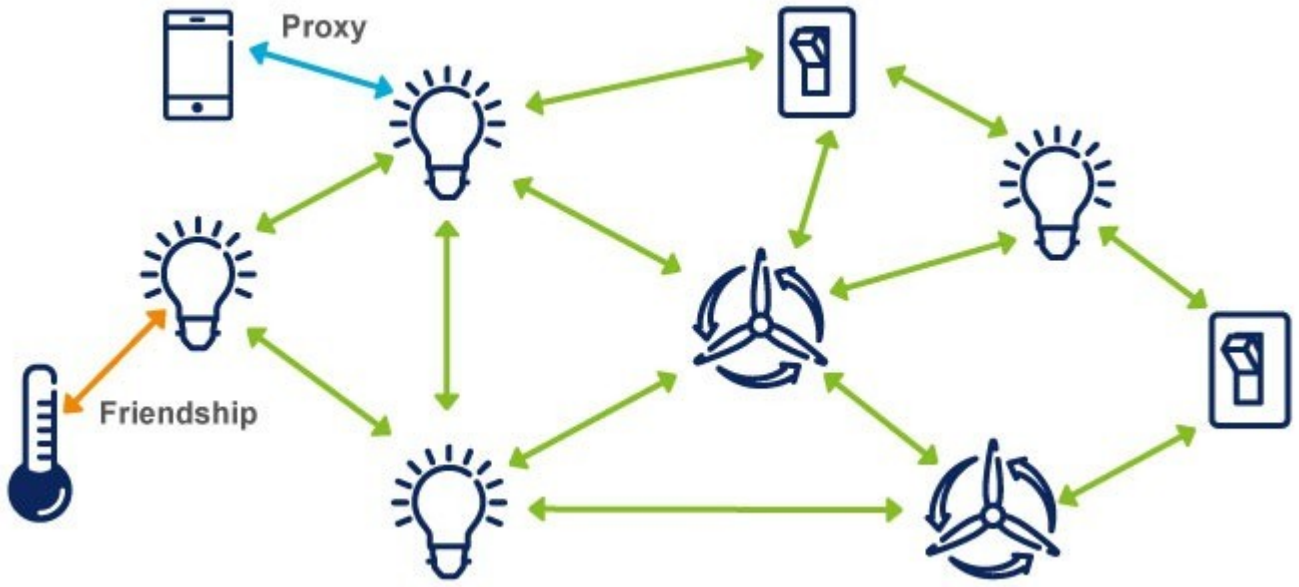
Bluetooth Mesh



- Many-to-Many
- Publish-Subscribe
- Relay-k
- Optimalizáltság



Köszönöm a figyelmet!