Converged Connectivity Solutions for Central Europe River Cruise

Objective
To create a future proof, integrated, end-to-end manageable, hybrid connectivity solution for river cruise and near-shore maritime vessels in Europe.

Background / introduction
The river cruise industry in Europe is still growing, despite the economic crisis. Top trend for 2014 for the global cruise industry is described as: "*Continued development and availability of technology to facilitate and lower the cost of onboard communications as well as to provide more efficient passenger servicing*"

For the ship owner or tour operator offering river cruises, investing in better and future proof internet facilities on the vessels is a real challenge. Making the right choices when a new vessel is built or when retrofitting the existing fleet demands for a clear and broad vision, ranging from expected usage to marketing strategy. It will become more and more difficult to block certain types of data or websites and servers effectively, without spoiling the user experience and expectations. It will also become more important to be able to respond to fast upcoming trends, such as cloud storage and the current switch from Twitter to Instagram or the increasing popularity of Apple Facetime and other photo and video based applications. In this area OTT (Over The Top) video has to be mentioned. OTT video now accounts for over 70% of downstream IP traffic in many operator networks around the world, and is growing at an increasing rate of 60% per year at the moment. The flood of OTT video traffic from Netflix, YouTube, Amazon, DailyMotion, BBC, Canal+, RTL and Sky, to mention a few, is rising fast as the result of consumer demand for on-demand and live video streaming to a growing number of smart devices.

The content offered and the way the internet connection of the vessel is used changes constantly, but a common aspect is that interactive use is increasing and users are more and more becoming content creators and less information consumers only. Technically, this means that the up-link, especially in non-symmetrical connections, and low latency is becoming increasingly important and an earlier encountered bottleneck. This trend is reinforced on cruise ships, as cruising is becoming more popular among a broader consumer group and the at the same time the use of social media in the existing customer segment is rapidly growing. We further foresee a fast adoption of upcoming trends like e-health and wearable tech, and other cloud related technology that is aimed to enhance the quality of life by the current and future cruising generation. On top of this, we also see that employee quality and employer loyalty is influenced by facilitating the need to stay in contact with the outer world, including the use of social media. Lastly, the cruise vessels are facing the same various needs as land based luxurious hotels to exist within a hospitality ecosystem. They even have a lot of extra modern nautical equipment that has to be monitored and managed, more and more supported by M2M-communication and cloud related tooling. It is expected that in 2020, 85% of the data volume transported over internet is between smart, connected devices, without any direct human involvement (M2M). The vessel, as well as its passengers and crew, once living in an "always connected world", makes the "always connected cruise vessel" inevitable in due time.

For a substantial part of the river cruise vessels, multiple WAN connection types will be deployed the coming years. The end-users (including networked devices) will continue to face changes in internet connectivity during the itinerary. The supply model for bandwidth and data volume for passengers and crew can be pure restrictive

in nature (tokens, pay-per-time/volume), be based on demand management or completely free use is offered. We strongly believe that a form of demand management must be installed to keep up with the expectations. Also maintenance and backup procedures can be adjusted to the quality of the available internet connection. We believe that the real challenge is to develop a flexible, adjustable and future proof, but above all: integrated and thereby manageable model for availability and quality of the internet connection. And implement, monitor, maintain (including to change, develop and improve) a solution together with all stakeholders in a service oriented chain model.

concept

On river cruise vessels we face a diversity of challenges to deliver a reliable network and internet connection to the guests, crew and network devices, satisfying nowadays needs. Several companies have developed general hybrid, load balanced and bonded solutions for vessels, combining multiple and diverse WAN-connections. Due to the non-stationary nature of vessels the mainly used networks for internet access are wireless: by satellite (satcom) and over the cellular mobile networks (G2/G3/G4). Both types of data connection are showing rapid technological developments, resulting in more bandwidth and a lower price per data volume, as also seen in landlines based internet.

Satcom has the advantage of broad coverage, not hindered by country boundaries, but can easily be blocked by high obstacles in the line of sight, such as mountains, buildings, bridges and quays. The price tag for satcom is relatively high, but expected to lower within a few years, due to technical developments that increase bandwidth, now already seen in the Ka-band developments. Satcom with Geo-stationary satellites (GOS) will always suffer from relatively high latency, while using non-stationary satellites in Low Earth Orbit need a constellation of satellites for continuous communication and still face other difficulties and practical restrictions.

The developments of the ***cellular networks*** are at least as impressive in respect to increasing bandwidth, combined with decreasing latency. Coming from hand-switched, circuit based networks extended with GPRS and EDGE for data, via UMTS/3G to full packet switched 4G networks that deliver much more efficient IP data connections. 4G with LTE technology is expected to reach 90% of the population of Western Europe in 2016. The political developments in the EU are also promising, especially the Digital Agenda for Europe of the European Commission: The Connected Continent initiative is inspired by the words of (former) EU-commissioner Nelie Kroes: "*In Telecoms, of all sectors, there is no place for borders*" and the European Commission has proposed that ultimately in 2016 pricing for data over mobile networks must be the same in all member countries. This means the current extra roaming costs will be eliminated for the majority of countries crossed by cruise vessels. In a press release of 17th February 2014 is stated: *"The Commission's Connected Continent legislative proposal (MEMO/13/779) asks the European Union's legislators (European Parliament and Council) to achieve a Single Market when making a phone call or browsing the Internet. The aim is to achieve a combination of regulatory obligations and market incentives which will induce mobile operators to extend their domestic plans/bundles so that by 2016 at the latest, customers throughout the Union are able to use their phones and smartphones at domestic rates while traveling throughout the Union ("roam like at home")."* The most recent step in this process is the lowering of the maximum end-user roaming price for data in the EU countries per 1th July 2014 from €0.45 to 0.20 per MB. The economical reasoning of the EU commission is widely adopted in the market, i.e. by Forrester in the report of 28 February 2014 "The 4G Roaming Race Is On – Sharp Price Cuts Expected". The concluding analysis speaks for itself: *"Affordable 4G roaming is a must to overcome user avoidance: If mobile*

operators continue to overcharge enterprise customers through very high-margin international data roaming charges, or if they charge higher fees for 4G roaming than for 3G, customers will jump ship at the first opportunity. High international data roaming charges have driven most travelers to rely on Wi-Fi and local SIM cards, and also on softphone VoIP, undermining the potentially strong revenues that operators could get from charging a modest fee (cheaper than Wi-Fi) for price-synchronized at-home-and-abroad usage."

The use of ***landlines based internet*** for cruise vessels is not very common at the moment. With internet becoming a commodity like electricity, why not also change to "quayside internet" when not sailing? Like diesel-generated versus quayside electricity, the connection will be much cheaper and probably also much better! Landlines based internet connections to homes and small businesses are still showing staggering figures for increasing speed and price drops. The speed (bandwidth) is constantly upgraded without extra costs over the last years. Fiberglass offerings start at 50 – 100 Mbps and offerings from 200 Mbps up to 1 Gbps symmetrical are coming into range for consumers and small businesses where fiber-to-the-home projects are realized. In the Netherlands, (unlimited) internet access with WiFi is supplied in around 10 river harbors by non-profit organization "Binnenvaartnet", for which a yearly subscription (of only €52 per ship/user) is needed.

Outline of an optimized concept: *i*-River

The *i*-River concept for Europe combines all three main and still rapidly improving internet access network types available in this region into an optimized model. This model with a fleet wide, flexible, future-proof network topology with centralized bandwidth allocation and management, less providers and a more predictable and lower TCO in the cruise vessel demand-market. Above all it will provide internet connectivity to cruise vessels of much better quality in all relevant aspects.

Basically the concept combines existing land based, maritime and cruise market oriented technology solutions with, for this sector, new ones into a quickly to deploy, actualized and specialized concept, narrowed down to the European river cruise and near-shore maritime market. It is based on the actual commercial, technical and political/regulatory possibilities and expectations. The status and possibilities of the three types of WAN connections and the integration with the on board information and entertainment systems are further discussed in an extended worksheet with more specific observations and to-do lists, followed by a proposal and status for the first integration steps.

The *i*-River concept for converged network connections for cruise vessels and other mobile use cases resembles the converged strategy seen at the operator level. Due to technical cooperation and convergence on various levels such as certification, roaming agreements between WiFi-providers and cellular operators can be expected. The once strictly divided technology realms of the operators are also converging at the company level and traditional landlines based carriers and mobile network operators are increasingly offering triple and quad play. Increasing consolidation (by take overs) is expected.

On board, we must provide a good internet connection. But it does not end there. Ultimately it are the guests, crew and on-board entertainment & information systems that are becoming increasingly dependent of this connection. *i*-River is therefor actively keeping up and exploring improvements and future use of the whole range of ICT infrastructures and devices on board of cruise vessels and the developing internet use and deployment.

Research worksheet & to-do list

concept

Component A: landlines based internet connection

A1. During its journeys along the rivers of Europe, usually more than half of the daytime of the trip the vessel is allocated at fixed docking places in towns or villages where excursions are held and/or passengers (dis)embark. It is around these moments in the cruise that the internet is used the most in terms of users/sessions and "heavy" applications like video- and photo upload and in terms of data volume for the guests. The availability of "fast, cheap and unlimited internet" will make remote data-intensive maintenance, i.e. VOD update, possible, which until now only could only be done on location.

A2. We see a trend where cruise vessels are not exclusively used in trips along the rivers during the cruising season (April to October) but increasingly also used as floating, and at those occasions stationary, hotels in the other part of the year. We also noticed that lately vessels docked in the winter season are more populated for maintenance and preparation for the next seasons and a working internet connection with increasingly bandwidth is needed.

A3. The vessels that are in the harbor or at a quay in metropolitan area for the described purposes/moments can use a landlines based internet connection (via WiFi or PowerLine). Also the satellite connection can be unavailable or hampered because of obstruction by buildings or the landscape. Landlines based internet will be anyhow much cheaper and faster (especially as long as 4G is not available). In a (multiple) fleet wide solution, scarce and more expensive bandwidth/data volume can be freed for other vessels in the fleet, when the vessel is stationary at a well known and often used urban destination. MTM integrates WiFi-access in ports in its Nexus "global hybrid network solution" for maritime vessels for this reason. We are discussing a PowerLine solution with Ubiquity, that provides shore current in the Netherlands in many river harbors under the name "Walstroom" and is looking into expanding this service to other European countries. And we will contact WiFi provider "Binnenvaartnet" and its partners to discuss and adopt the *i*-River concept.

A4. Satellite service provider Level421 shares the vision about having a hybrid centralized/managed network and their high-end Traveltronic domes include a WiFi-receiver as one of the WAN-connectors, next to a SIM card slot. But there is only an integrated offering for Satcom with cellular networks, the latter based on high international roaming prices.

In progress and to do:

1. analysis of period docked at planned and fixed locations during itinerary and related internet usage when available;
2. investigation how to provide landlines based internet via WiFi (or otherwise, i.e. by Powerline) on these locations to the vessels and seamlessly switch over to and from these connections;
3. Assessment and cost-benefit analysis where to place internet connected WLAN Access Points on docking/boarding locations for river cruise vessels;
4. Investigate possibilities and costs to route this WAN traffic (i.e. via VPN) to central hub and unify the network of the fleet;
5. Investigate extended business models for quay delivered internet for other cruise lines and other types of vessels, i.e. inland and near-shore maritime vessels.

Component B: cellular mobile data networks

concept

B1. The classical exploitation models of the mobile network operators are mainly based on the individual SIM card as central subscriber unit, with telephone number and subscription attached. The subscriptions are developed commercially and aimed at mass consumer markets with monthly fees, data volume bundles and overages per card. The volume of all individual data bundles together is on average used for no more than 20%. On the other hand 10-25% of the bundles is surpasses and charged heavily. The pricing and volume of the data bundles in many European countries started to be bandwidth depended as 4G/LTE became available in the networks of the operators. LTE/4G is still sold as an add-on option by many European operators, but more and more all subscriptions can use the maximum speed available everywhere.

B2. In metropolitan areas an internet download speed up to 50 Mbps is now common with LTE in some areas. LTE Advanced (LTE-A), already activated in some countries, increases the up- and download speeds theoretically up to 300 Mbps. Using one of the features of LTE-A, introduced in 3GPP release 10, Carrier Aggregation (CA: also performing instantaneous load-balancing!), Telstra and Ericsson even have combined one 20 MHz block in the 1800 MHz band with two 20 MHz carriers in the 2.6 GHz band and demonstrated a peak speed of 450 Mbps. In November 2014 Qualcomm indeed unveiled its fifth-generation LTE modem chipsets with theoretical up- and download speeds of 100 and 450 Mbps.

B3. What an individual cruise vessel needs NOW is:
- enough bandwidth with no more SIMcards than needed, dependent on the available networks and technologies, 2 – 10 SIM cards. Combining more than 2 SIM cards/mobile network connections will be necessary where no 4G and other fast internet connection is available.
- variable data usage or a suitable data volume per year (and not per month without roll-over and per country, as is now the case, mostly).

B5. The fleet as a whole benefit from SIM cards with a flexible yearly data volume to be used by all SIM cards (shared data usage, no overage/out of bundle pricing).

B4. The wholesale caps for data roaming (maximum operator to operator tariff) in the EU / EAA sank from €1 per MB on 1st July 2009 (first time regulated) to €0.05 five years later. Roaming costs for data are expected to completely disappear in the EU/EAA somewhere between 2016 and 2018. But what will be the end-user pricetag per MB/GB? We also notice the possibility that roaming as such in the EU is not removed, but there will be possibilities for foreign data plan subscriptions on SIM cards. Vodafone is already offering this possibility to its customers.

B5. The LTE connection of the Traveltronic domes can also be operated with user supplied SIM cards. The latest models of the Peplink WAN loadbalancers have a built-in SIM card slot for a LTE WAN port. We expect to see suitable LTE enabled WAN equipment more generally and with much more diversity in the near future.

B6. Now the frequency auctions for the 4G spectrum have been taken place in most European countries, further roll-out is planned for the majority of the areas. Fleet owners need to evaluate the suitability of the existing (mostly) UMTS (only) based GSM data technology on vessels and plan for upgrading to LTE(-A). Antenna cables, splitter/combiners and the antennas themselves can all be candidates to be replaced. For the passive components it is important to keep in mind that LTE differs from UMTS in used frequency range and polarization aspects (MIMO).

In progress and to do:

1. We are negotiating with mobile network operators and their partners to use 24x7 supported platforms with data-only SIM cards (preferably including SMS) that share data volume and have traffic for all SIM cards routed over the network of the carrier to a central hub, before the data is handed over to the internet. We received a quote for a flexible, two-year agreement from Vodafone in September 2014 for use of SIMcards on their M2M platform and are constructing a consortium that broadens the scope of the use-cases outside the river cruise vessels. This offer was predominantly based on use for cruise vessels with an itenary Amsterdam – Black Sea. In October we received additional offering from Vodafone and a trial set of M2M SIMcards with extended coverage, combined with entry to the web based platform managing the cards.

2. We still could setup a trial journey in the season with a cruise vessel from Amsterdam to the Black Sea to verify several aspects and assumptions, such as availability and which mobile cellular networks are hit, the frequencies and the bandwidth per SIM card available during the trip. On the other hand several ICT service providers for the main river cruise operators have indicated they already know which networks are preferred/necessary on this trip.

3. Being able to use 1 type of data SIM card for all vessels that connects to mobile networks everywhere in Europe and preferably more than one network per country is a goal worthwhile striving for, apart from the i-River concept as a whole. Other markets are explored to obtain quantity benefits.

4. Monitor the ongoing roll out of 4G/LTE networks and their pricing (and roaming) models in Europe. I.e. Vodafone Germany offers 4G/LTE enabled Red subscriptions for 20 GB per month for less than €60 and even "LTE at home" with a 30 GB bundle for €45.

5. Monitor the broadening of the traditional B2B M2M-market towards a more small business and consumer related technology ecosystem, which also comes with combining more types of WAN connections in the solution architecture. The transition of the M2M market from a B2B model, mainly focused on Fortune500 companies towards a B2C ecosystems like developer communities also is promising for broadening the scope.

6. Monitor developments like multi-IMSI technology and virtual(ized) SIM cards, such as recently went live in Africa with the technology from Movirtu and elsewhere with help of enabling technology from i.e. NAKA mobile.

7. Further investigate and follow hardware all-in-one solutions like Traveltronic with satcom, LTE and WiFi combined (i.e. from Huawei) and the new Peplink load balancers with LTE SIM card slot for future deployment. A lot of multi WAN port routers support USB modems for cellular networks also.

Component C: Satellite network

C1. The initial choice for satcom cabling and equipment when the ship is built or the retrofit of the vessel is planned and designed will limit the later choices to a great extend, because of the diversity and costly nature of the specialized and partly closed-ecosystem satellite equipment like the (3D self pointing, stabilized and shock proof) dish/dome, the transmitter (BUC), the controller (ACU) and the modem/router. The long term investment cycle of the satellite provider business is also reflected in the commercial offerings of the satcom providers and are in great contrast to the dynamic

aspects of internet use demands as described in the introduction of this outline.

concept

C2. As also indicated in the introduction, we still foresee a fading, but for the near future continuing, role for data connections via satellite for (at least the top-class) river cruise vessels in combination with the trend where high bandwidth and always-on internet access is a normal utility for guests and crew and the Internet of Things is growing more rapidly than 3 and 4G mobile networks will be deployed along the itinerary of the vessels.

C3. The evolving integration of (interactive) digital tv and two-way data connections is promising, also in the satellite market. For now VSAT and TVRO are separate worlds, also within the organizations the Satellite Service Providers themselves and their suppliers, services and pricing models. But for how long?

C4. The integration of satellite communications and 4G networks is another fascinating aspect that can show rapid evolution in the coming years. We have set the first steps to integrate 3/4G and satellite at the carrier level, but here is still a long way to go.

C5. Most cruise operators use Managed Services of "satcom airtime sellers", offering Maximum and Committed Information Rates (MIR/CIR), that are not easy to validate. Every operator with more than 5 vessels crossing footprints with a total bandwidth need exceeding a CIR of 2-4 Mbps download speed should seriously consider to get hold of and (let) manage its own line card(s) in the hub (ground station) for its fleet, when considering to use the iDirect platform. With self managed (or even owned) line-card(s) in the satellite hub, also a fixed part of the available frequency / TDM spectrum with corresponding bandwidth on the satellite beams is allocated, which can be freely distributed among the connected vessels ("ground stations") from and to this line card. The bandwidth allocation among the vessels can be real time adjusted according to the actual needs and availability. If the data is routed to a centralized access point before break out to the internet, the allocation of bandwidth among all the internet connections of the vessels can be fleet wide balanced according to the company policies, individual needs and the availability of the networks in real time.

C6. In the lower Danube part of their itinerary, the vessels nowadays face a degraded or no internet connection at all, most of the time, because on vast parts of the trajectory only GPRS (enhanced with EDGE, at the best) is available and the edge of the footprints for some satellite-dish combinations are reached. In many of these regions landlines based high speed internet is also lacking and is not expected to be available in the near future, due to social-geographical and economic reasons. It is exactly where satellites based backhaul for mobile network operators can be a viable option. Combining a backhaul for 4G networks by relative inexpensive terrestrial satellite connections (,as described in section A,) in commonly visited areas by cruise vessels offer potentially strong win-win situations. We do foresee problems with latency, of course, with this kind of solutions, when GSO-satellites are used.

C7. For the current offering by EPAK, also available with Ka-band technology and speeds up to 10 Mbps down and 4 Mbps upload, we must conclude that the offered VSAT Diversity Kit, which enables automatic switch over from Satcom to UMTS or L-Band WAN connection (but without load balancing) is aimed at maritime use for fail-over use and is not supported by a suitable management services that also cover other WAN connections than the satellite based.

In progress and to do:

1. Investigate (and influence future) investments in satellite equipment and long term contracts of ship-owners/operators;

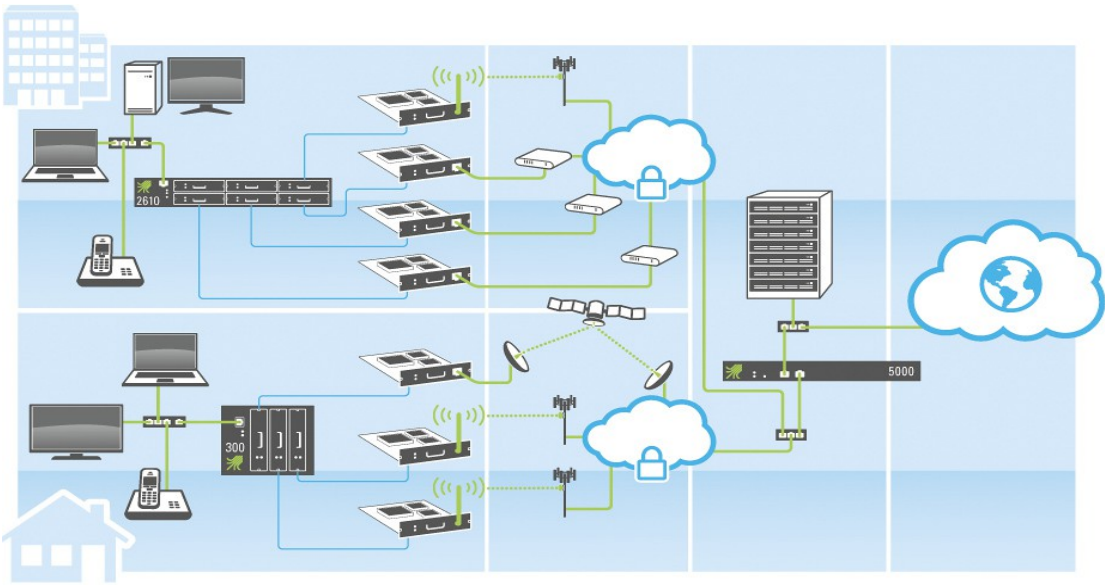
2. Further investigate VSAT/TVRO and 4G-satellite integration at carrier level;

3. Further investigate satellite offerings with European footprint and monitor expected new satellite launches and their planned platform architecture, capacity and footprints. And their supply and partner offerings (as described in C5): only managed services or also Virtual Network Operator with dedicated line-cards offered?;

4. Monitor technical developments and new offering, such as Ka-Ku developments, the Traveltronic AllinOne system and the iDirect X7 modem with satellite diversity and much higher throughput and evaluate their potential for the i-River concept.

Integration and optimization: the first steps

1. Most cruise vessels already make use of multiple internet connections, but they are not always or only partly integrated and therefor not manageable at fleet level or even for the indivuidual vessel. Generally we expect a greater contribution for the mobile cellular networks in the near future, but are confronted with a great diversity of providers and subscription types used. Consumer data subscriptions are using public gateways to the internet on mobile networks that often result in very poor connectivity. The first step in realizing the i-River concept will be to agree with a mobile network provider about ***centrally routed and managed and "in all countries" active/roaming SIM cards***. The outcome must include a technical and organizational suitable model with acceptable pricing, for which the final details can be set after a trial journey or data analysis and obtaining a more transparent and suitable pricing model. The current negotiations for using a global, 24x7 supported M2M platform for the cellular data connections are very promising, also in respect of having all data from connections of this type fleet-wide delivered to the data center over the network and proven high-quality M2M platform of the carrier. Thus avoiding data losses due to VPN overhead, normally 15-25%. This is especially important when only low-bandwidth connections like GPRS are available, as in the lower-Danube region.



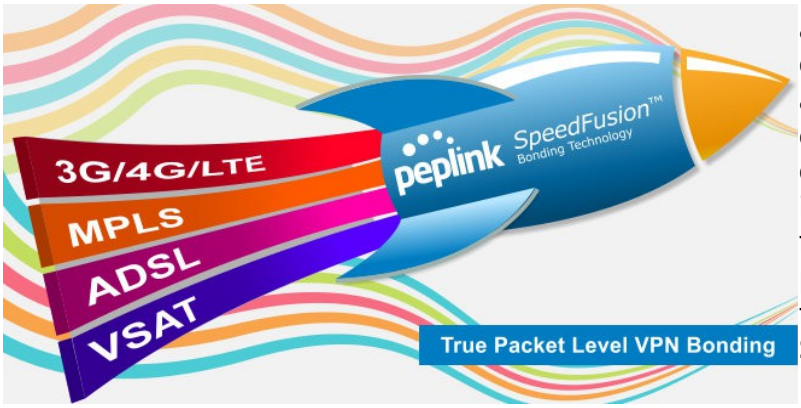
2. Multiple WAN-connections can be load-balanced or bonded. Most of the existing WAN bonding solutions, also from the brands used on cruise vessels, like the ones

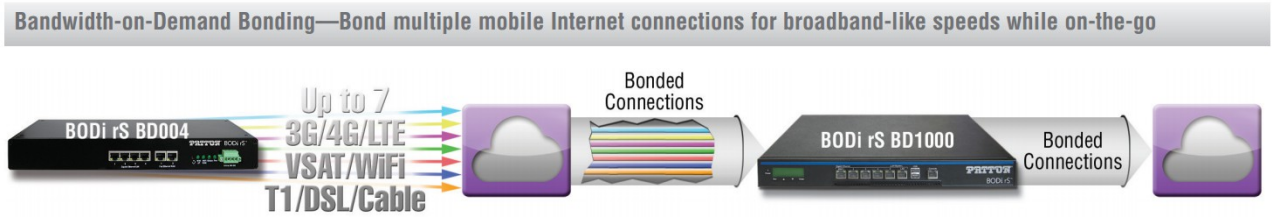
from Mushroom Networks, Viprinet, Peplink SpeedFusion and MP-NeT, are routers offering solutions for public internet access that are originally designed to replace (expensive) MPLS/leased line connections in corporate environments by multiple cheaper DSL connections or simply achieve higher bandwidth, i.e. in locations without broadband internet connections. As you can see in the diagram above, public internet gateways are used twice in this setup: once to reach the bonding router and in the data center (or head office) this router establishes the final internet connection. Bonding can be achieved at session or packet granularity for the up- and the down link, depending of the setup and most of the time also dependent of licenses and/or subscriptions. At the packet level (and sometimes even smaller granularity) this can also be considered as a form of WAN virtualization that opens up application specific features.

concept

Specialized mobility bonding solutions, on the other hand, mainly focus on bonding for single vehicle/purpose bandwidth enhancement at land-based vehicles, like HD video streaming (i.e. to replace much more expensive satellite based communication).

3. WAN-bonding through VPN over public internet gateways is promising regarding integration and manageability, also fleet-wide. But the overhead that VPN techniques are creating can be problematic, especially for low-capacity connections like GPRS. Further investigations are necessary to find the most flexible, future-proof solution for WAN-bonding for river cruising purposes. Several vendors, such as Peplink and Patton, are offering bonding, next to load balancing.





4. Meanwhile the statistics about the stop-over locations and internet usage can be further explored and further related to the possibilities for a landlines based internet connection on these locations, including the evaluation of maintenance procedures. The possibilities and solutions for integrating an extra intranet connection on the ships with WiFi (or wired PLC) must be further investigated and developed.

5. Optimization of the WAN-connection by integration of satellite, cellular mobile networks and fixed line connections at the carrier level are already under investigation. We do believe that shifting to 1 (internal, not public) gateway for all or most of the mobile carriers is a major step that should be followed by integrating the (management and gateway of) the WAN connections delivered by satcom.

6. Further WAN-optimization at the application and packet level, are under investigation, like the Riverbed case for MTM satellite-connections on sea cruise ships (40-60% more data throughput) and the launch of the new SteelFusion platform in September 2014. Also other (appliance and cloud based) optimization solutions to find most suitable and effective solution for river cruising with a high level of Quality of Experience.

concept

7. Especially concerning the mostly long term satellite-business, the contracts, platforms, and related hardware must be investigated on already sailing vessels. Fleet owners with plans for new to build vessels should be informed about this concept and the results so far to anticipate. The off-season 2014-2015 must be used to introduce the *i*-River concept as a sound and solid alternative for fleet-owners and cruise-vessel operators for their WAN-connections.

8. Providing a high quality internet connection is no insurance for a good user experience of the guests and workforce. The LAN and WiFi infrastructure, communication systems, (IP)TV setup and other entertainment systems on board and increasingly also mobile devices are delivering the user interface and experience. OTT video and multiscreen experiences are not yet integrated in the architecture of the entertainment systems on board. Sometimes hotel-TV solutions are deployed (i.e. Swisscom, Divitel), that are designed and managed for large, non-floating hotels with fixed landlines based internet connections. In the case of Swisscom, even fixed public IP addresses are obligatory for the VOD/rights management to function. Also the update of video content is very problematic during the season when no suitable broadband connection for the ships is available long enough to perform the update. Adding 10 new HD movies over a 4 Mbps satellite connection is a no-go! The proposed use of landline based internet connections is just a provision or workaround for the (already legacy IP and live broadcast) tv systems! On the other hand we also see new build vessels with Apple miniMACs or Intel NUC PC's acting as set-top box devices for a local video server for VOD and narrow casting purposes. Of course, these kind of "home solutions" also cause a lot of problems in a professional but small to mid-size hotel environment without immediately available hands-on ICT technical support. *i*-River is developing a future-proof, integrated entertainment systems architecture with integrated OTT and multiscreen viewing with strong partners in and outside the hospitality world. Especially in the high-end cruising market, customers expect at least the same enter- and infotainment experience as at home! Increasingly, this will also include game consoles (i.e. Xbox, Playstation), tablets, smart phones and (other) wearables.

9. Beside the enter/infotainment capabilities and quality, the customer and crew expect high quality, always on, wireless connections on-board. Specialized WiFi (and even private GSM) solutions for highly crowded environment are investigated to be deployed to keep up with the increasing number of simultaneous connections that are expected to function flawless within cruise-vessels.

10. Enabling the converging entertainment systems (like the mentioned OTT video) and communication technology (i.e. speech, messaging, narrow casting, wayfinding, emergency & alarm systems), domotica, and the other (also nautical) information systems on board is the ultimate goal, for which the WAN connections ("always on" and with other sufficient qualities) are becoming nothing else than a necessity that the *i*-River concept will provide.

For updates and more details, please contact *info@i-river.eu*