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Dunelm DVB-RCC Review

A Review of the European Activities Relevant to DVB-based Cable Modems

Summary

This 'magazine' provides a review of the standards, specifications, products and market opportunities in the European cable modem market. The particular emphasis is on activities that involve the Digital Video Broadcasting Return Channel for Cable (DVB-RCC) technology. The salient features of this first DVB-RCC review are:

- The DVB/DAVIC Interoperability Consortium (DDIC). The DDIC is a group of manufacturers attempting to provide multi-vendor data system interoperability based on the open international standards DVB-RCCL (ETSI ES 200 800) and DAVIC 1.5 for broadband communication over cable and wireless/microwave. DVB and DAVIC develop the standards based on market requirements, manufacturers develop products and the DDIC provides for interoperability - in close co-operation with the EuroCableLabs technical centre of excellence;
- EuroModem technology comparisons. A comparison has been made of the EuroModem compliant cable modems and head-ends available from a range of manufacturers. At the present time the range of vendors is limited and only the 'industree' cable modem has received interoperability certification by the EuroCableLabs.

The recent failure of the EuroDOCSIS specifications to gain formal acceptance within the European Telecommunication Standards Institute (ETSI) means that the EuroModem technology manufacturers have a key opportunity. Several EuroModem vendors have announced significant sales agreements with Asian-based operators; the Asian market is seen as a key opportunity for EuroModem. Even though EuroModem compliant technology is now available (these are Class A devices) it is still limited in its Quality of Service (QoS) provision and as such it is NOT a better solution than DOCSISv1.0. Vendors are rapidly working on Class B compliant EuroModem devices and these are, potentially, a more complete QoS solution than the DOCSISv1.1 approach. European operators are split over their adoption of DVB-RCC and EuroDOCSIS and so it is evident that within Europe there is a significant market opportunity for both technologies.

Contents

Press Releases & Announcements (Jan, 2000 - Mar, 2000)

- March, 2000, Telewest in the UK launch the first commercial cable modem Internet service. This is based upon their Blueyonder product and will be priced at £50 per month. The Blueyonder product is based upon Pace technology;
- March, 2000, the UK's Department of Trade & Industry agree to the merger between Cable & Wireless Communications and NTL;
- 15th February, 2000, Hughes Network Systems Europe (HNSE) launch their CableServe CS2500 Cable Data System (INA and cable modem), which enables operators to offer a host of revenue-generating broadband services via their existing cable television infrastructure;
- 31st January, 2000, Hughes Network Systems Europe (HNSE) wins a substantial contract from the Hunan Sanli Telecom Economy Trading Company to install CableServe cable data systems at the Hunan Multimedia Communication Bureau and the other 14 PTT bureaux operating within China's Hunan Province. HNS will install a complete CableServe system, including DVB-compatible data modems and head end servers. It will enable the Hunan PTT bureaux, such as Hunan Multimedia Communication Bureau, to enhance their HFC (Hybrid Fibre Coax) broadband multimedia communications networks to carry premium services such as telephony and broadband data.

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DVB/DAVIC Interoperability Consortium (DDIC)

The DVB/DAVIC Interoperability Consortium (DDIC) is a grouping of manufacturers attempting to provide multi-vendor data system interoperability based on the open international standards DVB-RCCL (ETSI ES 200 800) and DAVIC 1.5 for broadband communication over cable and wireless/microwave (LMDS). DVB and DAVIC develop the standards based on market requirements, manufacturers develop products and the DDIC provides for interoperability - in close co-operation with the EuroCableLabs technical centre of excellence. The initial work of the DDIC was sponsored by the European Commission ACTS programme in the IBCoBN project (ACTS AC101). Therefore, the DDIC enables the concept of the multiservice platform - one single system delivering video, audio, data and voice to residential devices such as cable modems, set-top-boxes, multimedia home platforms, residential gateways etc. The founding members of DDIC were: Alcatel, COCOM, DiviCom, Hughes Network Systems, Nokia Multimedia Network Terminals, Sagem, Simac Broadband Technologies, Thomson Broadcast Systems (a subsidiary of Thomson Multimedia), and Thomson Multimedia. In September 1999, the DDIC launched their web site: http://www.dvb-davic.org. The current DDIC membership is:

- Alcatel - provision of DVB-compliant INA;
- Cisco (formerly Cocom) - provision of DVB-compliant INA and cable modems;
- Com21 - provision of DVB-compliant INA and cable modems;
- Harmonic (including DiviCom) - provision of set-top boxes, MPEG-2 streaming devices and DVB-compliant INA;
- Hughes Network Systems - provision of DVB-compliant INA and cable modems;
- Nokia Multimedia Terminals - set-top box manufacturer;
- Pace Micro Technology - provision of DVB-compliant set-top boxes;
- Philips Digital Networks (formerly Philips Digital Video Systems) - provision of DVB-compliant INA;
- Philips SemiConductors Rennes (formerly Comatlas) - semiconductor device manufacturer;
- Sagem - set-top box manufacturer;
- Samsung Electro-Mechanics Co - set-top box manufacturer;
- Terayon Communication Systems (including ComBox) - provision of DVB-compliant INA and cable modems;
- The Industree (formerly Simac) - provision of DVB-compliant INA and cable modems;

- Thomson Broadcast Systems - provision of DVB-compliant INA;
- Thomson Multimedia - provision of DVB-compliant cable modems and set-top boxes.

DDIC Members

Alcatel

ALCATEL builds next generation networks, delivering integrated end-to-end voice and data communications solutions to established and new carriers, as well as enterprises and consumers world-wide. With 120,000 employees and sales of EURO 21.3 billion ($25.0 billion), Alcatel operates in more than 130 countries and is one of Europe's largest electronics and telecommunications manufacturers. Further information is available on: http://www.alcatel.com.

Cisco (Cocom)

CISCO, Inc. is the world leader in networking for the Internet. Cisco products include routers, LAN and ATM switches, dial-up access servers and network management software. These products, integrated by the Cisco IOS software, link geographically dispersed LANs and WANs. Cisco joined the DDIC as founding member upon the acquisition of Cocom A/S (29th September 1999). Cocom continues operation under the name Cisco Cable Products and Solutions A/S (Cisco CPS). Cisco develops and markets head-end transmission equipment (In-Band and Out-of-Band INAs) and customer premises equipment (cable modems) based on the DVB-RCCL standard. Cisco also develops DVB Medium Access Control (MAC) core technology. Further information is available on: http://www.cisco.com.

Com21

COM21 Inc. is a provider of system solutions for the broadband access market. The company's products based on the DOCSIS, DVB and ATM standards enable cable operators and service providers to deliver high-speed Internet and telephony applications to corporate telecommuters, small businesses, home offices and residential users. Com21 was ranked No. 1 in Europe in 1998 by Ryan Hankin Kent, and named the third largest supplier of cable modem technology, world-wide, through March 31, 1999. The rankings were based on independent market research studies conducted by GartnerGroup/Dataquest. Com21's ATM-based ComPORT® cable modems are commercially deployed worldwide passing 11.9 million homes. To-date, Com21 claim they have shipped 700,000 cable modems and 1,200 head-ends controllers world-wide. Founded in 1992, its stock is publicly traded on Nasdaq under the symbol CMTO. It is an ISO 9001 certified company, 400 employees, with headquarters in Milpitas, California, USA; the European Development Centre in Ireland, and sales and support locations in the United States, Canada, Europe, Asia, and Latin America. In August 1999, Com21 was named second on the short-list of recommended suppliers to provide cable modem products to the EuroModem Consortium. Further information is available on: http://www.com21.com.

Conexant

CONEXANT SYSTEMS Inc. was created when Rockwell International spun off its semiconductor systems business to shareowners in December 1998. Conexant, with a revenue of approximately $2billion per year, is the world's largest independent company focused exclusively on providing semiconductor solutions for communications electronics. With more than 30 years of experience in developing communications technology, the company draws upon its expertise in mixed-signal processing to deliver integrated systems and semiconductor products for a broad range of communications applications. The company aligns its business into five product platforms: Network Access, Wireless Communications, Digital Infotainment, Personal Imaging, and Personal Computing. Conexant is a member of the S&P 500 and Nasdaq-100 Indices. Further information is available on: http://www.conexant.com.

Harmonic (including newly acquired DiviCom)

HARMONIC Inc. is a leading provider of innovative broadband solutions that deliver video, voice and data to communications providers around the world. Harmonic's technically advanced fibre optic, digital video and IP data delivery systems enable network operators to provide a range of interactive and advanced digital services that include high-speed Internet access, telephony, digital video, HDTV, video & audio streaming, and video-on-demand. In May 2000, Harmonic acquired DiviCom. DIVICOM develops and implements end-to-end systems for digital video networks. In August 1996, C-CUBE finalized its acquisition of DiviCom. DiviCom not only designs system-level solutions for digital video networks, but it is also involved with service providers in developing the infrastructure and consumer interface for these complex networks. C-Cube is recognised as a leader in digital video compression technology. C-Cube was founded in 1988 and employs over 700 people world-wide. Based in Milpitas, California, C-Cube has offices in North America, Europe and Asia. C-Cube stock is publicly traded on the Nasdaq system under the stock symbol CUBE. Further information is available on: http://www.harmonicinc.com.

Hughes Network Systems

HUGHES NETWORK SYSTEMS, a Hughes Electronics company, develops broadband technologies specialising in satellite and terrestrial multi-service access networks. These are designed, manufactured and installed for governments, businesses, telecommunications operators and broadcasters world-wide. Specific products include multimedia home platforms, set-top boxes and cable modems. Hughes Electronics is a leading global provider of integrated entertainment and information products and services. Further information is available on: http://www.hns.com.

Nokia Multimedia Terminals

NOKIA MULTIMEDIA TERMINALS, headquartered in Helsinki, Finland, is a leading supplier of user-friendly terminals designed for the reception of digital broadcasting and interactive multimedia applications via satellite, cable and terrestrial networks. All terminals are based on the DVB standard. Nokia Multimedia Terminals currently supports most major software platforms including MediaHighway, OpenTV and Betanova as well as most leading Conditional Access systems such as Viaccess, Nagravision, Mediaguard and Betacrypt. Nokia Multimedia Terminals is a neutral technology provider and a supplier to broadcasters in Europe and Asia, and it collaborates closely with programme and content providers world-wide to offer consumers attractive products and services, such as online education, entertainment, and shopping. Further information is available on: http://www.nokia.com.

Pace Micro Technology

PACE MICRO TECHNOLOGY, plc is the world's largest dedicated developer of digital set-top box technology. This UK company is a pioneer of digital technology for the home and has played a key role establishing the international market for pay television services. This expertise is now being used to create the networked home of the 21st century in which the set-top box is a gateway for interactive communication, enabling consumer devices and services to interact with each other and the outside world. Since its establishment in 1982, Pace analogue and digital technology has been installed in over ten million homes world-wide. As Europe's largest manufacturer of satellite receivers, Pace has manufactured over 2 million digital receivers for broadcasters world-wide. Pace exports over 50% of output and was honoured with 'The Queens Award' for Export for 1998. Independent research analysts, Dataquest, recently identified Pace as Europe's leading digital set-top box manufacturer. Pace was the first manufacturer to provide digital satellite receivers to BSkyB for its launch of digital satellite in the UK. Pace was also among the first to manufacture receivers for ONdigital. With contracts to manufacture advanced digital cable set-top boxes for two of the UK's three major cable operators, Cable and Wireless Communications and NTL, Pace are the only manufacturer to be supplying digital receivers for all three digital platforms in the UK.

Pace now manufactures a broad range of digital set-top boxes. However, the early success of the company was founded on an innovative range of analogue receivers. From 1987 to 1995 Pace constantly pushed the limits of analogue technology with new generations of boxes that added increased channel capacity, improved displays and higher quality sound reproduction. Pace has also entered into an alliance with Cisco Systems Inc. to develop a new generation of multimedia set-top boxes that will deliver integrated cable-based digital TV, Internet data and telephony services. Pace is now actively involved in all digital platforms - satellite, terrestrial, cable, wireless and xDSL - through alliances with broadcasters, network operators and technology partners in the UK, Europe, Latin America, Australasia, the Far East and USA. In November 1999, Pace signed a contract with Time-Warner Cable for the provision of a minimum of 350,000 set-top boxes with integrated DAVIC cable modems, over a period of three years (delivery to begin at the end of 2000). Further information is available on: http://www.pace.co.uk.

Philips Digital Networks (formerly Philips Digital Video Systems)

PHILIPS DIGITAL NETWORKS is a manufacturer of digital technologies for television and displays, wireless communications, speech recognition, video compression, storage and optical products, as well as the underlying semiconductor technology that makes these possible. In February 1999, MediaOne agreed to purchase Philip's (with partners Canal+ and DiviCom) set-top boxes - these support the DVB return channel technology. Further information is on: http://www.broadcast.philips.com.

Philips SemiConductors Rennes

PHILIPS SEMICONDUCTORS RENNES, formerly Comatlas, became a wholly owned subsidiary of Philips SemiConductors, a division of Royal Philips Electronics, in June 1999. From March 2000, Comatlas changed its name and is now called Philips SemiConductors Rennes acting as the channel coding/decoding competence center for all Philips SemiConductors. Philips SemiConductors Rennes is participating in the quickly expanding consumer digital entertainment market. The company has a wide range of products for the digital set top box market including solutions for systems based on DVB as well as American and Japanese standards. Philips SemiConductors Rennes technology is found in roughly one quarter of all set top boxes sold world-wide. Philips SemiConductors Rennes products range from standard IC products, to system level solutions, to professional equipment. Further information is available on: http://www.philips.com.

Sagem

SAGEM, a French company, is an internationally based technology manufacturer of digital television and other telecommunication products such as GSM and facsimile terminals. Groupe Sagem had consolidated sales of FRF 22.4 billion in 1999 (46,3% exports) and employs 15,600 people, including 7,700 technical and managerial staff. They are the second largest French group in the field of telecommunications and the third largest European company in electronics for defence and security, Sagem is also one of the leaders in automotive electronics equipment. Sagem maintains a presence in more than twenty countries and has manufacturing centres in Germany, Brazil, Spain, the United States and the Czech Republic. Sagem offers a full range of MPEG-2/DVB equipment such as satellite, terrestrial, MMDS and cable set-top boxes, the latter includes a DVB-RC modem and embedded Internet functions. Further informa-

tion is available on: http://www.sagem.com.

Samsung Electro-Mechanics Co

SAMSUNG ELECTRO-MECHANICS CO., Ltd. started out in 1973 as a maker of electronic parts and has played a key role in Korea's electronic industry. Samsung has amassed an impressive bank of technology, which has allowed it to become a global company. At the same time, Samsung is preparing for the future through ongoing investment in new investments and technology acquisition. Samsung's ambitious research and development programme is creating core parts and components for the electronics industries area where cutting-edge technology is crucial. Further information is available on: http://www.sem.samsung.com and http://www.samsungstb.com.

Terayon Communication Systems (including newly acquired ComBox)

TERAYON COMMUNICATION SYSTEMS produces cable modem systems that enable CATV operators to launch reliable, high-speed, two-way broadband access services. Their systems are designed to enable cable operators to maximise the capacity and reliability of broadband access services over any cable plant. Terayon's products are deployed by major cable operators worldwide, including Cablevision Systems, Shaw Communications and TCA Cable TV in North America; several of Japan's leading cable operators, including Jupiter Telecommunications, a joint venture between Sumitomo and TCI International; and major cable operators throughout Europe and Latin America. Terayon's modem systems are fully integrated into the @Home Network. Terayon is based in Santa Clara, California, USA, has sales and support offices world-wide, and is traded on the Nasdaq National Market under the symbol TERN. In March 2000, Terayon acquired ComBox Ltd. to provide a range of DVB-compliant cable modems and INAs. Further information is available on: http://www.terayon.com.

The industree

THE INDUSTREE BV is a DVB broadband access company. Its CableFleet cable modem system integrates voice, video and data solutions over cable. The industree was set up just over two years ago (being previously known as Simac Broadband Technologies B.V.) and is located on the campus of the highly regarded Technical University of Eindhoven. In December 1999, The industree received 22million guilders from Atlas Venture and Crescendo Ventures (two venture capital organisations) in return for a minority stake. The industree develops the latest cable and wireless modem systems that operate according to the DVB standard and sells to a growing number of international clients. The industree has one of the most advanced DVB-RCC interoperability specifications and expects to announce commercially available DVB-compliant cable modem and INA products within the next few months. In November 1999, HB Telecom (based in Seoul, Korea but with facilities and markets in Korea, China and India) agreed to purchase 10,000 cable modems and associated head-end and management software technology from The industree. In September nvCasTel ordered 40,000 EuroModem-compliant cable modems from the Industree based on the best price/performance evaluation. Further details are available on: http://www.industree.nl.

Thomson Broadcast Systems

THOMSON BROADCAST SYSTEMS, a subsidiary of THOMSON multimedia, develops, produces and markets broadcast equipment and turnkey systems for the complete digital image chain, from production to transmission and broadcasting. A pioneer in MPEG2 digital compression and DVB related applications, Thomson Broadcast Systems provides complete cable head-end and return channel solutions. Further information is available on: http://www.thomsonbroadcast.com.

Thomson Multimedia

THOMSON MULTIMEDIA is the fourth largest global supplier of consumer electronics products, with sales over $6 billion in 1998 and 48,000 employees in over 30 countries. The Group has four main activities: Displays and Components, Consumer Products, New Media Services, Patents and Licensing. Within its activities Thomson multimedia develops, manufactures and sells television displays and components, consumer products such as televisions, VCRs, camcorders, audio & communications products, digital decoders, DVD players and professional video equipment. Thomson Multimedia was first in the list of recommended suppliers of the EuroModen compliant cable modems. Further information is available on: http://www.thomson-multimedia.com.

The EuroCable Labs

The EuroCableLabs was formed by eleven members of ECCA in October 1996. Originally named the ECCA Technical Cell (ETC) it was renamed EuroCableLabs in September 1997 and in March 1998 it was formed as an independent association. At present EuroCableLabs is responsible for the development of:

- EuroModem – the European cable modem specification that conforms to the ITU-T J.83 Annex A, ITU-T J.112 Annex A, ETS 300800 and ETS 300429 specifications;
- EuroBOX – the European set-top box specification;
- EuroLoader - the software loader for multimedia terminals for cable and cable modems.

Milestones in the history of EuroCable Labs are:

September 1999	The EuroLoader project was launched by members of EuroCableLabs.
August 1999	Publication of the Shortlist of EuroModem manufacturers.
May 1999	Publication of the EuroModem specification.

December 1998	The EuroBox project was integrated in the EuroCableLabs working groups. The EuroModem project was launched by members of EuroCableLabs.
June 1998	EuroCableLabs sent out a Request for Proposals with regard to bi-directional communication systems for CATV networks.
March 1998	EuroCableLabs was constituted as an international association under Belgian law.
February 1998	DVB seminar for EuroCableLabs members at Centre of Competence.
September 1997	The name ETC was changed to EuroCableLabs.
January 1997	Institute for Communications Technology ("Institut für Nachrichtentechnik" - IfN) signed an agreement of co-operation and became the Centre of Competence of ETC (ETC3).
October 1996	Eleven members of ECCA (European Cable Communications Association) founded the ECCA Technical Cell (ETC).

EuroCableLabs Membership

At the moment 22 partner organisations plus ECCA and the Centre of Competence co-operate in the framework of EuroCableLabs. This number means an increase of 100 % within a period of nearly two years. The current membership is:

Austria	Telekabel Wein (Vienna)
Belgium	ECCA (Brussels)
	RTD (Brussels)
	Electrabel (Brussels)
	Integan
Denmark	TeleDanmark Kabel TV (Copenhagen)
Finland	Helsinki Media (Helsinki)
France	France Telecom Cable (Paris)
Germany	Deutsche Telekom (Darmstadt)
Ireland	CableLink Ltd (Dublin)
Netherlands	CASEMA (Delft)
	CasTel (Groningen)
	ENECO (Rotterdam)
	VECAI (Den Haag)
Norway	Telenor Avidi (Oslo)
Sweden	Stjarn-TV-Natet AB (Stockholm)
	Telia InfoMedia TeleVision AB (Stockholm)
Switzerland	Cablecom Media AG (Zurich)
	SwissCableNet AG (Bern)
UK	NTL (Winchester)

Observer members at EuroCablabs are:

Belgium	Telenet (Mechelen)
Israel	Israel Cable television Association
Italy	Stream (Roma)
Netherlands	UPC (Amsterdam)
Portugal	TV Cabo Portugal (Lisboa)
Spain	Agrupacion de Operadores de Cable (Madrid)

7th EuroCableLabs Technical Committee Meeting

A report of the meeting of the 7th EuroCableLabs Technical Committee (ECL-TC) that took place in Copenhagen on 12 May 1999 is given below.

Twenty people attended the meeting and discussed the latest developments and achievements. During the meeting the Centre of Competence informed the participants about the current stage of the standardisation procedure of the important cable-modem standard ETS 300 800. The second version of this standard dated on November 1998 is the baseline document for the EuroModem specification and is still in ETSI's national voting procedure. It is expected that the standard will be officially approved by ETSI in summer this year.

Parallel to the development of the EuroModem specification a group of mainly US-based vendors started an initiative trying to standardise a Europeanised version of the American DOCSIS specification through ETSI. ECCA and ECL believes that this step, on the one hand, confuses the cable modem market and, on the other hand, splits it into two parts. If this will happen, cable modem manufacturers will either develop two different product types or support one standard only. Both possibilities result in an increase of product pricing due to a decrease of competition. Only after just one single standard (ETS 300 800) has been turned into products in the marked place the real competition will become possible - that between equipment manufacturers offering systems according to that standard. ECCA and EuroCableLabs started a counter-initiative objecting the adoption of a second standard in order to initiate a common EuroModem market with high competition between EuroModem vendors.

Simulation results received by the Centre of Competence regarding the transmission of ISDN telephony services via a EuroModem system underlined the decision to go ahead with the European standard and not to wait for a DOCSIS 1.0 solution till next year. The results showed a very high performance in terms of quality-of-service (QoS) guaranteed by the EuroModem that cannot provided by DOCSIS equipment available today. CableLabs US that attended in the afternoon session of the ECL-TC meeting pointed out that higher transmission protocol layers, being investigated by at the moment, can be easily adopted to the EuroModem solution. CableLabs US requested to co-operate with EuroCableLabs on this matter in order to make sure service interoperability. Another hot topic for the Americans was the development of a copy protection algorithm for digital video signals.

Large US-based film studios currently force the American industry towards a solution. It could be the case that this topic will become relevant for the European industry as well. In-home networks are a third activity proposed for co-operation. A document that analyses the current situation with respect to in-home networks was handed over to the colleagues of CableLabs US. Concerning digital set-top boxes, CableLabs was informed about the current stage of the work carried out by the Eurobox Consortium. Both future set-top box solutions, the American and the European, are focusing on independent software platforms such as the DVB's Multimedia Home Platform (MHP).

In-home networks as well as the Multimedia Home Platform for cable applications are topics of the new work plan that was agreed by the members of the ECL-TC during the meeting. Besides the ongoing work related to EuroBox, EuroModem as well as the contributions to the further development and standardisation of ETS 300 800, some additional work items were set up. The Centre of Competence will for instance investigate in a so called "Multimedia Cable Platform" which is a cable-related MHP application. At the moment in-home networks are investigated by some projects world-wide. ECL will not start its individual investigations, but it will observe the ongoing developments and will contribute if necessary.

European Cable Communications Association (ECCA)

The European Cable Communications Association is the European Association of cable operators and groups of European cable operators, as well as their national associations. The main goal of ECCA is to foster co-operation between cable operators, to promote and represent their interests at a European level. ECCA gathers European cable operators who have more than 40 million subscribers. The first informal co-operation between European cable operators started in 1949. As these informal meetings became more frequent, a formal structure for European co-operation was required and on September 2, 1955, AID (Alliance Internationale de la Distribution par câble) was set up by representatives of Switzerland, Belgium and The Netherlands. In 1993, AID was renamed the European Cable Communications Association, thus stressing the communication role of its members as well as the European goals of the Association. ECCA now has 29 members in 17 countries. It also has 5 associate members in Central and Eastern European. ECCA defends the interests of 'private' cable operators, of municipalities and utility companies operating cable networks, as well as those of cable operators related to telecom organisations. Eleven members of ECCA were responsible for the creation of the ECCA Technical Cell that eventually became the EuroCableLabs.

EuroModem Compliant Cable Modem Technology Comparison

A comparison of the current range of commercially available cable modems that comply with the EuroModem specification is shown in Table 1. This comparison is based upon technology from five manufacturers:

- Cisco - the DVB CAR100;
- Com21 - this is a re-badged version of the Cocom device which itself was the basis for the Cisco DVB CAR100;
- Hughes Network Systems - the HNS2510 external and HNS2520 internal cable modems. These are a part of the AIReach Multimedia 3000 product range;
- Terayon - the UCM-220 which is a re-badged version of the ComBox cable modem;
- The industree - the CableJet 900 (Ethernet interface) and the CableJet 910 (USB interface) cable modems.

The Comparison Criteria

The characteristics that have been used for this evaluation are:

- General - these are the characteristics that describe the interfaces and the standards compliance of the device. The specific features being compared are:
  - EuroModem Class: Class A or Class B as defined by the ECCA EuroModem specification
  - Standards: The core data protocol and physical communications standards with which the cable modem comply e.g. ES 300 800 i.e. the DVB-RCC protocol ETSI standard
  - HFC Interface: The nature of the CATV network connection
  - CPE Interface: The type of interface to the host computer e.g. 10BaseT Ethernet, USB, etc.

  - Management: The form of management protocol and/or interface supported by the cable modem
  - Internal/External: Whether or not the device is installed inside or is external to the host PC
  - Other Features: A brief list of the other services or functions that are supported by the cable modem e.g. IP Multicast, etc;
- IP & MAC Layers - the communication protocol features of the cable modem and the IP support capabilities. The specific features being compared are:
  - Data Services: The nature of the data services supported e.g. best effort, isochronous, or the three core DVB-RCC modes themselves
  - No. of CPEs: The number of PCs that can be connected to the network through the cable modem
  - No. of Channels: The number of upstream channels from which the cable modem can concurrently receive data
  - Security: The nature of the security features that are supported e.g. the form of encryption and authentication;
- RF-Upstream - the upstream physical layer functions i.e. the features for communication from the cable modem to the head-end. The specific features being compared are:
  - Frequency Range (MHz): The upstream frequency range, in MHz, within which the upstream channels must be allocated
  - Channel Bandwidth (MHz): The bandwidth, in MHz, that can be allocated to each upstream channel
  - Modulation: The modulation schemes that are supported on the upstream
  - Raw Signal Rate (Mbps): The upstream raw data rate, in Mbps, provided as a result of the modulation scheme and channel bandwidth;
- RF-Downstream (In-band) - the downstream in-band physical layer functions i.e. the features for communication from the head-end to the cable modem. The specific features being compared are:
  - Frequency Range (MHz): The in-band downstream frequency range, in MHz, within which the downstream DVB-C channels must be allocated
  - Channel Bandwidth (MHz): The bandwidth, in MHz, that can be allocated to each downstream channel
  - Modulation: The modulation schemes that are supported on the downstream
  - Raw Signal Rate (Mbps): The in-band downstream raw data rate, in Mbps, provided as a result of the modulation scheme and channel bandwidth;
- RF-Downstream (OOB) - the downstream out-of-band (OOB) physical layer functions of the EuroModem specification are not supported by any of the devices under comparison. The OOB functions are normally employed within Set-top boxes;
- Mechanical - the specific features being compared are:
  - Dimensions ('h' x 'w' x 'd'): The physical dimensions of the cable modem in terms of height, width and depth
  - Power Supply: The type of power supply required by the cable modem e.g. AC or DC.

Summary of Findings

The key findings from this comparison are:

- The industree CableJet modems are the most modern in terms of their specification. In comparison with the other cable modems these are new as a such they conform to the latest version of the DVB-RCC standard, namely ES 200 800. The other cable modems are very similar in capability with only small differences between each of them;
- The Terayon cable modem offers the broadest range of upstream data rates (all four rates are available) whereas the Hughes cable modem appears to have the broadest range of data services i.e. not juts best effort;
- With the exception of the Hughes device the others limit the number of devices that can be connected to the cable network. This should not be a constraint for home usage but main be a cause for concern in Small to medium Enterprises.

EuroModem Compliant Head-end (INA) Technology Comparison

A comparison of the current range of commercially available cable modems that comply with the EuroModem head-end specification is shown in Table 2. This comparison is based upon technology from five manufacturers:

- Cisco - the INA2320;
- Hughes Network Systems - the HNS CS2500, a part of the AIReach Multimedia 3000 product range;
- Terayon - the UCMT-2000 which is a re-badged version of the ComBox INA;
- The industree - the CableDock 200;
- Alcatel/Thomson - the DRC 7100 (at present there is little information available concerning this device).

Table 1 A comparison of the range of EuroModem compliant cable modems currently available.

Characteristic	Cisco DVB CAR100	Com21	HNS CS2510/20	Terayon UCM-220	The industree CableJet 900/910
General					
EuroModem Class	A - Euromodem 1.0	A - Euromodem 1.0	A - Euromodem 1.0	A - Euromodem 1.0	A - Euromodem 1.0
Standards	EN 300 800 EN 300 429	EN 300 800 EN 300 429	EN 300 800 EN 300 429	EN 300 800 EN 301 429	ES 200 800 EN 300 429
HFC Interface	–	–	–	F-connector	F-connector
CPE Interface	Ethernet RJ-45 10BaseT	Ethernet RJ-45 10BaseT	Ethernet RJ-45 10BaseT	Ethernet RJ-45 10/100 BaseT USBv1.1	900 - Ethernet RJ-45 10/100 BaseT 910 - USB Series-B
Management	SNMP	SNMPv2c	SNMPv2	SNMPv2 ComBox MIB	–
Internal/External	External	External	External and Internal	External	External
Other Features	Port-level Network Address Translation IP Multicast and Routing	Port-level Network Address Translation IP Multicast and Routing	Port-level Network Address Translation IP Routing	IP Multicast	Integrated IP Routing
IP & MAC Layers					
Data Services	Best Effort	Best Effort	Best Effort Fixed Data Rate Committed Data Rate	Best Effort	Best Effort
No. of CPEs	CAR100-PC: 1 CAR100-LAN: 20	–	Unlimited	16	12
No. of Channels	1	1	1	1	1
Security	–	–	40 and 56-bit DES 512 Diffie-Hellman	40 and 56-bit DES 512 Diffie-Hellman	56-bit DES
RF-Upstream					
Frequency Range (MHz)	–	–	–	5-65	5-65
Channel Bandwidth (MHz)	2	2	2	0.2-4	1 or 2 (depends on the data rate)
Modulation	QPSK	QPSK	QPSK	QPSK (16QAM optional)	QPSK
Raw Signal Rate (Mbps)	3.088	3.088	3.088	0.256, 1.544, 3.088, 6.172	1.544 or 3.088
RF-Downstream (In-band)					
Frequency Range (MHz)	110-862	88-860	118-862	110-862	110-862
Channel Bandwidth (MHz)	8	8	8	8	8
Modulation	64QAM and QPSK	64QAM and QPSK	64QAM 256QAM	64QAM 256QAM	64QAM (256QAM optional)
Raw Signal Rate (Mbps)	41.4Mbps	42	42 (64QAM) 56 (256QAM)	42 (64QAM) 56 (256QAM)	42 (64QAM) 56 (256QAM)
RF-Downstream (OOB)	*Not Supported*	*Not Supported*	*Not Supported*	*Not Supported*	*Not Supported*
Mechanical					
Dimensions ('h' x 'w' x 'd')	248x200x45 (mm)	50x245x200 (mm)	45x245x200 (mm)	60x233x160 (mm)	51x133x199 (mm)
Power Supply	9-15V DC	9-15V DC	9-15V DC	5V DC	External 230-240V, 50Hz

The Comparison Criteria

The characteristics that have been used for this evaluation are:

- General - these are the characteristics that describe the interfaces and the standards compliance of the device. The specific features being compared are:
  - Standards: The core data protocol and physical communications standards with which the INA comply e.g. ES 200 800 i.e. the DVB-RCC protocol ETSI standard
  - HFC Interface: The nature of the CATV network connection
  - External network Support: The type of external networks to which the INA can be natively connected e.g. fast Ethernet (100BaseT)
  - Management: The form of management protocols supported by the INA
  - Management Interface: The network interfaces through which the network management systems can be connected e.g. DHCP server
  - Other Features: A brief list of the other services or functions that are supported by the cable modem e.g. IP Multicast, etc;
- IP & MAC Layers - the communication protocol features of the cable modem and the IP support capabilities. The specific features being compared are:
  - Data Services: The nature of the data services supported e.g. best effort, isochronous, or the three core DVB-RCC modes themselves
  - Security: The nature of the security features that are supported e.g. the form of encryption and authentication;
- RF-Upstream - the upstream physical layer functions i.e. the features for communication from the cable modem to the head-end. The specific features being compared are:
  - Number of Channels: The maximum number of upstream channels that can be supported concurrently by the INA
  - Channel Bandwidth (MHz): The bandwidth, in MHz, that can be allocated to each upstream channel
  - Modulation: The modulation schemes that are supported on the upstream
  - Raw Signal Rate (Mbps): The upstream raw data rate, in Mbps, provided as a result of the modulation scheme and channel bandwidth;
- RF-Downstream (In-band) - the downstream in-band physical layer functions i.e. the features for communication from the head-end to the cable modem. The specific features being compared are:
  - Number of Channels: The maximum number of downstream channels that can be supported concurrently by the INA
  - Channel Bandwidth (MHz): The bandwidth, in MHz, that can be allocated to each downstream channel
  - Modulation: The modulation schemes that are supported on the downstream
  - Framing: The protocol encapsulation methods supported for in-band downstream communications
  - Raw Signal Rate (Mbps): The in-band downstream raw data rate, in Mbps, provided as a result of the modulation scheme and channel bandwidth;
- RF-Downstream (OOB) - the downstream out-of-band (OOB) physical layer functions of the specification. The OOB functions are normally employed within Set-top boxes. The specific features being compared are:
  - Channel Bandwidth (MHz): The bandwidth, in MHz, that can be allocated to each OOB downstream channel
  - Modulation: The modulation schemes that are supported on the OOB downstream
  - Framing: The protocol encapsulation methods supported for OOB downstream communications
  - Raw Signal Rate (Mbps): The OOB downstream raw data rate, in Mbps, provided as a result of the modulation scheme and channel bandwidth;
- Mechanical - the specific features being compared are:
  - System Rack: The description of the system rack
  - Configuration Range: The range of cards that can be supported by the system rack
  - Power Supply: The type of power supply required by the cable modem e.g. AC or DC.

Summary of Findings

The key findings from this comparison are:

- The quality of the descriptions of the INAs is unsatisfactory and so no form of real comparison can be made. A key difference is the support or otherwise of the out-of-band downstream communications capability. Within Europe, Set-top box support will require an OOB downstream capability;
- The Terayon and The industree INAs have the broadest support in terms of upstream data rates. In contrast it is the Cisco and Hughes INAs that appear to offer the broadest range of data services.

Table 2 A comparison of the range of EuroModem compliant head-ends currently available.

Characteristic	Cisco INA2320	HNS CS2500	Terayon UCMT-2000	The industree CableDock 200	Alcatel/Thomson DRC 7100
General					
Standards	EN 300 800, EN 300 429 DAVIC 1.2 (OOB) SCTE DVS/167	EN 300 800 EN 300 429	EN 300 800 EN 300 429	DVB 2.0 (ES 200 800, EN 300 429) ECCA Euromodem 1.0	EN 300 800 DAVIC 1.5
HFC Interface	BNC	F-type connector	ASI BNC connector LVDS 25 pin D-type	F-type connector	–
External Network Support	10/100 BaseT, RJ-45 UTP	10/100 BaseT, RJ-45 UTP 10 Base2 BNC, DB-15 AUI	100 BaseT, RJ-45 UTP	10/100 BaseT, RJ-45 UTP	100 BaseT, RJ-45 UTP
Management	SNMPv2c and RADIUS	SNMPv1 and RADIUS	SNMP		–
Management Interface	–	–	100 BaseT, RJ-45 UTP	10/100 BaseT, RJ-45 UTP Console interface RS-232	–
Other Features	NAT, DHCP relay agent, BOOTP relay agent	–	–	In-operation configuration using hot-swap and hot-download	–
IP & MAC Layers					
Data Services	Contention Mode Reservation Mode Fixed Rate Mode 32 QoS levels supported	Best effort Fixed Rate Minimum Bit Rate	–	–	–
Security		40 or 56 bit DES 512-bit Diffie-Hellman	40 or 56 bit DES 512-bit Diffie-Hellman	–	–
RF-Upstream					
Number of Channels	4 or 8	4 or 8	1-8	1-16	–
Channel Bandwidth (MHz)	1 or 2	1 or 2	–	–	–
Modulation	QPSK	QPSK	QPSK 16QAM - Optional	QPSK 16QAM - Optional	–
Raw Signal Rate (Mbps)	Grade B - 1.544 Grade C - 3.088	Grade B - 1.544 Grade C - 3.088	Grade A - 0.256 Grade B - 1.544 Grade C - 3.088 Grade D - 6.176	Grade B - 1.544 Grade C - 3.088 Grade D - 6.176	–
RF-Downstream (In-band)					
Number of Channels	1	1 or 2	–	1-2	–
Channel Bandwidth (MHz)	8	8	–	–	–
Modulation	QAM 4/16/32/64/128	QAM 4/16/32/64/128/256	64 and 256 QAM QAM 16/32/128 Optional	Integrated QAM Modulator, 64-256QAM (optional)	–
Framing	MPEG, DSM-CC MPE and Direct IP	MPE Direct IP MPE Ethernet MAC bridging	IP Encapsulation	–	–
Raw Signal Rate (Mbps)	Up to 40	–	42 (64QAM) 56 (256QAM)	42 (64QAM) 56 (256QAM)	–
RF-Downstream (OOB)			–		
Channel Bandwidth (MHz)	1 or 2		–		–
Modulation	QPSK	*Not Supported*	*Support cliamed in the literature but no details given*	*Not Supported*	–
Framing	SL-ESF, AAL5, Direct IP		–		–
Raw Signal Rate (Mbps)	Up to 3		–		–
Mechanical					
System Rack	19" standard sub-rack	19" standard sub-rack	–	19" - 8 slots - Compact PCI	–
Configuration Range	Up to 2 RX cards Up to 1 TX card	–	–	Up to 4 Rx cards Up to 2 Tx cards 1 System Controller Optional I/O card	–
Power Supply	AC 115-230V	AC 100-250V	VDC -36/-72 VAC 85/264	AC 230-250V Up to 2 (Redundant) Compact PCI power supplies	–

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List of Abbreviations

AAL	ATM Adaptation Layer
AC	Alternating Current
ACTS	Advanced Communications Technologies & Services
ATM	Asynchronous Transfer Mode
BOOTP	BOOT Protocol
CATV	Community Antenna Television
CPE	Customer premises Equipment
DAVIC	Digital Audio Visual Council
DC	Direct Current
DDIC	DVB/DAVIC Interoperability Consortium
DES	Data Encryption Standard
DHCP	Dynamic Host Configuration Protocol
DOCSIS	Data Over cable Service Interface Specification
DSL	Digital Subscriber Line
DVB	Digital Video Broadcasting
DVB-RCC	DVB Reverse Channel for Cable
ECCA	European Cable Communications Association
ETC	ECCA Technical Cell
ETSI	European Telecommunication Standards Institute
EU	European Union
GSM	Global System for Mobile
HDTV	High Definition Television
HFC	Hybrid Fibre Coax
INA	Integrated Network Adapter
IP	Internetwork Protocol
ISDN	Integrated Services Digital Network
ITU	International Telecommunications Union
LAN	Local Area Network
LMDS	Local Multichannel Distribution System
MAC	Medium Access Control
MHP	Multimedia Home Platform
MMDS	Multichannel Multipoint Distribution System
MPEG	Motion Picture Encoding Group
NAT	Network Address Translation
OOB	Out-of-Band
PTT	Public Telegraphy and Telephony
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrature Phase Shift Keying
RADIUS	Remote Access Dial-In User Service
SL-ESF	Signalling Link Extended SuperFrame
SNMP	Simple Network Management Protocol
USB	Universal Serial Bus
UTP	Unshielded Twisted Pair

Contact Addresses

Further information is available from the following web-sites:

Alcatel	http://www.alcatel.com
Cisco Systems Inc.	http://www.cisco.com
Com21 Inc.	http://com21.com
Conexant Inc.	http://www.conexant.com
DDIC	http://www.dvb-davic.org
Harmonic Inc.	http://ww.harmonicinc.com
Hughes Networks Systems	http://www.hns.com
Nokia Multimedia	http://www.nokia.com
Pace Micro Technology	http://www.pace.co.uk
Philips Digital Networks	http://www.broadcast.philips.com
Philips SemiConductor	http://www.philips.com
Sagem	http://www.sagem.com
Samsung	http://www.sem.samsung.com
	http://www.samsungstb.com
Terayon Communication	http://www.terayon.com
The industree	http://www.industree.nl
Thomson Broadcast Sys	http://www.thomsonbroadcast.com
Thomson Multimedia	http://www.thomson-multimedia.com

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