Network Your Building For TransACT

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Many mistakes are being made in cabling buildings, caused by people not thinking through what needs to be done. The result is needless inconvenience, irritation and expense for the users of the building. Do not be harsh on your building users.

This document gives advice and background on correctly cabling a building for a Local Area Network (LAN) connected to TransACT. The advice is intended for building owners, architects, builders, electricians, cabling companies and computer consultants. It applies to most buildings, such as houses, units, shops and small offices.

Large office buildings are already doing the right thing. A lot of this document is simply extending the lessons, already learnt in large office buildings, out to smaller buildings.

TransACT Installation

When cabling for the TransACT Home Pack is installed in a building in a TransACT-cabled suburb [1], the TransACT installation contractor will install a black 4-pair *lead-in cable*, starting from TransACT's pole-top box out on a nearby power pole, then going into the building. The cable ends at the *network distribution box* (a small connection box), typically in the roof space, or some other inconspicuous place. The network distribution box is the legal boundary between cables owned by TransACT and cables owned by the building owner. The box contains no electronics at all, it is just the place where the lead-in cable gets joined to another cable or cables. Normally, only two of the incoming four pairs in the lead-in cable are used, one for data, one for telephone. The other two pairs are available to carry optional extra services.

A *pair* means a pair of wires, two thin plastic-insulated copper wires, twisted together. A cable may contain any number of pairs, but 4-pair cable is very common. Note that it is not necessary that all pairs in a cable should be used. Spare pairs are common, they are just left unused and do not cause any trouble.

The contractor installs two electrical sockets, the data socket and the phone socket (details below), plus their associated cables back to the network distribution box. Those cables are normally blue 4-pair network cables. The set-top box is connected and demonstrated to be working with the television and the internet. The telephone is also demonstrated to be working. The contractor will install other cable and sockets, if the building owner so specifies, but that is an extra cost service.

Note most carefully, the data socket and the phone socket will be installed wherever the building owner specifies. It is up to the building owner to specify correctly.

Data Socket

The *data socket*, carries TransTV (television) and TransWEB (internet). The RJ45 data socket is normally installed next to the television, ready for the set-top box. More precisely, the data socket carries a VDSL (Very-high-speed Digital Subscriber Line) signal on pair 4, from the nearest TransACT node, outside of the building. The VDSL signal has in it, bitstreams for both TransTV (television) and the internet connection. Both internet service and TransTV will stop if there is something wrong with the VDSL signal. Plugged into the data socket is the *data cable*, with the other end plugged into the set-top box or a VDSL modem. The data cable is a 3m white crossover network cable with square plastic RJ45 connectors at each end.

Phone Socket

The *phone socket*, carries a standard analog telephone line, known as TransTALK. The telephone pair is on pair 1. The phone socket is normally installed next to the telephone. This document explains why it would be better for the data and phone sockets to be placed at your central point (see the Central Point section, below).

Types of Set-Top Box

A TransACT Set-Top Box (STB) can be supplied in one of two different types: (1) the early large black ones, made by Motorola, and (2) the later small silver ones, made by i3. An STB produces audiovisual signals for the television (TransTV). These signals are of a kind that will not satisfactorily travel more than a few metres, so that is why the STB has to be next to the television. Despite the name, the STB does not have to be on top of the television, just close enough and visible from the viewing position.

Black Set-Top Box

Initially, TransACT supplied black STBs. The black STB produces audiovisual signals for the television, plus it also sends and receives internet data. The internet side is entirely separate from the television side. The STB can be switched to standby, producing no television signal and showing only the time on its display, and the internet side will still be working. However, if the STB is deprived of 230VAC power, then both TransTV and internet access will stop.

The STB has four cables, one power, one audiovisual, and two identical network cables, all supplied with the STB by TransACT. The power cable is a standard black IEC power cable, going off to a power point. The audiovisual cable (black) provides analog left audio, right audio and composite video to the television. In this document we are mainly concerned with just the network cables. The data cable goes between the RJ45 data socket on the wall, to a socket on the STB, near the power cable.

The other network cable, the *WAN cable*, goes to the subscriber's computer or broadband router. WAN stands for “Wide Area Network”. TransACT is a WAN. The WAN cable is another white crossover network cable, the same as the data cable, it just carries different signals. The default simple arrangement is to have the computer near to the STB, with the WAN cable plugged between the STB and the computer. The computer runs WAN software (typically PPP, Point to Point Protocol) and thus gets connected to the internet via the STB.

Central Point

However, there can be a lack of harmony when somebody wants to watch TV and at the same time, somebody else wants to use the computer in the same room. So, many people do not like the default simple arrangement. They want the computer in another room, away from the television, or they want to run multiple computers in different rooms. That is a much better arrangement, someone can be watching TV and simultaneously, other people can be using their computers in other rooms. Everybody is in their own space and harmony is restored.

To achieve all that, what is needed is a broadband router. That is a little box of electronics, typically priced from $50.00 to several hundred dollars, which can have multiple computers plugged into it via their own *LAN cables*. LAN means “Local Area Network”. The router runs the WAN software (PPP), which simplifies the network software needed on the computers. It also does NAT (Network Address Translation) which allows multiple computers to share one public IP (Internet Protocol) address. NAT has significant computer security advantages. There is a lot of scanning and probing happening on the internet continually, mostly by criminals. A router defends the computers from

this activity, which makes the computers safer from malware. However, prudent computer security practices are still required.

The router sits at a *central point* where all the LAN cables from all the computers, plus the WAN cable, come together. The central point could be next to the TV, but that can be messy, what with all those cables. The usual arrangement is to have the central point at some place where all those messy cables are hidden, such as in a cupboard, in a garage, under some stairs, or similar. The building owner decides where the central point will be, then runs LAN cables to it, from every place where there *might* be a computer, printer, telephone, or television (with the STB). The router needs power, so the central point needs a power point, as well.

Meanwhile, next to the STB there would normally be *two* RJ45 sockets on the wall, the data socket and a socket for the WAN cable to the central point. So there are *two* sockets and *two* cables (the data cable and the WAN cable) going from the wall to the STB. That is *still* kind of messy. Also there is only one data socket installed by TransACT, so if someone wanted to move the STB to another location, they are out of luck. Would it not be nice if the data socket could be put at the central point and somehow the VDSL and WAN signals carried by the one cable?

Stubby and Modwan Cables

Well, it can be done [5]. At the STB end there is a *stubby cable*, which is a Y cable with *two* RJ45 connectors at the STB end and *one* RJ45 connector at the wall end. “Stubby” comes from STB and Y, so STB + Y = stubby, get it? The stubby cable is not actually a short cable, it can be as long or longer than the original data cable supplied by TransACT.

At the central point there is a *modwan cable*, which is also a Y cable, one connector for the data socket, one connector for the WAN socket on the router and one connector to go to the STB, via the stubby cable. Modwan comes from “Modified WAN”.

The stubby and modwan cables rely on the fact that the VDSL signal is carried only by pair 4 in the data socket, plus the WAN signal is carried only by pairs 2 and 3 in the WAN cable. However all network cables have *four* pairs of wires in them, so there are actually enough pairs to go around.

The advantage of using the stubby and modwan cables is that now the STB can go anywhere there is a LAN socket. If the building owner does a good job of predicting all the places where a television or a computer might be wanted, then has a LAN socket installed at each place, then the STB or any computer can be put next to any LAN socket.

Silver Set-Top Box

The silver STB was made by a company called “i3 micro technology”, in Kista, Sweden. That company changed its name to “Tilgin” in 2006 [3]. Supplied with the STB, by TransACT, is another small box of electronics, the *home gateway*, which is actually a VDSL modem, which, in addition, separates the TransTV data from the internet data. The home gateway has RJ45 network sockets on it. One goes to the data socket, one to the STB and one to the broadband router. The home gateway would be put at the central point. The stubby and modwan cables are unnecessary, since the STB does not contain a VDSL modem. The STB (which is next to the television, as per usual) is fed its TransTV signal from its nearby LAN socket. There is a short LAN cable from the home gateway to the wall socket leading to the STB, then, at the STB another cable from the LAN socket to the STB. The data socket (VDSL) only needs to be next to the home gateway, not the STB.

The STB converts the TransTV data to audiovisual signals, to suit the television. It is an “IPTV” STB. The audiovisual cable (black) provides analog left audio, right audio and composite video, as

usual. Both the home gateway and the STB need access to 230VAC power, as expected. The WAN cable goes from the home gateway to the broadband router, which are both at the central point.

In 2008, Tilgin's STB unit was bought by Amino Technologies [4], so Tilgin no longer makes STBs. There are a number of different manufacturers of home gateways and IPTV STBs, so TransACT may change or add other suppliers at some future date. It may become possible to use a general purpose computer (such as a Home Theatre Personal Computer, or HTPC) instead of the TransACT-supplied STB. Later STBs will support full-HD television through an HDMI cable.

It may reasonably be expected that TransACT will continue to have a separate home gateway and STB, joined by LAN cable, in future installations. The days of the VDSL modem and the STB all being in one box, as in the black STB, are over.

LAN Sockets

Notice that any device that uses a LAN socket will also use power. So, any LAN socket should have a power point right next to it. It would be foolish to put a LAN socket on a wall then have its associated power point a long way away. There is a rather nice style of double power point which is designed to have an extra general purpose switch mounted between the two switches of the power point. Those things can be bought with no extra switch, then pop in an RJ45 socket instead. There you have, in a nice neat package, a LAN socket and power point, all in one thing. However, your electrician should be careful when running the cables in the wall. Keep the LAN cables well separated physically (at least half a metre) from the power cables, except where they unavoidably need to come together, such as at crossings and power points. Both power cables and standard LAN cables are not shielded, so given a bit of physical proximity, the power cables will inject hum into the LAN cables, from the 230VAC in the power cables. That might cause problems with the LAN. The hum will definitely cause problems if you want to use a LAN cable as a telephone cable – as explained below.

One good way to avoid this problem is to use shielded LAN cables, such as category 6 cables. They are getting cheaper, so Cat 6 cable should be the default LAN cable installed, whenever there is a choice.

Printers

So now there are LAN sockets for every computer. What about printers? The usual thing with multiple computers is that each one has its own printer. That is not such a good idea. Inevitably, there are many different kinds of printers, so there is a whole collection of different kinds of printer consumables needing to be bought. Somebody is always running out of something, so there is a lack of harmony. Plus all those printers might be cheap to buy individually, but together, they add up to quite a bit. Also, the cost of running all those printers can get to be significant. Inkjet printers are particularly expensive to run, even though they are cheap to buy in the first place. The inkjet printer manufacturers know they have got you as a captive customer, once you have bought the printer. The price of inkjet printer cartridges is so high that it can easily cost $0.40 or more *per page* of printing. Multiply that by several thousand pages printed per year and suddenly, inkjet printers do not look so cheap.

The strategy of selling the printer cheap, but making the consumables expensive, is known as the “razor blade business model”, in honour of the manufacturers of disposable razor blades, in the early twentieth century. They first figured it out. Sell the razor cheap, but make the blades expensive. It is a very profitable business model. However, prudent consumers would be wise to be on the lookout for it. What is profitable for the manufacturers is not necessarily good value for the consumer's money.

What to do? Answer, get a network monochrome laser printer, with duplexer and a big paper tray, then put it at a convenient location where everybody can use it. Many of those printers have low running costs of around $0.02 per page, more than a factor of ten cheaper than running an inkjet. The printers are relatively expensive, so the razor blade business model is mostly gone. Pick a manufacturer who allows a competitive market in refilled cartridges and you know the razor blade business model is gone. Talk to your local cartridge refillers, before buying the printer, they have good advice.

Cheaper printing is important because documents often get printed multiple times. When a document is being developed, it often happens that it gets printed in a close-to-final state several times, as the last few changes are made. People should not feel that a document was so expensive to print that they have to tolerate errors. Also, if printing is cheap, printing web pages becomes less of a decision. Web pages often disappear. Since the website is controlled by somebody else, they can decide to make a certain interesting web page vanish, without your knowledge or any warning. However, if you have printed that web page, then you have your printed copy for as long as you wish.

Why monochrome? Because monochrome (just black and white, no colour) laser printers are the cheapest to run. Colour lasers are nice, but can still cost about $0.10 or more per page. Inkjets are cost prohibitive on a per page basis. Almost always, printing in monochrome is adequate. The words are what matters, not the coloured pictures. Monochrome lasers can quite happily print a coloured picture as a black and white picture, which is almost always satisfactory. There should be a colour printer available, for infrequent use, when somebody really needs colour. Since the colour printer is used infrequently, it can have high per page costs and that does not matter too much.

Why have a duplexer? Because documents printed on both sides of the paper are so nice to handle and to store. Print a 30-page report with duplex and it is easy to staple and read. Print the same report single-sided and it is difficult to staple and hard to handle. The bigger the document, the more duplexing matters. Once you have tried a printer with a duplexer, you will never want to give it up.

Why have a big paper tray? By “big”, what is meant is “capable of taking a full ream of paper”. A ream is 500 sheets. Reams come individually wrapped, so when you open one, there you have 500 sheets. If all those sheets can go into the printer straight away, then you do not have part reams lying around, being messy and getting lost. Also, the amount of refilling of the printer is minimised.

What is a network printer? That is a printer with a network interface built into it. The printer plugs into a power point and a LAN socket, and that is it. In ancient times, printers had “parallel” interfaces which had to be plugged into a computer, then the computer had to be configured to “share” that printer over the LAN. That worked, but the old parallel interface is about 30 times slower than a modern 100Mbit/s LAN connection. Also, the computer had to be on to print anything. It is better to put the network interface into the printer, then you get faster, more reliable printing without having to worry about a certain computer being on, nor pay for the electricity to run the computer. Most modern printers can be set to go into a silent low-power sleep mode if they are idle for a certain time. They wake up automatically once they receive a print job from the LAN. So, most of the time, the printer sits there silent, asleep, not bothering anybody and using negligible electricity. Harmony is preserved. However, anybody who wants to print has merely to use the normal print facility in their software, then with no extra effort, the printer wakes up and the document is printed. After a while, the printer goes back to sleep. It is an ideal arrangement.

So where to get a suitable laser printer? All the large printer manufacturers have suitable models. Some research on their websites, being careful to remember all the features you want (monochrome laser, networking, duplexing, big paper tray), will reveal suitable model numbers. Then some

further research on computer retailer, stationery and cartridge refiller websites will allow you to estimate per page costs for the various printers. Then you can make a buying decision.

There is another way, though. Buy a reconditioned printer. Professional system administrators, for large organisations, are well aware of the delights of network lasers. Everything in this document is old news to them. For many years, they have been buying high quality reliable network lasers, in vast quantities. Then, after a few years, perfectly good printers get written off and disposed of. In every large city, there are some small companies who specialise in buying these now unwanted printers, reconditioning them and selling them for a fraction of their new price. Were you to find one of these companies [2], you would have a source of robust reliable printers, plus their associated consumables, at good prices. Furthermore, since these companies recondition the printers, they are also good at fixing the printers, if anything should ever go wrong.

Telephones

Telephones are in transition. In the old days, telephones were simple analog devices, you had one telephone connected back to the exchange by one pair of wires. The incoming telephone line was wired by your telephone company to your primary telephone socket, usually near the kitchen, then a telephone was plugged in and that was the end of the job. Multiple telephones were unusual. Answering machines were rare. Caller Line Identification displays did not exist. ADSL was unheard of. Auto-dialling burglar alarms were not invented. Modems were something that only computer scientists knew about. Sharing the one line between a telephone and a fax machine was a preposterous idea. Anybody who even knew about all those non-telephone devices was probably a dangerous loony.

If the telephone system were to be redesigned today, it would be all digital right up to the telephone, with no analog telephones or telephone lines. Analog means that the electrical signal varies continuously, in direct proportion to the variations in air pressure at the microphone or speaker. Sound, such as a conversation, is merely small variations in air pressure. The trouble with analog is that it involves tiny electrical signals being sent long distances over pairs of wires. There is little immunity from electrical interference, such as hum from power lines. Alas, the telephone companies are not about to give up the gloriously profitable business of analog telephone lines.

ISDN (Integrated Services Digital Network) was supposed to replace analog lines with digital, but the telephone companies discovered that *some* customers were willing to pay high prices for ISDN. So they greedily kept ISDN prices high, thereby ensuring that ISDN stayed a niche product. So analog telephone lines are still everywhere. Luckily LAN cables are just cables, insulated wires in a bundle. The wires do not care whether they are carrying a small fragile analog telephone signal or LAN signals.

Telephones are starting to move to the digital realm. There exist “IP telephones” which plug into a LAN socket. They also have another LAN socket on the telephone, into which a computer (or a printer, etc.) can be plugged. So what you see is a single LAN socket on the wall, then a daisy chain network cable arrangement of first the telephone, then the computer. Millions of office workers have exactly that. Formerly, for each office worker, there would be two sockets, one for the telephone (going to the office PABX), plus one for the computer (going to a LAN switch). With IP telephones, only one LAN socket is needed per worker, instead of two sockets.

The best thing to do about cabling for an analog telephone is to feed it through LAN cable. Likewise for any fax machine or modem, since to the telephone system they appear to be analog telephones. Give the telephonic device a LAN socket and a power point. The LAN socket is wired with LAN cable which goes back to the central point as per usual. The telephonic device plugs into the LAN socket. Meanwhile, at the central point, the LAN cables going to telephones do not get

plugged into any router or switch. Instead, they simply all get connected in parallel with the incoming analog telephone line. That is easy to do with readily available telephone connector hardware. If there are multiple incoming analog telephone lines, for example a fax line and a voice line, allocate each telephonic device to one or the other. Never connect two incoming lines together. More advanced users could install a PABX (Private Automatic Branch eXchange) at the central point, but PABXs are expensive.

When and if IP phone systems come down to a reasonable price, you can easily change over to IP phones. Just plug the LAN cables going to telephones into your new IP-compatible PABX, located at your central point. Then change the phones. No building wiring changes will be needed.

If you buy a fancy telephone which needs power, that is no problem, you have prudently ensured that there is a power point next to every LAN socket.

If you get ADSL instead of a TransACT STB, you put a *central filter* and the ADSL modem at the central point. The central filter blocks the ADSL signals from getting to the telephones. The WAN cable from the ADSL modem plugs straight into the WAN socket on the router, which is already there at the central point. Then you no longer need your STB, stubby cable or modwan cable. Plug the LAN cable into a LAN switch or the router. The free LAN socket near the television could then be used for something else, such as a network media player or a Home Theatre Personal Computer (HTPC).

Multiple Devices

Suppose you want to run multiple LAN devices in one room, such as a computer and a printer, or multiple computers, but there is only one LAN socket in the room. What happens then? Answer, you need a small LAN switch. These are widely available from computer shops for prices around $50.00 or less. Nobody bothers with anything less than eight way. With an 8-way switch, plug the network cable going to the LAN socket into the uplink port, then you may plug up to seven devices into the remaining ports. Problem solved.

Decisions for the Building Owner

Notice that all computers, printers, telephones and the STB need the same thing, a LAN socket and a power point. All LAN sockets are connected back to the central point. TransACT should be instructed to place the data socket and the phone socket at the central point. It would be wise for the building owner to arrange for two network cables to be laid from the central point to the proposed location of the network distribution box. That makes things easier for the TransACT installation contractor. Make sure all cables are laid with no tightness or sharp corners anywhere, with at least 1m free length at each end. Always consider the possibility of subsequent wiring changes. Allow slack cable. It is easy to shorten a cable, but much more difficult to make it longer.

The location of the central point is important. There might get to be quite a bit of equipment there eventually, so it is wise to select some place where there is a reasonable amount of free space. A high shelf in a walk-in cupboard is ideal. Some of the equipment at the central point might have fans, so it would be wise to select some place where the noise of fans is not going to bother anybody. Alternatively, always select equipment which is silent.

Consider the difficulty of running cables to the central point. The cheapest possible time to be laying cables is when a building is being built. Look at any building under construction, before the inside walls get covered up with plaster (or wall panelling). You will find the walls festooned with cables for things like light switches, power points, television aerial, door bell and burglar alarms. There are also telephone cables, satellite TV cables, ground cables, light dimmer wiring, intercom wiring, solar panel cables, hot water controllers, heat pump thermostats, fire alarms, speaker cables,

microphone cables, video power cables, video cables and yet others not in this list. There are many cables above the ceiling as well. When you can see all those other cables, that is the ideal time to lay network cables. Once the plaster goes on, running cables gets much more difficult and expensive. It is greatly to your advantage, as a building owner, to adequately plan and install all cable runs before the walls are finished. Notice what electricians do, they lay cables and install wall brackets, then they leave stub ends of cable hanging down at all the places where there will be any electrical fitting, such as a switch, light fitting or power point. Then they wait for the plasterers and painters to finish, then they go and install the fittings. Result, beautifully painted walls with nice new fittings on them, with not a speck of paint on the fittings. The customers are happy.

The major cost of running a cable is the labour cost of putting it there, then terminating the ends. The price of the cable itself is usually a minor factor. So your central point does not have to be all that central. Accessibility is more important than exact location. A garage on one side of the building is quite all right if there is an easy pathway to run cables, such as through an easily accessible roof space.

Plan ahead by thinking of all the places where you *might* want to have a computer, printer, telephone or television. You give yourself flexibility by having more LAN sockets than you think you need at first. For example, say there is a room where you are not sure where the computer will go. There might be two likely spots with no neat way of running a LAN cable across the room, if you guess wrong. In that case, put in two LAN sockets. Sure, one of them might not get used, but now you have the freedom to put the computer where you want, and maybe change your mind later. Also, it is surprising how people think of things to do with vacant LAN sockets. IP telephones might get to be cheap. Someone might want to plug in a visiting portable computer. A storeroom might get turned into a study. Somebody might buy a fancy specialised printer. Babies grow up.

Television is changing. In future all televisions may have a network media player next to them. In that case, every television needs a television aerial socket and a LAN socket. It could happen that television tuners could migrate from the television to the LAN. Then the tuner could be out near the TV aerial, controlled over the LAN and feeding data to the LAN. Multiple TV aerials, pointed in different directions, would then be more practical.

Remember that every LAN socket should have a power point next to it.

Notice that the STB has a LAN socket, but it has a special status, it is carrying the VDSL signal and the WAN signal, not an ordinary LAN signal. The trick, explained above in the Multiple Devices section, will not work. If you wanted to have some LAN device next to the television, in addition to the STB, then an extra LAN socket is needed, or a long cable from another LAN socket elsewhere in the room.

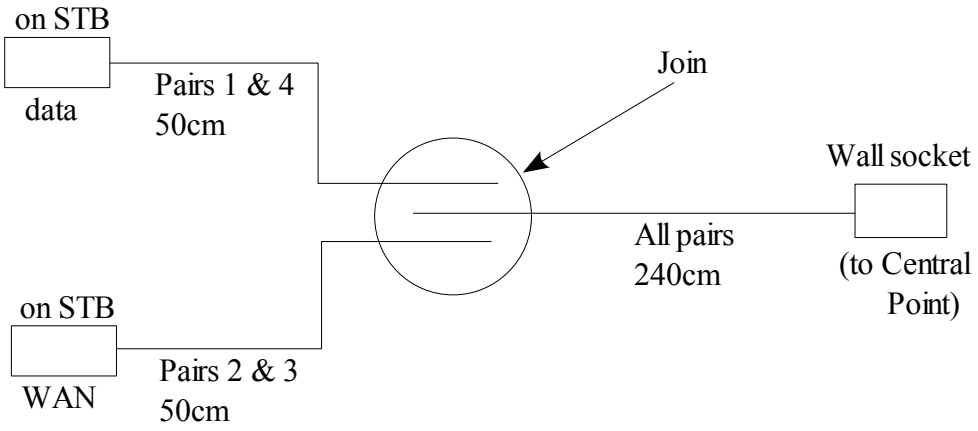
LAN cable technology may change. Consider the possibility that optical fibre cables may get installed. If there is some place where running a new cable would be difficult, put in conduit and run the cable in that. It is easy to pull new cable into a conduit.

Wall Insulation

The presence of wall insulation can make it particularly difficult to run cable. Place conduit in walls for LAN cable, *before* wall insulation is installed. Preferably, the process of laying LAN cable should be fully complete before wall insulation is installed.

Stubby Cable

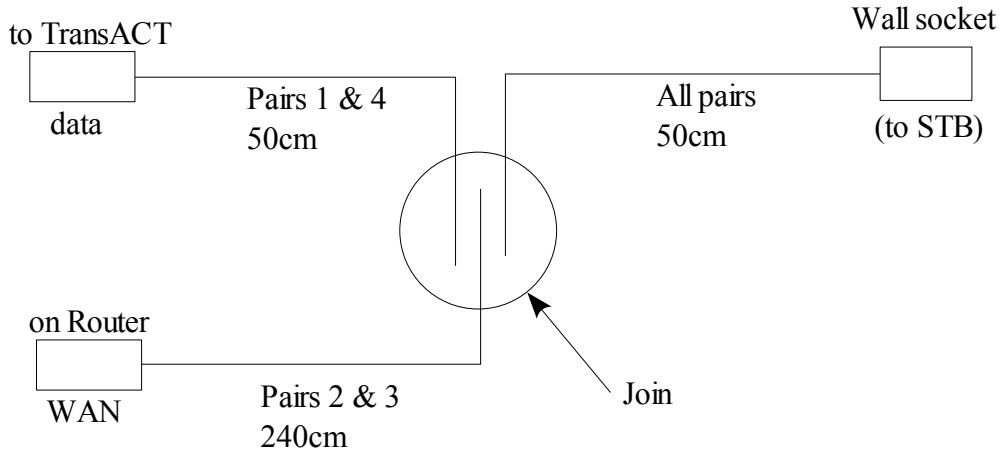
The stubby cable is located at the STB. It is a crossover cable for the WAN pairs 2 & 3, also for the telephone pair 1 & the VDSL pair 4.



Wall Pin	*Pair & Leg*	*Wall cable Wire Colour*	*To which Cable*	*Cable Wire Colour*	*Pin*
1	2 T +	White/Orange	WAN	White/Green	3
2	2 R -	Orange	WAN	Green	6
3	3 T +	White/Green	WAN	White/Orange	1
4	1 R -	Blue	data	Brown	8
5	1 T +	White/Blue	data	White/Brown	7
6	3 R -	Green	WAN	Orange	2
7	4 T +	White/Brown	data	White/Blue	5
8	4 R -	Brown	data	Blue	4

Modwan Cable

The modwan cable is located at the central point. It is a straight through cable for all pairs.



Wall Pin	*Pair & Leg*	*Wall cable Wire Colour*	*To which Cable*	*Cable Wire Colour*	*Pin*
1	2 T +	White/Orange	WAN	White/Orange	1
2	2 R -	Orange	WAN	Orange	2
3	3 T +	White/Green	WAN	White/Green	3
4	1 R -	Blue	data	Blue	4
5	1 T +	White/Blue	data	White/Blue	5
6	3 R -	Green	WAN	Green	6
7	4 T +	White/Brown	data	White/Brown	7
8	4 R -	Brown	data	Brown	8

References

[1] For more details about the installation, see the TransACT service installation FAQ at: http://www.transact.com.au/knowledge/installTransACT.aspx

[2] A printer reconditioning company, in Canberra, is Laser Printer Terminal Australia, 4/56 Heffernan Street, Mitchell, ACT, Phone: (02) 6241 7730. Their website is at: http://www.lpt.com.au/

[3] Reported in the website "tvover.net" at: http://www.tvover.net/2006/03/23/i3+Micro+Technology+Becomes+Tilgin.aspx On 2006 March 23 "i3 micro technology AB", whose website was formerly at www.i3micro.com, changed its name to "Tilgin AB". Tilgin is located in Kista, Sweden. It now makes residential gateways and supplies them to WAN providers, such as TransACT, who apply their own branding. Tilgin's website is at: http://www.tilgin.com/

[4] Reported in the "Xchange Newsletter" on 2008 November 20, at: http://www.xchangemag.com/hotnews/amino-to-buy-tilgin-set-top-box-unit.html Amino Technologies has bought Tilgin's Set-Top Box unit. Amino is located in Cambridge, UK. Amino's website is at: http://www.aminocom.com/

[5] Stubby and modwan cables are available from me, Anthony Glenn. Price is $80.00 for a set of both. Please call on (02) 6286 3903 to order. Alternatively, any electronic expert can make them up for you, using the details in this document.