CPC field-specific training

H04L12: an overview
Outline

- **The main H04L12 groups**
  - H04L12/40 : Bus networks
  - H04L12/2856 : Access networks
  - H04L12/2803 : Home networks

- **Other H04L12 symbols**

- **Classification rules in H04L12**

- **Classification principles in H04W**
The H04L12 Main group

- Created in the 90s initially to cover topics related to the transmission of packets in LANs, contention resolution for shared-access medium and basic networks topology aspects (star, ring, linear networks)

- The old H04L12 structure is still visible in the current IPC scheme

- The current CPC scheme of the main group has been revised frequently over the last 12 years in order to cope with the booming development of the Telecom area in the 2000s. Three different areas emerged as the most active sectors of the main group: H04L12/40, H04L12/2803 and H04L12/2856
The main H04L12 groups
Bus networks – H04L12/40

An overview
The main H04L12 groups

Recent trends in H04L12/40

- Constant flow of new applications in this field, related mostly to the development of bus technology in:
  - The car industry (CAN, FlexRay, LIN)
  - Advanced communication systems for industrial automation
  - Simple network infrastructure in home/office environment (LON, CEBus, CoAx)
  - Bus in avionics, e.g. ARINC
The main H04L12 groups

CPC scheme in H04L12/40

- The CPC scheme, updated in 2009, includes general aspects of communication on a bus, reflecting the evolution of the technology in this field
  - Specific architecture of a communication node
  - Data rate management on the bus
  - Priority mechanisms
  - Flexible bus arrangements

- CCA entries were created to specify:
  - bus standards (CAN, FlexRay,...)
  - A particular use (airplane, vehicle, industrial automation,...)
The main H04L12 groups
Definition and neighbouring fields

A bus network includes one or a plurality of shared communication lines interconnecting at least 3 distant stations, wherein data is transferred serially in the form of frames or bitstrings along the bus.
The main H04L12 groups
H04L12/40006 – Architecture of a communication node

Details on the *hardware* elements comprised in a bus communication node, which contribute to the communication functionalities of the node. In particular, this class covers the inter-working of the various hardware components and implementation details of specific hardware components. This class has 6 sub-entries.
The main H04L12 groups
H04L12/4013

- Documents referring generally to the selection of a particular data rate on a bus network, based on different factors, i.e. instantaneous network load.

- Rate adaptation on a bus maybe be necessary for achieving optimal transmission performance, by finding a good trade-off between packet loss rate and data transmission speed. A LIN bus supports for instance various bitrates, CAN FD is a high-rate extension of CAN.
The main H04L12 groups

**H04L12/40143**

- Documents related to the introduction of certain criteria to prioritize the transmission of data on the bus

- On a vehicle bus for instance, information about car safety shall have priority over messages carrying monitoring data

- Sub-entries:
  - **By scheduling the transmission of messages at the communication node**
  - **By using dedicated slots associated with a priority level**
    - In a TDMA bus communication system, certain time slots might be reserved for transmission of data having a high level of priority.
  - **By assigning priority to messages according to a message field**
    - Typically a message field or tag indicates a priority level, which can be read by any node connected to the bus.
The main H04L12 groups

**H04L12/40169**

- Documents covering various flexibility and adaptability aspects, such as fast network re-configuration, flexible topology change, seamless connection or disconnection of a new node to/from the bus.

- In general, this class covers scalability of bus networks and reconfiguration aspects.

- Redundancy aspects are covered by 4 sub-entries.

- Related fields:
  - Arrangements for maintenance or administration involving management of faults; events, alarms in H04L41/06
  - Automatic restoration of network faults in H04L41/0654
The main H04L12 groups

H04L12/4035

- Bus systems with centralized control, in which slots of a TDMA packet structure are assigned based on a contention resolution carried out at a master unit
  - Created to cover TDMA aspects appearing in recent patent documents
  - Related field: TDM multiplexing per se in H04J3/1694
  - Shall not be used for documents dealing with FlexRay
The main H04L12 groups
H04L12/40052 – High-speed IEEE 1394 serial bus (Firewire)

- This FireWire group has been less active over the last decade. Reason: declining interest from the industry

H04L12/40 CCA entries

- Particular bus standard (CAN, LIN, FlexRay,...) in H04L12/40208/LOW

- Transportation means (Vehicle, Airplane,...) in H04L2012/40267/LOW

- Bus in industrial automation systems in H04L2012/4026
The main H04L12 groups
Access Arrangements H04L12/2856
The main H04L12 groups
Recent developments in H04L12/2856

- Last revision: 2010

- Rapid growth of H04L12/2856 during the 2000s, less active nowadays

- Trends and recent evolutions of access networks showed an integration of broadband networks (optical, cable) into access arrangements at the detriment of conventional access network architectures (xDSL over twisted-pair copper wires)
  - Goal: provide more customers with greedy data services (Triple-play; multimedia file sharing, e.g. peer-to-peer)
The main H04L12 groups
Structure of the scheme – Definition

- The reorganisation aimed at focusing on 3 main aspects of access networks:
  - The general architecture: point-to-point, point-to-multipoint (e.g. over physical broadcast channels)
  - Aspects related to an optimized usage of the available access network resources (enabling high-rate data transfer over bandwidth-limited access networks)
  - Details about access network equipment (DSLAM, BRAS, Optical units)

Definition:
- **Access arrangements**: An access network is a part of a global wired communication network that connects subscribers to their service providers in the public data network
The main H04L12 groups

Neighbouring fields

- Wireless access networks H04W
- Provision of optical networks H04Q11/0067
- Management of WDM parameters H04J14/02
- Broadband networks H04L12/2801
- Access to open networks H04L12/5691, H04L12/5692
- Circuit-switched access networks H04M7/1205
- Access arrangements for telephone services H04M7/00M8
- DSL end-user equipment (DSL modem, xDSL splitters) H04M11/062
- Home network gateways H04L12/283/LOW
- Transfer of video data stream from a video server to a subscriber H04N7/173
- Access networks H04L12/2856
The main H04L12 groups
H04L12/2858 – Access network architectures

- **L12/2859**: Point-to-point connection between the public data network and the subscribers
  - A connection between an end-user and the service provider is established by means of a point-to-point protocol, over various types of aggregation networks, such as ATM or Ethernet (PPPoX sessions)

- **L12/2861**: Point-to-multipoint connection from the public data network to the subscribers
  - Data is transmitted over a shared communication medium on the downlink and the uplink
  - On the downlink, data is broadcast by the service provider to all subscribers, and each subscriber extracts the data which is aimed to him, out of the stream of multiplexed data
The main H04L12 groups

H04L12/2863 – Arrangements for combining access network resources elements

- **L12/2865**: Logical combination
  
  *For instance, multiplexing of individual subscriber connections or grouping of frequency slots on a cable network*

- **L12/2867**: Physical combination
  
  *Refers to grouping of physical network resources such as devices, interfaces, wires, in order to enhance the total throughput provided to a given subscriber*
The main H04L12 groups
H04L12/2869 – Operational details of access network equipments (1)

- **L12/287**: Remote access server, e.g. BRAS
  
  A remote access server is a device that routes traffic to and from an access multiplexer (e.g. DSLAM) on a public data network

- **L12/2872**: Termination of subscriber connections
  
  Covers essentially the handling of PPPoX sessions

- **L12/2874**: Processing of data for distribution to the subscribers
  
  Details about specific data processing for distributing various multimedia flows, originally formatted to optimize their transport through an IP network, over the access network to the subscribers

- **L12/2876**: Handling of subscriber policies
  
  Differentiated access management for subscribers, based for instance on profiles, time of the day, traffic volume...
The main H04L12 groups
H04L12/2869 – Operational details of access network equipments (2)

- **L12/2878** - Access multiplexer, e.g. DSLAM

  An access multiplexer is a device, located normally in a telephone exchange or in multi-dwelling units of a service provider, that connects multiple end-user terminals to a public data network access node (e.g. a BRAS) through an aggregation network.

- **L12/2879** – characterised by the network type on the uplink side
  - **L12/2881** : IP/Ethernet DSLAM
  - **L12/2883** : ATM DSLAM
  - **L12/2885** : Arrangements interfacing with optical systems
The main H04L12 groups
H04L12/2869 – Operational details of access network equipments (3)

- **L12/2887** - characterised by the offered subscriber services
  - **L12/2889** : Multiservice, e.g. MSAN
    Support of different DSL technologies, i.e. ADSL, SDSL, VDSL, or different end-user connection types, like Ethernet, powerline, etc...
  - **L12/289** : Single service

- **L12/2892** - characterised by the access multiplexer architecture
  Related to specific hardware designs of the access multiplexer
  - **L12/2894** : Centralised processing
    All complex traffic processing (e.g. classification, filtering, QoS, etc) is performed on a single central chip, e.g. on the uplink card
  - **L12/2896** : Distributed processing, e.g. on line cards
    Some or all complex traffic processing is off-loaded to the line cards, which may include dedicated processors
The main H04L12 groups
H04L12/2869 – Operational details of access network equipments (4)

- L12/2898 - Subscriber equipments
  Entry concerning the design of devices carrying out generic L2 or L3 data processing operations, located at the interface between a private or home environment and the access network, like set-top boxes having networking functionalities and home or residential gateways.
The main H04L12 groups
Home networks H04L12/2803
The main H04L12 groups
Recent trends in H04L12/2803 (1)

- Very active field since many years, related mostly to the development of smart home with the following applications:
  - Interaction between IoT devices located in a home network
  - Energy saving techniques
  - Control and monitoring of smart home appliances
  - Location-based services in a home environment
The main H04L12 groups

Recent trends in H04L12/2803 (2)

- Became recently the focus of major Tech companies:
  - *Google*: takeover of Nest Labs in 2014, development of Google Home and Google Chromecast
  - *Amazon*: Echo and Alexa technologies, takeover of Ring (video security) in 2018
  - *Apple*: Siri, HomeKit
  - *Facebook*: Aloha project

- In the future: AI-based technologies
The main H04L12 groups
CPC scheme in H04L12/2803

- The CPC scheme, updated in 2007, includes general aspects of home network technologies:
  - Exchange of data about the home network devices
  - Controlling aspects
  - Reporting aspects
  - Adaptation between various types/protocols of home networks

- CCA entries were created to specify:
  - Type of home appliances (Audio/Video, white goods)
  - Network type (wireless, PLC)
The main H04L12 groups
Definition and neighbouring fields

Home networks H04L12/2803
- Smart Grids, smart meters H02J03, H02J13
- IoT devices in a wireless network H04W4/14
- Monitoring of network devices H04L43/00
- Network management H04L41/00
- Power Lines Communication H04B3/54
- Factory/Industrial automation G05B19

Exchange and retrieval of information regarding which element having which attributes are present in the network.
The main H04L12 groups

**H04L12/2807 – Configuration aspects**

Exchange and retrieval of information regarding which element having which attributes are present in the network

<table>
<thead>
<tr>
<th>H04L12/2809</th>
<th>Discovering of user services/home devices (e.g. UPnP discovery)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H04L12/281</td>
<td>Description of capabilities of devices and services in a home network</td>
</tr>
<tr>
<td>H04L12/2812</td>
<td>Description of contents available in a home network</td>
</tr>
<tr>
<td>H04L12/2814</td>
<td>Provisioning of control software for controlling home appliances (e.g. macros, firmware updates, ...)</td>
</tr>
</tbody>
</table>
The main H04L12 groups

H04L 12/2816 – Controlling aspects

Exchange of information that triggers action of at least one device

| H04L12/2818 | Control from a device located outside both the home and the home network |
| H04L12/282  | Control based on user interaction within the home. The command is issued within the home network |
| H04L12/2821 | Avoiding conflicts related to the use of home appliances, e.g. window blind opening AND air cooling |
The main H04L12 groups

**H04L12/2823 – Reporting**

Exchange of information that triggers action of at least one device

<table>
<thead>
<tr>
<th>H04L12/2825</th>
<th>Reporting to a device located outside the home and the home network</th>
</tr>
</thead>
<tbody>
<tr>
<td>H04L12/2827</td>
<td>Reporting to a device within the home network; wherein the reception of the information reported automatically triggers the execution of a home appliance functionality</td>
</tr>
</tbody>
</table>

**H04L12/2829**: involving user profiles according to which the execution of a home appliance functionality is automatically triggered
The main H04L12 groups

H04L 12/283 – Processing of data at an inter-networking point of a home automation network

Covers adaptations between different types of networks

| H04L12/2832 | Interconnection of the control functionalities between home networks |
| H04L12/2834 | Switching of information between an external network and a home network (e.g. home gateway functions) |
| H04L12/2836 | Protocol conversion between an external network and a home network |
The main H04L12 groups

H04L 12/2838 – Distribution of signals within a home automation network

Distribution of a variety of digital data signals from/to appliances within the home network
Outline

- The main H04L12 groups
  - H04L12/40 : Bus networks
  - H04L12/2856 : Access networks
  - H04L12/2803 : Home networks

- Other H04L12 symbols

- Classification rules in H04L12

- Classification principles in H04W
Other H04L12 symbols
Other relevant / active symbols in H04L12

- H04L12/10: Data and Power over communication lines
- H04L12/12: Power management of network devices
- H04L12/28: Virtual LANs
- H04L12/42: Ring networks
- H04L12/2801: Cable networks
- H04L12/462: L2 switching
Other H04L12 symbols

CPC scheme in H04L12/4641

This CPC group, updated in 2011, includes general aspects of virtual LANs (VLAN):

<table>
<thead>
<tr>
<th>CPC Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H04L12/4645</td>
<td>Frame tagging: operation details on tag insertion/stripping, frame with multiple VLAN tags. Ex: PBB(-TE), MAC-in-MAC encapsulation</td>
</tr>
<tr>
<td>H04L12/467</td>
<td>VLANs without frame tagging, e.g. port-based VLAN</td>
</tr>
<tr>
<td>H04L12/4675</td>
<td>Exchange of information about VLAN in a network: registration information, types of protocols used (MVRP, GVRP, VTP)</td>
</tr>
</tbody>
</table>
Other H04L12 symbols

**CPC scheme in H04L12/42 – Ring networks**

- Within this old group, the main symbol is H04L12/437: Ring fault isolation or reconfiguration (ERPS,EAPS,...)
- Other H04L12/42 symbols are rarely used /outdated
### Other H04L12 symbols

#### Other symbols

<table>
<thead>
<tr>
<th>H04L12/10</th>
<th>Power and data are conveyed over the same data communication line. Main application: Power-over-Ethernet (Common keywords/acronyms: PoE, PSE, PD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H04L12/12</td>
<td>Management of power modes of network nodes. Exchange of data packets to induce a transition from a stand-by or sleep mode to an active mode of operation, and vice-versa</td>
</tr>
<tr>
<td>H04L12/2801</td>
<td>Transmission of data over coaxial cables (coax) Examples: DOCSIS, MoCA. Keywords: CMTS, CM</td>
</tr>
<tr>
<td>H04L12/462</td>
<td>Layer-2 switching operations (now mostly H04L45)</td>
</tr>
<tr>
<td>H04L12/4625</td>
<td>Layer-2 bridging functionality</td>
</tr>
<tr>
<td>H04L12/4633</td>
<td>Encapsulation (e.g. tunneling)</td>
</tr>
</tbody>
</table>
Outline

- The main H04L12 groups
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  - H04L12/2856 : Access networks
  - H04L12/2803 : Home networks

- Other H04L12 symbols

- **Classification rules in H04L12**

- Classification principles in H04W
Classification rules in H04L12

What is not in H04L12?

- Wireless networks (H04W) are generally not classified in H04L12, unless:
  - the documents covers aspects of a home network employing wireless communication to support communication between home devices within the home network
  - the document mentions two main inventive applications in wired AND wireless networks (e.g. power saving in WLAN and LAN)

- Routing technologies are classified in H04L45, although this area is part of H04L12 in the IPC scheme, i.e. H04L12/70 (major source of error upon converting IPC symbols into CPC symbols)
Classification rules in H04L12

Some classification rules in H04L12

- Different invention information symbols may be allocated to a single document (**completeness**).
  Example: Exchange of packets to wake-up a home appliance (1) and subsequently trigger a function of the home appliance (2) Invention information symbols: H04L12/12 (1) and H04L12/282 (2)
  - BUT: the symbols should be accurate and not too generic! otherwise, too much noise is generated (**accuracy**)

- Document circulation: in Telecom, documents have often to be circulated to different classifiers working in different fields so a good knowledge of neighbouring fields is necessary
Outline

- The main H04L12 groups
  - H04L12/40 : Bus networks
  - H04L12/2856 : Access networks
  - H04L12/2803 : Home networks
- Other H04L12 symbols
- Classification rules in H04L12
- Classification principles in H04W
Classification principles in H04W
Basic structure of H04W (1)

- Unlike other H04 subclasses, H04W is composed of a matrix structure:
  - Subclasses H04W4 to H04W76 contain functions (e.g. channel access, resource allocation, ...)
  - Subclasses H04W80 to H04W92 contain locations
- Functions groups cover all the layer 2 and layer 3 functionality that are wireless specific
- Location groups contains all nodes, all topologies and all interfaces that can be found in wireless networks
- If a function is specific to a location, we allocate the function subclass and a location subclass as an additional information: If the function is independent of the location, no location subclass is allocated
- If an invention is specific to a node and if the invention is not the improvement of a function, only a location subclass is allocated.
  - This is rarely the case.
  - This also applies to topologies and interfaces.
Classification principles in H04W
Basic structure of H04W (2)

Example:

- The invention is about **hand-off where packet loss is avoided**. The invention is implemented in a **WLAN**.
  - If the principle of the invention can be applied to any networks, only a function code for hand-off **H04W36** is allocated and no location subclass is added.
  - If this is not the case because a specificity of WLAN is used, a location subclass for WLAN **H04W84/12** is allocated, in addition to the function subclass corresponding to the avoidance of packet loss in hand-off.

- The invention is about **a new way of implementing an interface between Node Bs**.
  - Only the interface subclass **H04W92/20** is allocated. This is rarely the case.
Thank you for your attention !