The Kerpen HomeNet System

White Paper

Version 1.2

HomeNet Distribution System

Introduction

The Kerpen HomeNet System is the worlds most versatile, flexible and user-friendly Home distribution system. It allows any combination of Telephones, PCs, Televisions, Audio, and Video etc to be connected around the home without the need for multiple cabling systems or multiple outlet plates or "Wall Acne"

The cable is verified up to 1.4GHz making HomeNet the only twisted pair system able to carry Video/RF/DVB/FM/DAB signals without expensive compression units. The system is backwards compatible to support all the services normally run over lower grade cable (Category 5, 5E, 6 and even Category 7) with significant additional headroom. This provides a truly future-proof distribution network.

With individual pair shielding and an overall braid screen, a single HomeNet cable can simultaneously support the same services as up to four "normal" cables and totally negates the need for separate Coax, thereby reducing the number of cables required and bringing true flexibility to the home.

With a full range of simple plug in adapters, only the required pairs are used for each service leaving the remainder free to connect other devices. Video/RF/DVB/FM/DAB use just one pair, as do Telephones, Infrared and Composite video. Computer Networks (Ethernet 10/100baseT), Stereo Audio, Broadband, ISDN and S-VHS utilise 2 pairs.

HomeNet outlets are supplied as standard 50mm x 50mm Euro-modules to fit all leading ranges of accessory plates. The angled module will accommodate one or two connectors; completely eliminating the "Wall Acne" associated with lower grade multiple outlet/mixed media systems.

HomeNet can be configured as a completely passive system or can be combined with active electronics to enhance the facilities available.

Key Features & Benefits

- Total Flexibility – Connect a TV, Telephone, CCTV Camera or Computer at any point.
- Multiple Connections – Connect up to four devices simultaneously to one point.
- Distributed Services – Watch Video, DVD, Satellite or Cable on any or all TVs in the house*.
- Control – use your I/R handset to switch channels or control your equipment from other rooms.
- Compatibility – Works with almost all consumer equipment so clients do not have to replace their equipment.
- One Connector Type – Reduces "Wall Acne" where multiple outlets would normally be required.

- Discrete Wiring – Installed at build phase so no trailing cables.
- Central Connection Box – Easy to make changes or add services.
- Highest Specification Cable – Leading Edge Technology means no upgrades required.
- Desirability – Superior system to competitors.
- Necessity – 40% of houses will be "Smart" in 10 years**.
- Adds Value – And makes the house easier to sell.

Overview of the HomeNet System

The HomeNet System comprises of four basic sections, which together provide the flexibility and bandwidth to support almost any application.

HomeNet 8 Cable – This is the backbone of the system. It transports whatever services are required around the home in a star wired format.

HomeNet 1200 Connector – This is the key to the flexibility of the system. This unique connector provides complete shielding around each pair of the cable right through the connector. This ensures that no signals can "bleed through" or cause crosstalk with any other service being carried in the same cable. Its unique design allows only the required pairs to be connected for each service, leaving the remainder free to connect other services now, or in the future.

HomeNet splitters – These combine and split the various services to allow multiple presentation of a single source for patching to one or more HomeNet outlets around the home. These are housed in the central wiring rack that is usually sited in a utility area.

HomeNet Patch Cables and Adapters – These plug into the required number of pairs of the HOMENET 1200 connector for the service to be connected. Patch Cables are used to patch between splitter ports and the rack end of HomeNet 8 cables running out to rooms in the house. Adaptor Cables are used in the rooms to convert the HomeNet 8 twisted pair(s) back to the native cable type and connector for the service being distributed. Various types and lengths are available to suit most applications.

The following sections describe the four component parts in greater detail:

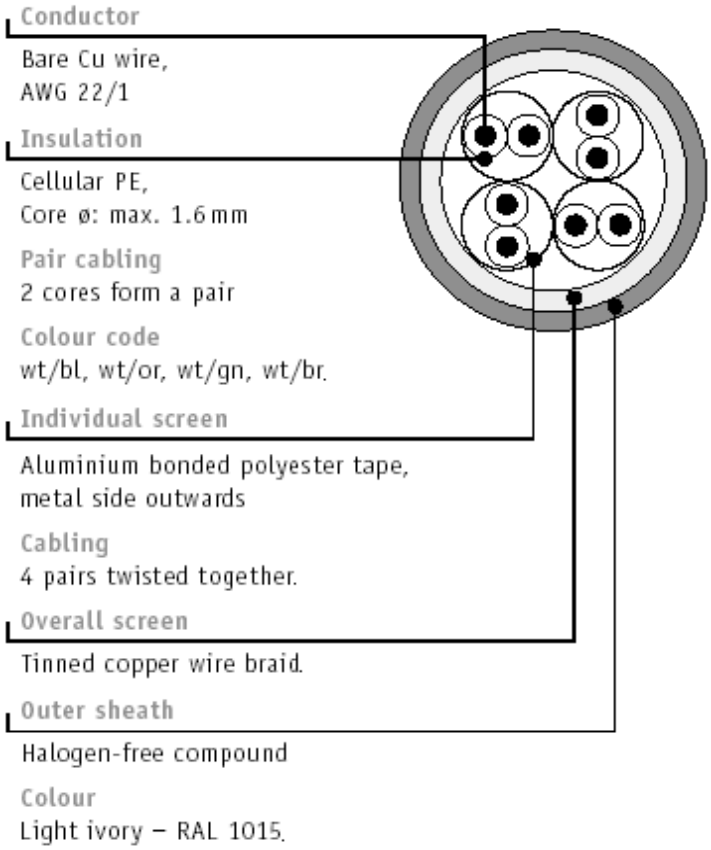
* **Subject to certain conditions**
** **Source: The Joseph Rowntree Foundation as reported in The Sunday Times Home Supplement 23/02/03**

HomeNet 8 Cable

This unique cable negates the need for any other distribution cabling in the home. It replaces all other types of twisted pair and RF Coaxial cable

With Four individually screened pairs, each colour coded for easy identification, the HomeNet 8 cable provides the highest bandwidth copper cable channel available today.

The Cable consists of four pairs, each with a foil screen to segregate services and maintain integrity throughout the cable length. The two wires of each pair are 22AWG and are twisted in a very controlled manner to provide maximum balance and coupling out of any induced noise. The four foil screened pairs are then twisted together in a controlled manner to provide a robust, symmetrical element which is then over-wrapped with tinned copper wire to provide a high percentage braid shield coverage.



HomeNet 8 cable demonstrates a positive Attenuation to Crosstalk ratio (ACR) at frequencies in excess of 1400MHz (14 times better than cat 5E) with very controlled impedance to provide a stable channel to distribute services.

The outer sheath is Low Smoke Zero Halogen AND Flame retardant and is fully independently verified for performance, emissions and immunity to all relevant international standards. Sheath colour is Cream to RAL 1015 and an O/D is approx. 8.5mm.

In addition, HomeNet 8 is in full compliance with the new IEC 61156-7 standard for Multi-Media cables up to 1200MHz, has backwards compatibility to all CENELEC and

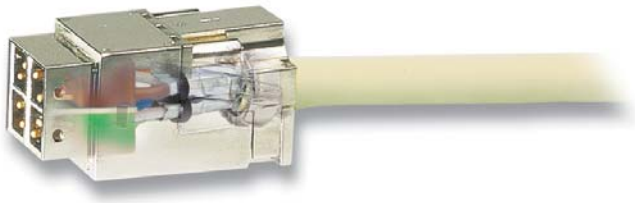
ISO/IEC cabling standards for Category 5, 5E, 6 and even Category 7 providing support for all legacy equipment as well as that still to emerge.

HOMENET 1200 Connector

The HOMENET 1200 Connector provides the user interface for the system. The connector is used at both ends of each length of HomeNet 8 cable and its unique design continues the high quality pair/signal segregation that is the key to the system's flexibility and multimedia capacity.

The HOMENET 1200 Connector's characteristics are matched to the HomeNet 8 cable to create minimal signal degradation during the transition from cable to connector pins and the patented quadrant design provides a simple and effective interface for the whole range of HomeNet adaptor cables.

Termination of the connector is very simple, requiring no specialist tools. The bared ends of the pairs are simply pushed into the connector blocks where barbed retainers provide a high quality electrical connection and strain relief. Contact surfaces are brass with gold plating and rated for 1000+ mating cycles



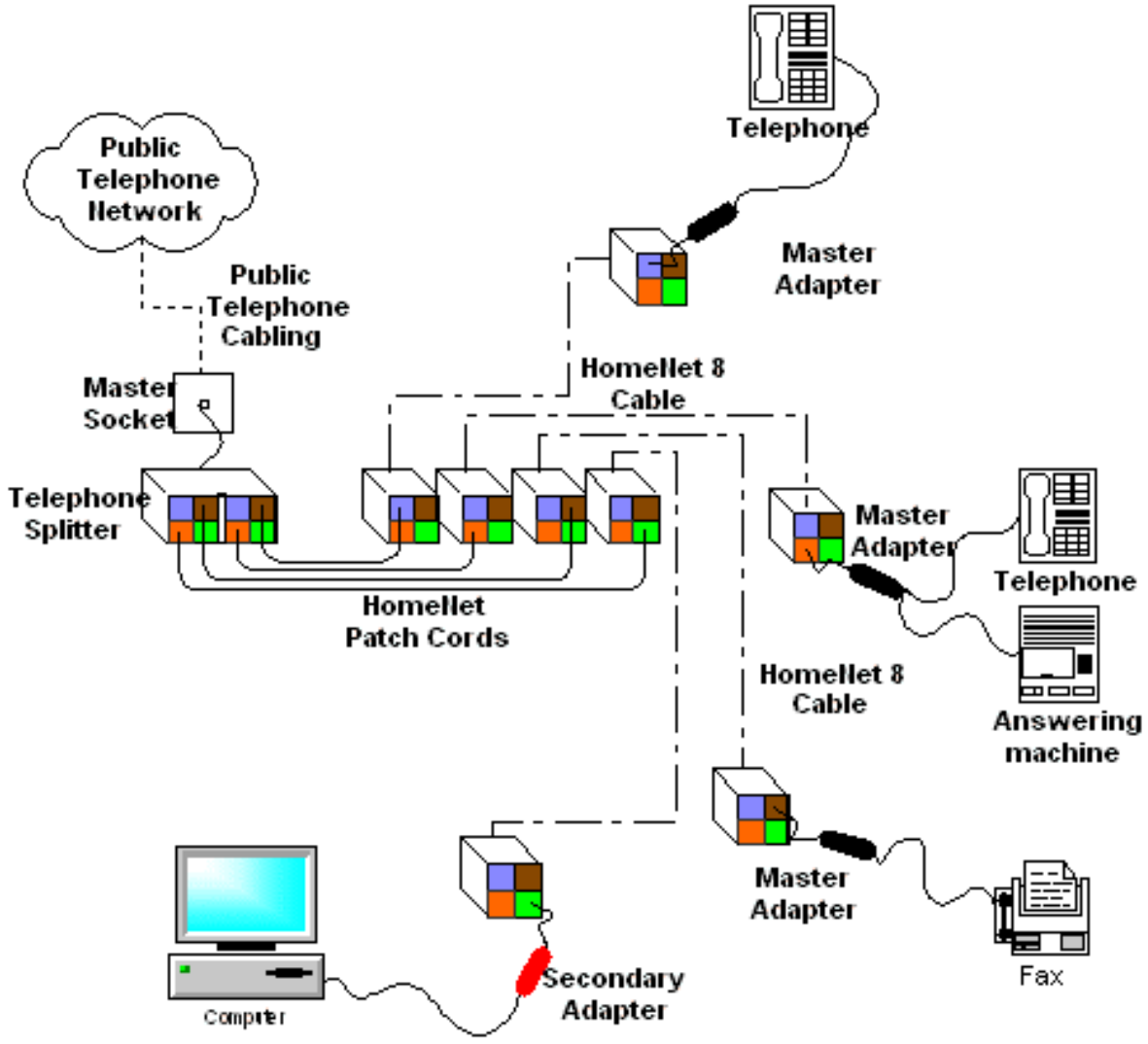
Grounding continuity between the cable and the connector is created by use of a 360-degree shield-clamping ring, which also acts as a strain relief.

The quadrant pair separator and the connector body are constructed of a two layer (Copper then Nickel), metallised ABS that assumes the shielding function from the cable foil and braid. This ensures minimal crosstalk, so a signal in a pair remains in that pair right through the connector. This exceptional connector also conforms to the relevant European standards for emissions and immunity to EMC and EMI.

Each quadrant of the connector provides one pair and the connector blocks are colour coded to match the cable pairs. This not only assists the installer when making off the connector but also facilitates the connection of adaptors to the right pairs at both ends of the connector.

HomeNet Splitters HomeNet splitters provide the connection method from the source equipment and services to the various devices around the home. They provide the converting and splitting function in one unit and are designed to mount in the standard HomeNet patch panels in the main rack.

Telephone Splitter - The telephone splitter allows connection to a single incoming telephone line (cable, BT or other) and allows up to seven telephone handsets or devices such as fax machines/modems/satellite boxes etc. to be patched around the home. The unit consists of two parts. The connection lead to the incoming line is usually supplied as a two-metre lead with a standard telephone plug on one end and a 1 pair HomeNet plug on the other. The second part is the splitter itself. This is essentially two HomeNet connectors with all pairs commoned together. These are simply mounted in the standard patch panels in the main rack.



Connection is made by inserting the Telephone plug into the incoming line master socket; the other end is inserted into any quadrant of the two connectors that make up the splitter. By the insertion of this lead, the remaining seven quadrants are all presented with the incoming line on the two pins of each pair. These are then simply patched to any quadrant of any of the outgoing cables to the rooms of the house.

Home PABX connection is also possible using the HomeNet system. Extension ports from the PABX are simply converted from standard twisted pair to the required number of HomeNet connectors to allow them to be patched around the home. 1 pair or 2 pair master or secondary adaptors are then used to provide connection to the handsets

There is more information on HomeNet Telephone adaptors in the later section.

RF Splitter – The HomeNet RF splitter is an eight-way unit and in fact acts as both a splitter and a converter. It performs the function of an Impedance Matching Device or Balun to convert from unbalanced 75-Ohm coaxial cable to balanced 100 Ohm twisted pair. A Coaxial cable has two conductors, the centre core and the outer braid. These two conductors are impendence matched and converted to the two wires of a balanced twisted pair to allow patching using a one pair HomeNet patch cable.

The Rear of the splitter has a single F type Female connector for the connection of Coaxial feeds from Antennae and other RF equipment. The front of the splitter is HomeNet 1200 interface providing two connectors of four quadrants each. This allows connection of up to eight devices around the home.

Multiple coaxial feeds (Off Air TV, Digital TV, DAB, FM, Video, CCTV etc.) can be combined in the wiring rack using traditional passive or active coax combiners which are both cost effective and readily available. When all services are combined into a single coaxial cable, this is fed directly into the RF splitter to allow patching to the cables serving the house. Should a user require more than 8 devices a second, third or fourth 8 way RF splitter can be put into the system although care is required to ensure sufficient signal strength still exists.

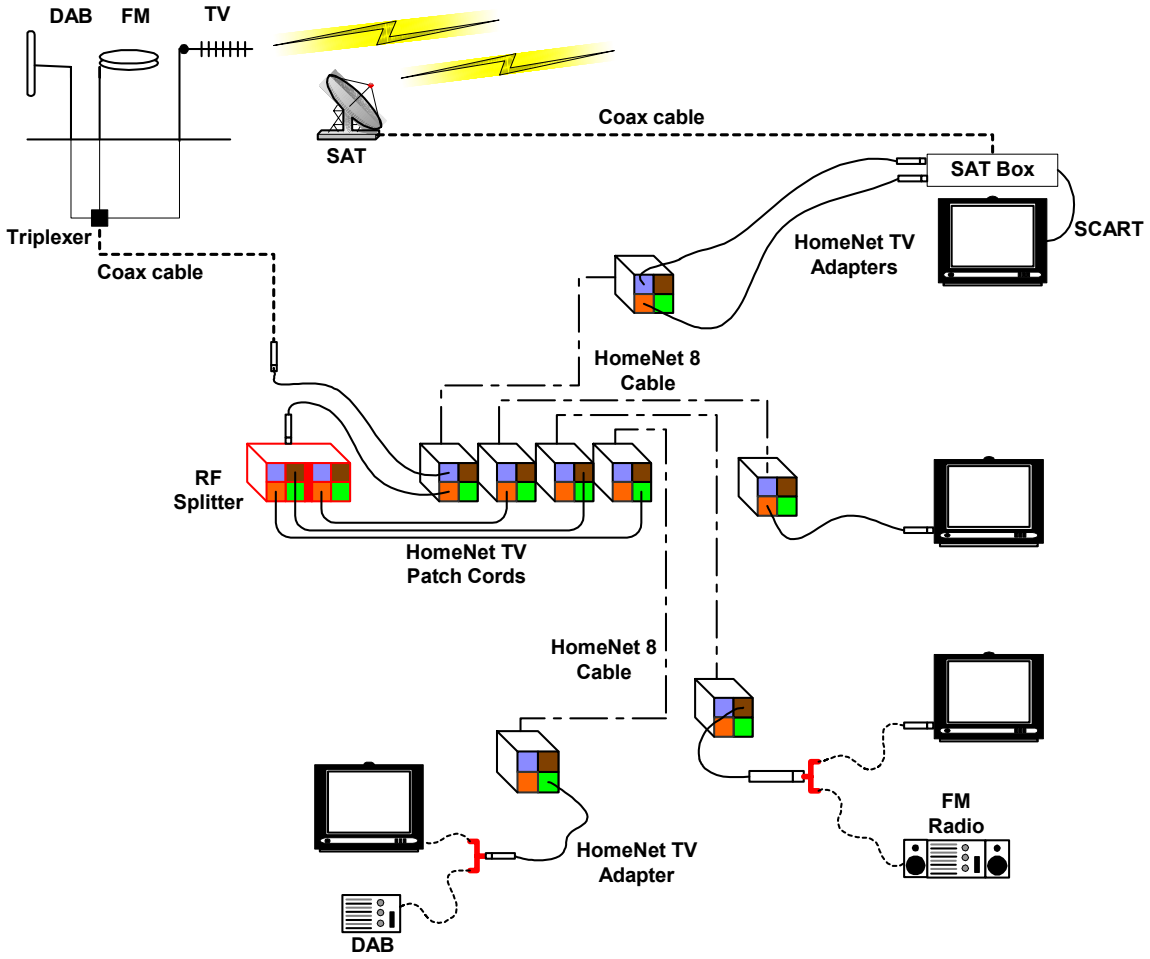
Should some or all of the incoming signals be below recommended levels then these can be amplified using a standard and cost effective RF amplifier prior to inserting into the RF splitter.

At the device end, HomeNet RF adaptor cables are utilised to convert the signal back to 75-Ohm coax ready to insert into the appropriate input of the device. Signals such as DAB and FM can be diplexed off at the RF adaptor to feed Audio systems etc.

Any Modulated device (Games Consoles, Satellite, Cable TV, RF CCTV Cameras, Video players, etc.) as well as normal Off Air and Digital Terrestrial TV can be fed into the system and distributed throughout the home. If the device does not have an on-board modulator (SCART, S-Video or Composite output only) a separate modulator can be utilised to provide the required RF output. For example, The SCART out port of the DVD player in the Lounge can be modulated using a separate modulator box and the output from that can be converted to twisted pair with a HomeNet RF adaptor that is plugged into one of the quadrants of the nearest HomeNet connector. This signal can then be converted back to coax at the main rack using another HomeNet RF adaptor. This would then be combined with normal off air antennae feeds to provide DVD output to all TVs in the house as an additional channel. Some simple setting up is then all that is required to tune the frequency of the modulator attached to the DVD player to avoid interference with terrestrial TV channels.

To maintain the best picture quality at the DVD location, the unit can still be connected to the local television using Composite, S-Video or SCART.

HomeNet RF Distribution with SAT box in Lounge

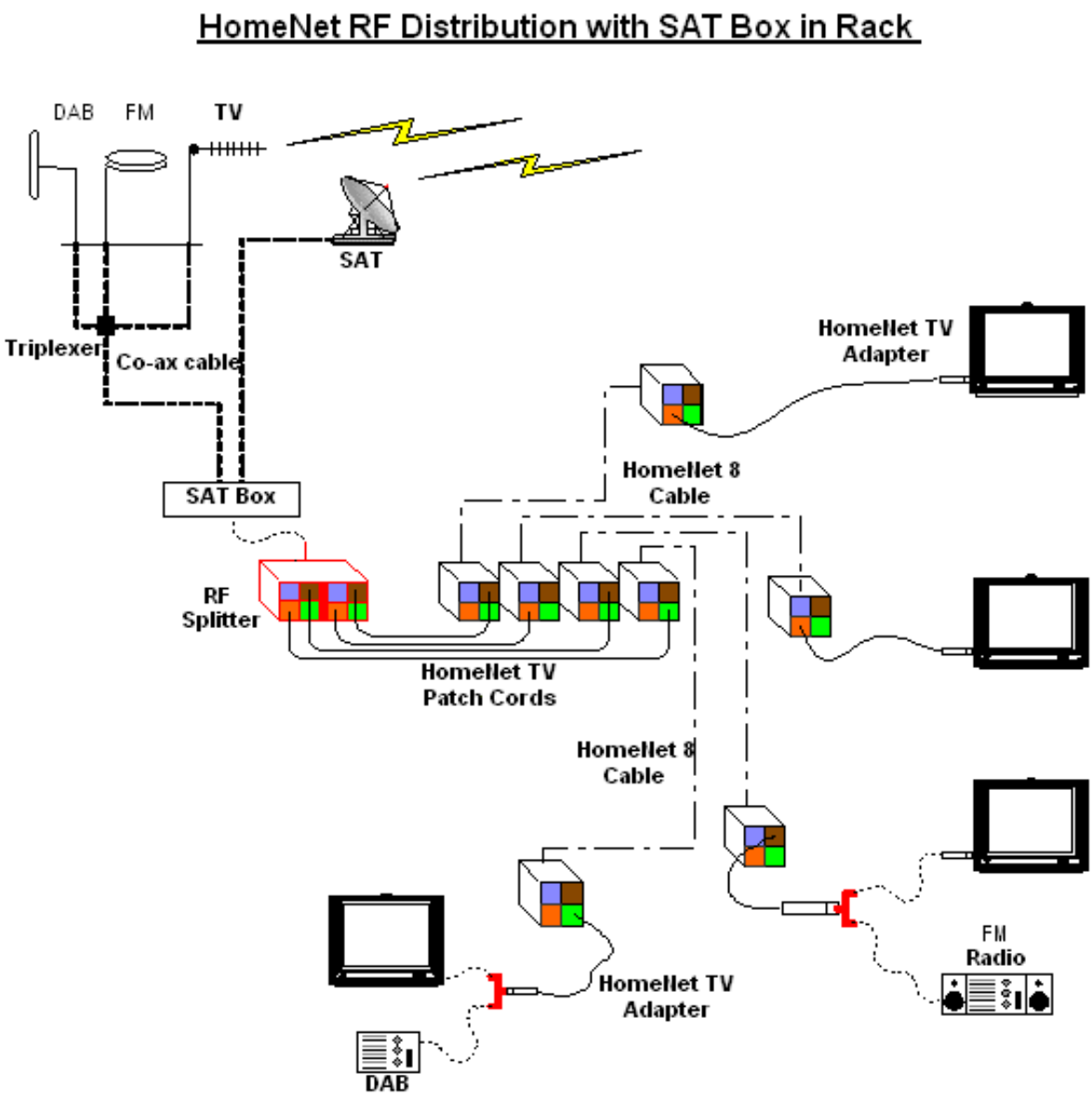


NOTE: SCART users will need to connect using a Pin 8 disabled lead to avoid problems associated with auto port switching if the local TV is to be used to view other channels or devices whilst the DVD is being used to view a movie in another room.

Note that a coaxial cable feed is still required from the dish to the satellite box. This is due to the very high frequencies involved that will only transmit via the HomeNet 8 cable over very short distances.

The same scenario can be used for Satellite/Cable boxes, video players and games consoles where the output is already available as a modulated coaxial port.

The versatility of HomeNet system allows all your existing equipment to be utilised to the maximum. The DVD player that could only be watched in the lounge is now available on every TV. The Video player in the children's bedroom is now available everywhere. And imagine this…. with a TV Out card fitted to their PC, you can view whatever is on your children's PC screen simultaneously on any TV in the house – useful for checking out what they are surfing on the web or making sure they really have gone to bed!



In this scenario, no control of the Satellite box is available at the remote TV sets. Third party infrared systems such as tvLINK are available very cheaply to provide this remote control. Please note that the standard HomeNet splitter does not pass the DC voltage necessary to power these devices. Should tvLINK or a similar system be required, an alternative splitter is available which provides the full DC pass through.

Network Systems - The HomeNet system can be used to provide computer connectivity or networking to allow multiple access to Broadband or ISDN Internet connections, sharing of peripheral devices such as Printers, and scanners and transferring files between computers in the home.

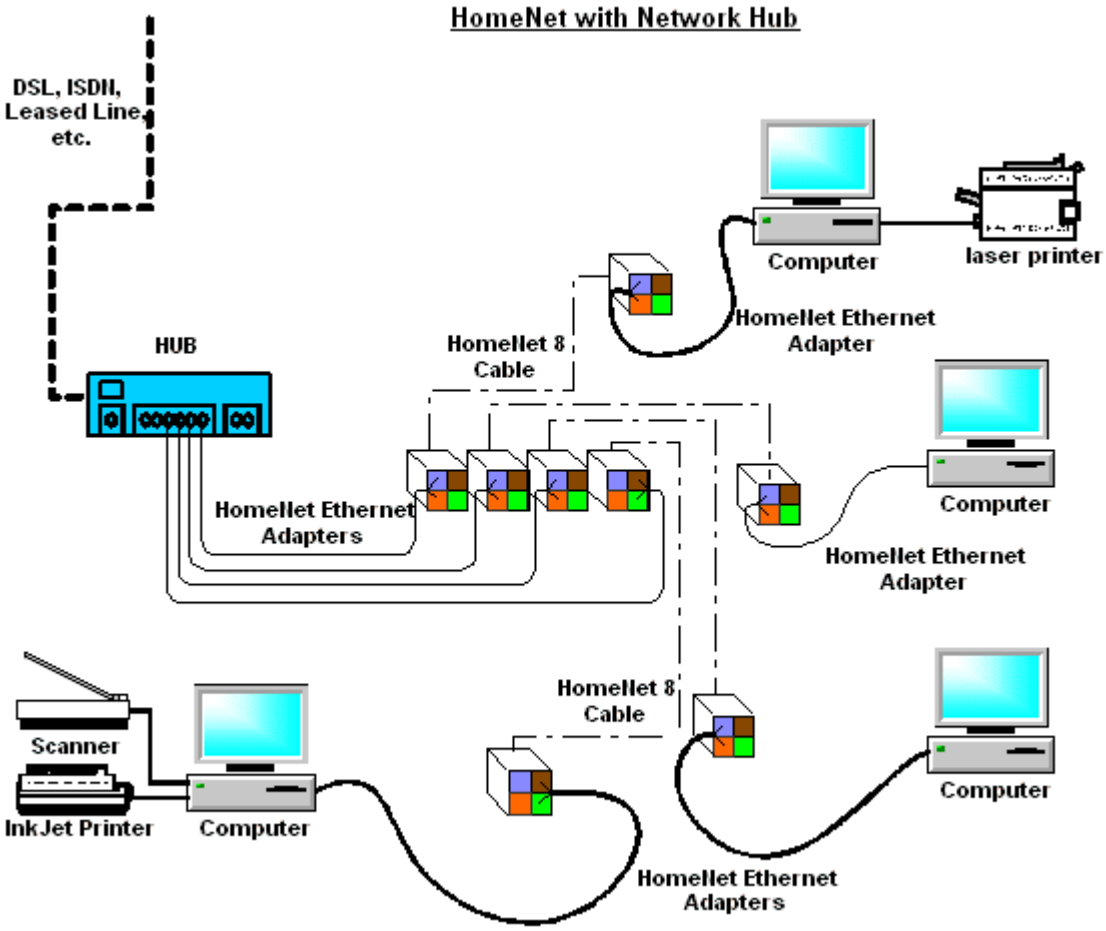
HomeNet Distribution System

There is no HomeNet Computer Splitter. The connection between computers is achieved using standard networking hubs that are available very cheaply in the local high street.

The most widely used network protocol is Ethernet and it is available in three speeds. 10Megabits Per Second (Mbps), 100 Mbps (sometimes called Fast Ethernet) and 1000Mb (sometimes called Gigabit Ethernet).

The first two speeds are most suitable for use in the home as the equipment required is very cheap and widely available and they only use two pairs to communicate between PCs. It is possible to support Gigabit Ethernet over a HomeNet system but the equipment is still quite costly and it would utilise all four pairs of a HomeNet cable therefore preventing it's use for any other services at the same time.

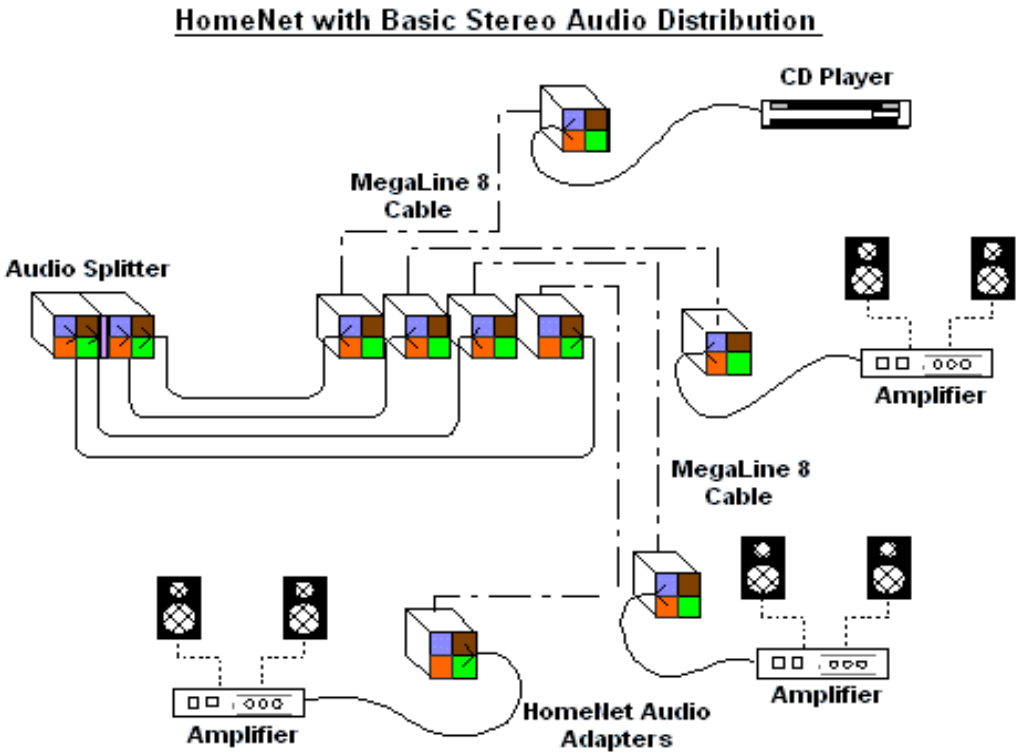
Ethernet networking uses RJ45 connectors as standard. These are the normal 4 pair plugs seen on other home distribution systems. With HomeNet, only the two pairs required are connected to the outlet, leaving the remaining two pairs for the connection of other services such as telephones or Televisions.



There is more information about the HomeNet Networking Adapter cable in the following section.

Audio Splitter - The HomeNet Audio splitter allows distribution of line level audio throughout the home. Line Level is the output from Hi-Fi equipment such as Tape decks, CD players and Tuners BEFORE it is amplified. The output from the equipment can be adapted to one or two HomeNet pairs and connected into the nearest HomeNet outlet to take it back to the central rack. Once at the central rack, the splitter provides connections to up to three amplifiers (provided each amplifier has a an auxiliary input port) around the home.

Due to the thickness of the copper in HomeNet 8 cable and the distances involved, it is not possible to distribute speaker outputs via HomeNet. It is therefore always necessary to have an amplifier at the remote location to provide the necessary amplification and speaker connections.



In the setup above, each local amplifier can be set to the required volume and tonal values for the individual user. Once the remote CD is playing it can be selected on any or all of the amplifiers and heard on the local speakers as if it were in the same room.

If the local amplifier also has local sources such as a tuner, tape player or record deck, these can be selected in preference to the remote CD player to provide localised control over the music content.

This particular setup is useful for providing stereo quality sound from DVD players or Video players to rooms where a local amplifier (such as a midi-system) exists. This allows stereo sound through the local speakers to accompany the picture on the TV. In this way,

devices such as Video and DVD players become both RF and Audio sources simultaneously. HomeNet can also be utilised as part of the control network for a third party whole house audio system providing multiple remote sources to multiple zones throughout the house.

NOTE: All of the above systems are shown individually. However, as will be seen later in this document, it is possible to mix and match systems to fully utilise the HomeNet system and provide unique flexibility. Remember, any pairs of a HomeNet connector not used for one system are freely available to use for another. It is possible therefore to have a Networked PC, a Telephone Handset (with Answer phone and/or fax attached) and a Television all connected to a single run of HomeNet 8 cable and HomeNet connector in a room.

HomeNet Adapter Cables

HomeNet Adapter Cables are the key to the flexibility of the system. The patented design of the HOMENET 1200 connector allows just the required pairs to be connected leaving the remaining pairs available for other services. This unique design allows any combination of plugs to be inserted into an HOMENET 1200 connector **SIMULTANEOUSLY**, to provide multiple connections. For example, it is possible to plug in up to 4 x one pair adapters at the same time. It is also possible to plug in 1 or 2 x two pair adapters at the same time. It is equally possible to plug in 1 x two pair adapter and 1 or 2 x one pair adapters at the same time.

Dependant upon the service to be supported, the HomeNet Adapter cables come in 1 pair, 2 pair or 4 pair variants. A telephone adapter utilises a one pair plug, as does an RF adapter, whereas a 10 Mbps or 100Mbps Network Adapter uses two pairs, as does a stereo Audio adapter. Gigabit Ethernet adapter cables use a four pair plug. These different pair counts ensure that you only utilise the pairs required for the service to be distributed.

At the other end of the Adapter Cable, you will find the normal "native" interface for the service to be supported. For example, an RF Adapter has a 1 pair HomeNet plug at one end and a Coaxial plug at the other. The Coaxial plug is compatible with industry standard F-type connectors, however, an F-type to push-fit aerial coax barrel is also included in every pack. This ensures compatibility with almost all consumer RF equipment. Should the gender of the F-Type or push fit interface be incompatible with your equipment, a cheap female to female "gender bender", available from all good TV or DIY stores is all that should be required.

All HomeNet Adapters are completely passive with no external power supplies or Batteries required. Where power is required, it is derived from the source equipment or service via the HomeNet cabling. An example of this is the ringing circuit in a HomeNet Telephone Adapter, which is powered from the incoming line exactly like a standard telephone socket.

Specials – New applications for the HomeNet system are coming out all the time. If we don't have an adapter to suit your requirements, it is usually possible to engineer a solution in a relatively short time. Recent applications for which adapters have been made include: Composite video (1 x video channel, 1 x Audio channel) using RCA connectors to 1 and/or 2 HomeNet pairs. S-Video (4 pin DIN) to 2 HomeNet pairs, Infra Red using 3.5mm mini-jack to 1 HomeNet Pair, ADSL using RJ11 to 2 HomeNet pairs, ISDN using RJ45 to 2 HomeNet pairs. These are all in addition to our standard range of adapters described below.

There are also occasions when services provided by a splitter unit need to be inter-connected or "patched" between the splitter output and the HOMENET 1200 connector on the end of a cable run to a room. These Patch Cords have HomeNet connectors on both ends and are available in 1 pair, 2 pair and 4 pair variants. These are simple straight through leads providing pin-to-pin connectivity for patching of services. An example where patch cords are used is to connect from the output of a TV splitter (HOMENET 1200 1 pair per circuit) to the outlet in the rack that feeds a particular room. The patch cord provides the inter-connection from the output port to the input to the room and then a standard HomeNet TV Adapter is used at the room end.

Different varieties of cable are available for different applications. For example, the 1 pair HomeNet patch cord for telephones is a lower grade (and cost) than a 1 pair HomeNet patch cord for RF. Both have identical plugs 1 pair on the end, however the cable used for the telephone patch cord is an unshielded 1 pair cable whereas the cable used for the RF patch cord is a fully shielded 1 pair cable. The shielded cable is required for RF due to the much higher frequencies involved. It is possible to utilise an RF patch cord for telephones but this would be wasteful and costly for the user. It is not possible to utilise a telephone patch cord for RF as this would result in high signal losses and interference that would drastically affect the picture and/or sound quality.

1 pair and 2 pair patch HomeNet patch cords

Telephone Adapters - All incoming telephone lines (Cable BT or other) have a Ringer Equivalence Number or REN. This is normally accepted as 4 but can actually vary between 3 and 6. Each telephone device has a REN (usually 1). In this instance, if all devices have a REN of 1 and the line has a REN of 5 then it is possible to reliably connect up to 5 devices and all of them should ring when an incoming call comes in. At this point it is worth noting that REN is most important when deciding on the number of devices that need to ring when there is an INCOMING call. Non-Ringing Devices can be considered as approximately half their published REN. Also most modern equipment is

given a REN of 1 when in fact it could be as low as 0.3 so an element of experimentation is required. Older devices such as fax machines; answer phones and old style GPO telephones can have REN values as high as 3 or 4.

The HomeNet telephone splitter is provided with 7 output ports because users often wish to connect devices such as Modems or Satellite boxes that need a connection to the telephone line for OUTGOING calls only. As mentioned above, the REN of the device is much less critical here and it is possible to connect these with a non-ringing capable (or secondary) adaptor to reduce their REN and allow more than 4 or 5 devices in total on a single incoming line.

Standard HomeNet Telephone Adapters have a 1 pair HomeNet connector at one end, an in-line mastering (ring generation) circuit and a standard BT type socket for handset connection at the other end. Unlike conventional telephone wiring which is usually arranged in a daisy chain from one socket to the next and uses three wires (2 for the line and 1 for the ringing circuit), HomeNet utilises just two wires to each location and provides localised mastering in the adapter cable. There is no difference in functionality to conventional telephone wiring except the added flexibility of being able to put a handset anywhere you wish.

For devices that require access for **outgoing** calls only (not required to ring on incoming calls) a secondary adapter is also available which, whilst outwardly identical, does not provide the mastering. These are particularly useful for equipment such as Modems and Satellite boxes.

Should more than 7 telephone devices be required on a single incoming line, optional REN Boosters are available to increase the REN value of the incoming line to allow more connections. This is a powered device and would normally be sited in the main rack.

RF Adapters – As described briefly above, an RF Adapter has a 1 pair HomeNet plug at one end and a Coaxial plug at the other. The Coaxial plug is compatible with industry standard F-type connectors, however, an F-type to push-fit aerial coax barrel is also included in every pack. This ensures compatibility with almost all consumer RF equipment. Should the gender of the F-Type or push fit interface be incompatible with your equipment, a cheap female to female "gender bender", available from all good TV or DIY stores is all that should be required.

HomeNet RF Adapters perform two tasks. They provide the change of connector type from 1 pair of HomeNet to coaxial F-type and they also provide impedance matching and balancing to ensure signal integrity and stability as the signal passes through the HomeNet system. The in-line adapter or "silver bullet" provides full frequency passing from 4

to 862 MHz and is therefore fully compatible with all FM, DAB and RF equipment including Digital Video Broadcasting. In addition, all HomeNet RF components (Splitters and Adapters) are bi-directional and provide full return path support for future interactive services.

HomeNet RF Adapters also allow DC passing and are therefore compatible with most third party infra-red systems (such as tvLINK which is a standard feature of most modern Sky TV boxes) which use the coaxial cable to carry DC power for their device and the return control signal in addition to the normal TV signal.

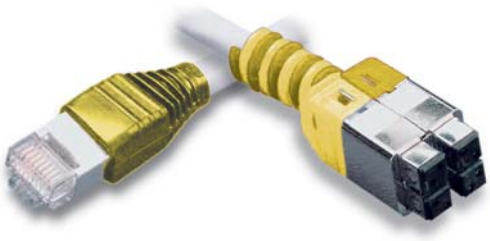
Audio adapters – HomeNet Audio adapters utilise 1 or 2 pair cables dependant on the service to be connected. A single channel of Audio (Mono) uses a single pair and Stereo Audio uses two pairs. The Audio connection is made using in-line female RCA connectors (also known as Phono) allowing use of standard audio inter-connects to extend the cable length.

Audio adapters are manufactured with RF grade cable to allow Composite Video to be connected. Composite video is commonly used as the output method from cameras, games consoles and some Video/DVD equipment. Composite video can either be picture only (one pair adapter), picture and mono audio (2 pair adapter) or picture and stereo audio (1 pair adapter for picture and 2 pair adapter for stereo audio)

Network Adapters – HomeNet Network Adapters are available in 2 pairs or 4 pairs as required. Ethernet networking is by far the most common type of networking protocol utilised in the home and is readily supported by many high street vendors. Ethernet is available in three different speeds with the two slower variants, 10Mbps and 100Mbps being the most common, cost effective and best supported.

All Ethernet equipment is supplied with industry standard 4 pair connectors (known as RJ45). However, the network itself only utilises two of these four pairs, one to send and one to receive. HomeNet Ethernet Network adapters have RJ45 connectors to connect to your PC network card or hub whilst the other end has a HomeNet 2 pair plug. This allows connection of two PCs simultaneously on one run of HomeNet 8 cable or allows the connection of one PC and one or two other devices such as telephones or TVs. The two pairs of the cable are connected to the right pins of the RJ45 connector to ensure system compatibility. HomeNet Network adapters are also available for use in Token Ring networks (much less common) as well as for Gigabit Ethernet (using all for pairs).

Standard Ethernet Adapter



Gigabit Ethernet Adapter

Miscellaneous Adapters - A full range of adapters is available for the most common applications for telephone, RF, Network and Audio. However, as new applications develop, adapters are also developed to suit. There is a wide range of bespoke adapters and all HomeNet cable/connector variants are available as raw-ended cables to allow the installer/user to make connections to proprietary plug/sockets for an application or to connect via screw terminals to specialist equipment.

In short, if it isn't in the catalogue or pricelist, it doesn't mean it can't be done!

Summary

The HomeNet system is unique in the UK as it utilises Category 8 cable (to IEC 61156-7) to distribute multiple services. The cable is verified up to 1.4GHz making HomeNet the only twisted pair system capable of carrying Video/RF/DVB/FM/DAB signals without expensive compression units. The system is backwards compatible to support all the services normally run over lower grade cable (Category 5E, 6 and even Category 7).

With individual pair shielding and an overall braid screen, a single HomeNet cable can simultaneously support the same services as up to four "normal" cables and totally negates the need for separate Coax to each room. With a full range of simple plug in adapters, only the required pairs are used for each service leaving the remainder free to connect other devices. Video/RF/DVB/FM/DAB use just one pair, as do Telephones, Infrared and Composite video. Computer Networks (Ethernet 10/100baseT), Broadband, ISDN, Stereo Audio and S-VHS utilise 2 pairs.

HomeNet outlets are supplied as standard 50mm x 50mm Euro-modules to fit all leading ranges of accessory plates. The angled module will accommodate one or two connectors; completely eliminating the "Wall Acne" associated with lower grade multiple outlet/mixed media systems.