Reporter Backpacks

— instant and mobile newsgathering from anywhere

Markus Berg and Matthias Hammer
IRT

The provision of up-to-date news coverage is still under great pressure from time and cost restraints. It is not always easy to judge in advance if a newsworthy event justifies the assignment of a whole OB team with an OB van and associated equipment ... or just a reporter with minimal equipment.

The IRT in Germany has conducted several tests in the last two years on commercially-available "reporter backpack" solutions and the main findings are discussed here.

Today, media consumers are accustomed to receiving a flood of up-to-date news from Twitter and similar media/social networks. This does not mean however that professional news coverage, based on facts, is not appreciated by the public – as a well-established and "serious" counter-balance to these modern social networks.

However, up-to-date news coverage by professional broadcasters is still under great pressure concerning time and costs! It is not always easy to judge in advance if an event justifies the assignment of a whole OB team with OB van and equipment – especially when the event/incident happens in a hard-to-reach location, possibly without access to power and fixed broadband networks (cable, DSL etc.). Since OB teams usually bring a lot of equipment with them, they can generally find solutions to most of the difficult problems they might face ... but this requires a lot of time-consuming effort.

Wouldn't it be nice if we could reach any news location quickly and with a minimum of effort? The solution to this might come in the form of an ultra-mobile system: a camera, microphone and portable autonomous transmission entity, put together for example as a compact backpack (as offered today by several companies). However, there are not only backpacks available for this purpose: you can also find small boxes, thin camera-plug-on devices, shoulder bags and, of course, 19-inch rack mount solutions, e.g. for cars and trucks.

The IRT has conducted several tests in the last two years on commercially available "reporter backpack" solutions and the main findings are reflected in this article.

Why use reporter backpacks?

Wherever up-to-date mobile phone networks are available, reporter backpacks can be used for acquiring audio and video content. In special cases, you can also use additional fixed lines and Wireless LAN, e.g. from a hotel or café, for connecting your backpack to your broadcast station. And this even works when your satellite system isn't available, such as in tunnels, street canyons, underground train stations or large buildings which offer broadband mobile reception.

"First response for news" is the most discussed use case when the topic of reporter backpacks is raised. And yes, it's quite easy to imagine why. You are busy in your broadcasting station, probably located in the city centre, and are informed about a great story, e.g. in a suburban area. But it is clear, to get there by car or truck through all the city's traffic jams will take too long, especially for the next news bulletin. Luckily, you have your reporter backpack ready and get to the scene fairly quickly – maybe by motorbike or even by underground train if the streets are closed to traffic or are too crowded.

Figure 1
A reporter backpack in use

Arriving at the scene, you just boot up your backpack which automatically connects you via mobile phone networks to your broadcasting station and, *voila*, you have an early live feed while awaiting the ENG truck, if still needed. Parallel to the live transmission, your material is also stored locally on your backpack's hard disk at an even higher quality level, for use later, or can be sent as a nonlinear store-and-forward upload to provide your station with additional non-time-critical material.

Imagine this level of independence taking place in your workflow. Thanks to these opportunities, an editor has a great tool to enhance his/her programme – and a very new way of broadcasting?

By using local wireless networks, live reporting is possible directly from a moving vehicle such as a motorbike, train, bus, boat, helicopter or even from hot air-balloons.

Of course it doesn't always have to be an extreme situation such as a breaking news story. Standard transmissions from, for example, cycling events could also be supplemented very nicely by flexible reporter backpacks. However, covering a big cycling race has its challenges. Reporters are moving fast over a long distance, often covering different groups of cyclists. Also, crashes are part of the racing thrill. But when one of these professional cyclists is brought to hospital, is it worth sending a whole team in an OB van, far away from the race to the hospital, just to shoot a few seconds of live video? With a reporter backpack, you have a cheap and flexible tool to move around large events and send back live pictures.

How do they work?

Well, firstly, in order to allow almost "unlimited mobility and autonomy", as many mobile networks as possible are used. Secondly, these networks are bundled together in order to increase the available bitrates.

To achieve this, SIM cards for the most important mobile operators of the region are used, mostly up to three different networks. The operating costs of a handful of cellular contracts seems to be considerably smaller than the costs of satellite-based transmission systems.

Reporter backpack systems consist of two main entities: the backpack itself and a server in the data centre of the broadcaster. The mobile backpacks/terminals come with several mobile (UMTS…) modems (up to 14, depending on the product). Each modem uses its own SIM card. So, one can use different SIM cards (and hence different IP connections) in parallel.

Using more than one SIM card from the same provider decreases the probability of failures and potentially increases the available bitrates. However, in the IRT's tests, using more than two SIMs per provider did not improve the efficiency of the transmission.

Transmissions over these bonded mobile networks offer the same kind of “best effort” as all other transmissions via the internet. However, by spreading the traffic over the different mobile phone modems – using proprietary VPN technologies (as some of the examined products do) and providing some kind of over-provisioning inside the virtual “overall“ network – the performance can be kept quite constant at a satisfying level.

The backpack modems create a connection to the server in the broadcaster’s data centre. The complete traffic load is distributed by the mobile terminal across all modems and transmitted to the server, where the various data streams are re-assembled and forwarded to their final destination in the production network *(see Fig. 2)*.

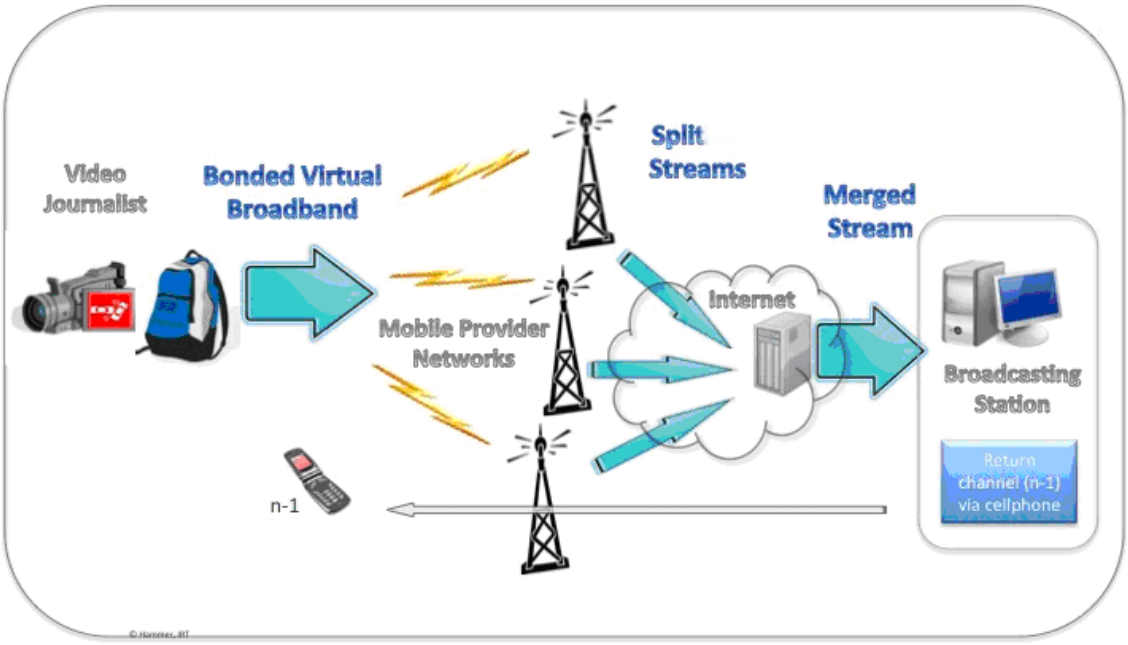

Figure 2
Connecting a backpack

Some pros and cons

In this transmission chain, buffers are needed to smooth out the bandwidth peaks and lows in the unmanaged networks. In 3G networks, 1.5 seconds of buffering can be considered as the minimum. A buffer size of up to three seconds or, in the worst cases, 12 seconds is quite realistic but makes interviews impossible. Even a “simple” live contribution requires some training between the reporter in the field and the moderator in the studio, to cope with the initial delay. Although some commercially-available backpacks give you the possibility to communicate bidirectionally via the bonded channel, this is not very useful due to the added-up buffer delay. So the intercom between the backpack reporter and the broadcasting studio (n-1) is normally realized via a standard GSM mobile phone connection with relatively small delays.

Most commercially-available products also offer an option to transfer content via FTP. This allows us to transfer selected material, stored in the backpack or on a USB memory device, to the broadcaster’s server via the bonding VPN. Some vendors additionally allow using different variations of a “store and forward” functionality. The material is recorded to disk while filming and, in parallel, transferred nonlinearly to the server. The big advantage here is the flexibility of transmission and, if needed, the constant higher quality. If a lot of “mobile” bandwidth is available, you may be transmitting near real-time. If the bandwidth is low, however, you may suffer from a signal break until you are re-connected or the data speed cranks up again. This may be an interesting compromise for situations where live broadcasting is not important or, indeed, not possible due to network conditions.

While working with backpacks at the scene, most of them are powered by the same type of rechargeable batteries as used in the camera ... which is quite comforting and gives wireless free-

dom (autonomy) of up to 2 hours. In the field, it is quite useful to have the possibility of charging and/or changing flat batteries while the backpack is still running and some commercially-available solutions offer just that. Otherwise, it can be quite annoying to see the battery power running out while sending live material: rebooting the reporter backpack and re-establishing the network connections can take up to five minutes.

Such a reporter backpack adds flexibility to the workflows of the journalists and the whole creative team. It also reduces the operating costs since the expenses for material (buying or renting it) and human resources are cost-effective. First of all, they can be used for gathering quick first information ("hot news"), but these flexible solutions are also of value for extended coverage such as producing extra Web TV content, spontaneous interviews or behind-the-scenes reports.

Some of the commercial solutions have add-on features such as Wi-Fi/WLAN integration (for use with a public Wi-Fi network) or fixed Ethernet connectivity: these add-ons extend the backpack's possible uses beyond just A/V contributions. For example, a backpack also can be used as a mobile high-performance Wi-Fi access point, including VPN connectivity to the broadcaster's office network.

One of the backpack's strengths – flexibility – might sometimes turn into a weakness, especially when mobile networks behave very dynamically. Since the characteristics of a transmission via unmanaged IP networks are generally hard to predict, this effect applies even more so to these systems. Hence, they must be able to cope with extreme variations, for example by using scalable video codecs, adaptive streaming and buffers. This leads to the fact that when the available bandwidth drops, a decreased picture quality will be the consequence. To deliver a constant media stream, it is important to switch fast enough down to a lower bitrate before the buffer is running out. Equally important, but much more difficult to test in real live situations, is to switch back to higher-quality bitrates.

Finally there exists a kind of "sword of Damocles". Users of reporter backpacks who have to deal with disasters and/or (national) emergencies may find that public bodies (e.g. the emergency services) have "taken over" the mobile providers' networks. In this case, and the behaviour may vary among countries, the mobile data networks will not be available, or only in a very restricted way.

IRT tests

After testing several products in the IRT's labs and in the field, we got a good overview of where the smart – or not so smart – differences and similarities between products are. Power supply, availability, bandwidth usage and robustness are only some of the points we checked on reporter backpack solutions in the IRT tests.

At a basic level, the different solutions are all very similar. Several transmission channels are bundled, if available. Besides the mobile networks, all established network interfaces may be used. The transmission quality and resilience increase with the performance and reliability of the networks used. The crucial differences are as always to be found in the implementation details.

How does the system handle a varying transmission capacity – which can happen, for example, when the network becomes heavily loaded or when moving around – without increasing the trans-

Abbreviations

3G	3rd Generation mobile communications	**SIM**	Subscriber Identity Module
A/V	Audio / Video (Visual)	**TCP**	Transmission Control Protocol
DSL	Digital Subscriber Line	**UDP**	User Datagram Protocol
ENG	Electronic News Gathering	**UMTS**	Universal Mobile Telecommunication System
GSM	Global System for Mobile communications		
LAN	Local Area Network	**USB**	Universal Serial Bus
OB	Outside Broadcast	**VPN**	Virtual Private Network
QoS	Quality of Service	**WLAN**	Wireless Local Area Network

mission delay through increasing the buffer sizes to impractical dimensions? The current delays of between 1.5 and 3 seconds are unacceptable, especially when conducting interviews. For live transmissions (without interaction), these delays can be handled. Besides this, an improvement of the transmission characteristics is achieved by using optimized, delay-independent protocols such UDP instead of TCP.

The biggest challenge is the dynamic behaviour of the network connections. Not only that, the capacity of mobile internet accesses is quite limited inside a mobile cell and the reporter is in direct competition for bandwidth with all other mobile users.

All essential functions can typically be controlled via touchscreen, directly at the backpack, which usually works fine – even in bad weather conditions. As long as the camera can be used in rain, the backpack should keep its internal electronic parts dry and working ... but remember there is always some kind of high-performance computer working inside. And when the backpack has to be closed for rain, it's also closed for the hot air coming from the chipset inside.

To prepare for lack of capacity, scalable video codecs are often used internally in the transmission chain to bring additional robustness to the transmission. In the case where the available network capacity decreases too much, e.g. when two out of three (mobile) networks are suddenly not available, the codec and the flexible bonded VPN keep on providing a continuous audio/video stream – temporarily in lower quality. Encoding at constant bitrate would produce a definitely unwanted black or freeze frame.

Conclusions

In the last few years, a lot of different reporter backpack products have become available and a wider range of solutions and competitors have appeared on the market. Comparing them is extensive because they have many (similar) features while some important differences between them are often hidden in the details. So, before deciding what to buy, it is extremely important to know your workflow. What kind of system can easily be integrated in your workflows and does it really improve them?

And what about the concerns for quality. Audio transmission already works fine, thanks to the smaller data rates than for video. The video quality obtained with up-to-date backpack systems over

Markus Berg joined the IRT's Digital Networks department in January 1997 after he graduated in communication engineering at the Technical University of Saarbruecken. He worked as a research engineer and project leader in the field of adaptation of broadcast applications on high speed networks, especially ATM and IP, leading various projects dealing with co-operative postproduction over ATM/IP networks, Wide Area Networking Technologies and research on QoS issues for broadcasters.

Since April 2002, Mr Berg has been Head of the IRT's "Network Technologies" department. He is a regular speaker at national and international conferences and seminars on networking, and is the Chairman of the EBU's Strategic Programme on Future Network and Storage systems (SP-FNS), He is also Chairman of the EBU project group FNS/VCIP (Video Contribution over IP).

Matthias Hammer, Dipl.-Ing. (FH), graduated in electrical engineering at the Munich University of Applied Science and joined the IRT's "Broadcast Networks and Servers" department in 2001. He still works at the IRT, currently as a research engineer and project leader in the fields of storage area networks, WAN file transfers for contribution, and also the acquisition of material by video journalists.

Mr Hammer is a member of various EBU working groups, covering projects that deal with network security, new access networks and the adaptation of high-speed backbones serving the needs of broadcasters.

high-speed mobile networks (3G) can also be surprisingly good. But often you have to deal with a compromise which may be tolerated in many use cases when looking at cost savings, improved flexibility and up-to-dateness.

Contributing a satisfying high-definition (HD) video live over a bonded mobile connection is possible with many available solutions but this level of quality challenges even fast 3G networks. So, to be realistic, this would be a task for upcoming properly-deployed 4G networks, especially when some kind of QoS will become available. So far, all backpack transmissions over IP are “best-effort” connections.

The IRT will continue its testing of these new mobile systems and will report to broadcasters via the EBU.

This version: 11 September 2012

Published by the European Broadcasting Union, Geneva, Switzerland

ISSN: 1609-1469

Editeur Responsable: Lieven Vermaele

Editor: Mike Meyer

E-mail: tech@ebu.ch

The responsibility for views expressed in this article rests solely with the authors