



# Extending the Corporate IT network to the D-Eng Van

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## Introduction

In recent years, with the advent of more powerful computer systems, low cost editing systems and advanced compression techniques, the Electronic News Gathering (ENG) van is now capable of not just collecting the news but editing the stories prior to transmission back to the studio. 3G wireless networks could be used for the network link back to the corporate network but these tend to have limited bandwidth and range. In addition most systems are designed for surfing the internet, where the traffic profile tends to be asymmetric. i.e. large amounts of data are downloaded from the internet with only low bit rate requests going in the forward direction. In ENG applications, connection to the internet, e-mail and access to the corporate network, are all worthy reasons for providing network access to the van, but the real requirement is to be able to upload compressed video files. The promise of WiMax is on the horizon with symmetric speeds in the 70 Mbits/sec or 70 Miles range, but these items are mutually exclusive so in the mobile environment 10 Mbits/sec at 1 miles will probably be more typical. In addition this is a shared system so within a WiMax base station coverage area, the bit rate for a single upload will rarely reach these speeds.

If we consider the size of a typical 2 minute segment the amount of data can vary depending on the content, the video format and the video compression technology so we will pick some formats and bit rates so an idea of the magnitude of the problem can be achieved.

A MPEG 2 HD stream at ATSC rates of 19 Mbits/sec results in a file size of nearly 300 Mbytes for the 2 minute segment. Using Mpeg 4 will half this to approximately 150 Mbytes/sec. Although smaller file size are possible, depending on the quality of the video that is required, these numbers will be used in this illustration. Uploading either of the files sizes over the currently available wireless service provider's networks results in transfer times from approximately 20 minutes to 100's of minutes. In an operation where getting the clip back on time, it is important to reduce the upload time to as little as possible.

With most wireless provider networks, the medium is shared hence you cannot improve this speed by adding multiple modems since in most cases you just end up sharing the bandwidth available with yourself.

## DVB-T

With the advent of Digital ENG vans using industry standard DVB-T transmission protocols, there is another medium available which can transfer large amounts of data at high bit rates over considerable distances; the digital microwave radio. The DVB-T standard allows the choice of multiple modulation methods, forward error correcting schemes and bandwidth to be traded depending on the operating environment. The COFDM modulation method employed in DVB-T is designed for operation in non -ideal radio channels, where reflections from buildings and objects can introduce significant impairments and hence is ideal for operation in an urban environment. The D-ENG van is equipped with a RF transmitter capable of transmitting many watts of power and a high gain antenna.

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**Table 1 DVB-T : Useful Bit Rates**

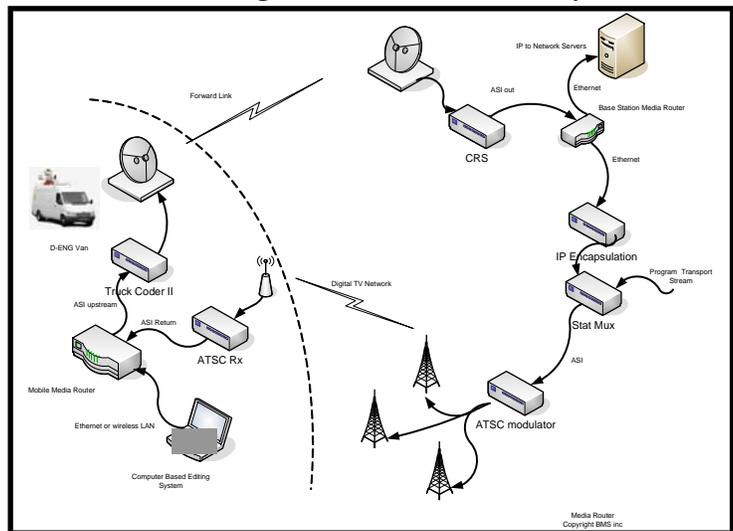
Modulation	Code rate	Useful Bitrate (Mbit/s)			
		$\Delta/TU = 1/4$	$\Delta/TU = 1/8$	$\Delta/TU = 1/16$	$\Delta/TU = 1/32$
QPSK	1/2	4.98	5.53	5.85	6.03
QPSK	2/3	6.64	7.37	7.81	8.04
QPSK	3/4	7.46	8.29	8.78	9.05
QPSK	5/6	8.29	9.22	9.76	10.05
QPSK	7/8	8.71	9.68	10.25	10.56
16-QAM	1/2	9.95	11.06	11.71	12.06
16-QAM	2/3	13.27	14.75	15.61	16.09
16-QAM	3/4	14.93	16.59	17.56	18.1
16-QAM	5/6	16.59	18.43	19.52	20.11
16-QAM	7/8	17.42	19.35	20.49	21.11
64-QAM	1/2	14.93	16.59	17.56	18.1
64-QAM	2/3	19.91	22.12	23.42	24.13
64-QAM	3/4	22.39	24.88	26.35	27.14
64-QAM	5/6	24.88	27.65	29.27	30.16
64-QAM	7/8	26.13	29.03	30.74	31.67

Reliable file transfer protocols require some form of acknowledgement that the data has been correctly received. This results in round trip times that can limit the speed of transmission even if a high speed data path exists.

The growth of the internet of recent years has been fueled by the open nature and availability of the Internet Protocol (IP) and the various higher level protocols based on it. TCP/IP, FTP, UDP, HTTP etc. Most of these require some form of acknowledgement to make them reliable forms of communication and file transfer. UDP does not require acknowledgments and often forms the basis of one way transmission schemes, but this is considered an unreliable form of communications, since there is no way of ensuring the message is received correctly.

Some form of return channel is therefore required to allow the bandwidth of the microwave radio to be utilized for file transfer. Various methods have been proposed. One typical method is to use the ATSC stream being transmitted from the station to convey the return data. Another approach would be to use the 25 KHz Digital Return Link channels created by the FCC. Both of these methods suffer from the same disadvantage in that the ENG van is only connected to the network while the microwave link is operational and that additional infrastructure is required.

Broadcast Microwave Services approach is different in that it provides constant communications with the corporate network and takes advantage of the high speed microwave radio data channel when it is operational.



**Figure 1 TCII Media Router using ATSC Return channel**

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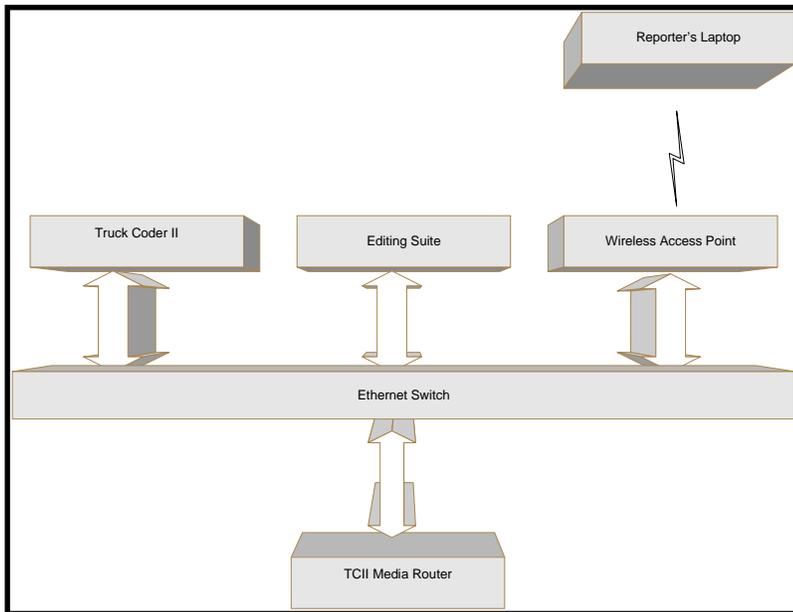
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The TCII Media Router is configured by the use of web pages run on each of the units. These web pages can be accessed remotely and hence an ENG van can be administered from the studio without the knowledge of the technician/ cameramen in the van and once configure the system requires no user intervention. In addition, the use of the Media Router allows the Truck Coder II and any other IP addressable equipment in the van to be accessed remotely.



The TCII Media Router provides Gigabit Ethernet connections to the corporate network and the ENG van. All file transfer protocols and applications are run on the systems connected to the Media Router, i.e. the FTP server in the corporate network and the Video Editing computer in the van. The Media Router just acts like a network router, routing the IP packets over the available network.

Figure 2 D-ENG Van IP Network example via Media Router

## File Transfer

The choice of file transfer applications have typically been FTP (File Transfer Protocol), SFTP (secure FTP) or SCP (Secure Copy) to provided reliable file transfers. These in return require the return channel to be available and have the file transfer speed limited by the total Return Trip Time. Using an EVDO Modem only to upload a 150 Mbyte file will take over 3 hrs. Examples of transfer rates using the TCII Media Router with a 1x EVDO return link for various transmission modes can be seen in Table 2 for Data only ie no simultaneous video. As can be seen it is the round trip delay that dictates the overall transfer rate.

Table 2 FTP Transfer Rates with Data Only

Modulation	Code rate	Guard Interval $\Delta/TU$	Useful Bitrate (Mbit/s)	FTP Transfer Speed Mbps	Transfer Time for 150 Mbyte file
64-QAM	1/2	1/16	14.93	3.2	7 mins 39 sec
64-QAM	7/8	1/32	31.67	3.3	6 mins 40 sec

Transfer speeds can be improved by increasing the Buffer sizes used in the FTP but in these examples, tests were performed with the default settings.



## Advanced File Transfer

In recent years, advances in file transfer protocols and packet erasure coding have resulted in higher throughputs being available that are immune to round trip delay. One such software packages is FileCatalyst 2.0 from Unlimi-Tech Software. FileCatalyst is a software based solution designed to accelerate and optimize file transfers across networks. With less than 1% overhead, FileCatalyst is immune to the effects that round trip latency and packet loss have on traditional file transfer methods like FTP, HTTP or CIFS. Since this application software is IP based and runs on the client computer in the D-ENG van and the server at the corporate network, it can operate across a Media Router System, without any changes to the configuration.

In addition to the Media Router dynamically adjusting its transmitted bit rate to match the available bandwidth of the link, FileCatalyst also dynamically adapts to the available bandwidth of a connection. This results in a better matched system and improved performance.

Table 3 Shows the advantage of using FileCatalyst with the Media Router.

**Table 3 Advanced File Transfer Rates with No Simultaneous Video**

Constellation	Code Rate	Guard Interval	Useful Bitrate Mbits/sec	FTP Mbits/sec	% of Capacity	File Catalyst Mbits/sec	% of Capacity
QAM 64	1/2	1/16	17.56	3.2	18.3	9.6	54.4
QAM 64	7/8	1/32	31.67	3.2	10.1	11.8	37.1
QAM 16	1/2	1/16	11.71	3.2	27.6	6.6	56.7
QPSK	1/2	1/16	5.85	2.7	45.9	3.3	56.4

This is the average transfer speed of the file over the link and includes the time for FileCatalyst to adjust its transmission rate to the available bandwidth; the peak rates are therefore much higher.

Hence with a 12 Mbps transfer rate, the 150 MByte file can be transferred in under 2 minutes.

## Conclusion

The BMS Truck Coder II and Media Router combination produce a viable method for extending the corporate network to the D-ENG Van. It provides continuous connectivity to the corporate network anywhere that wireless phone access can be obtain and high speed data transfers when the microwave radio link is active. When couple with an advanced file transfer program such as FileCatalyst further speed increases can be obtained. The TCII Media Router can additionally be configured to use the ATSC broadcast network as a return path. Other custom combinations and hard disk storage options are available on request.

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