

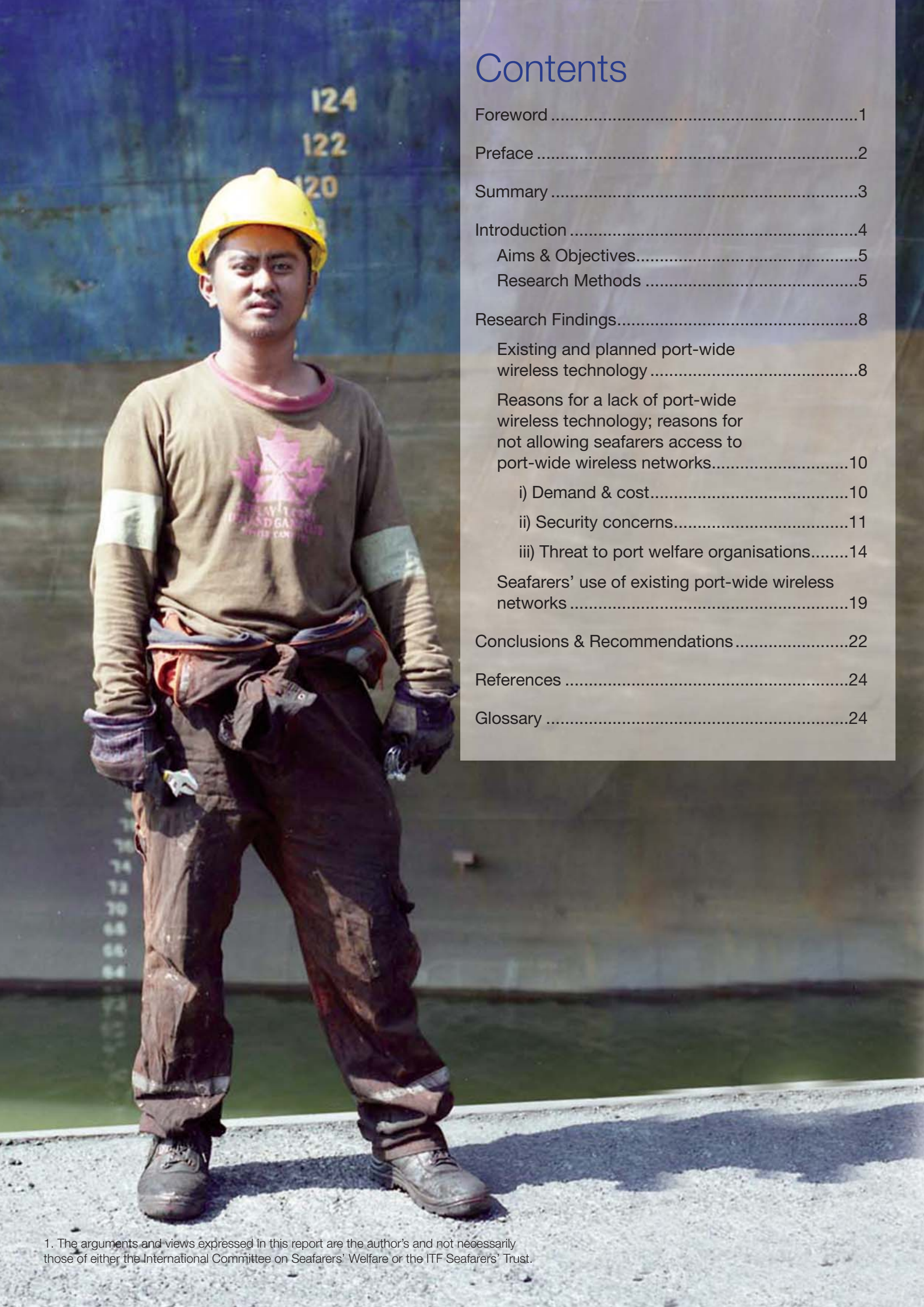


Developments in New
Technology & Implications
for Seafarers' Welfare –

Seafarers' access to WiFi and WiMAX in ports

A report commissioned by the
International Committee on Seafarers' Welfare

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1. The arguments and views expressed in this report are the author's and not necessarily those of either the International Committee on Seafarers' Welfare or the ITF Seafarers' Trust.

Foreword

The genesis for this report was a press enquiry from a well known maritime publication asking us about the availability of WiFi and WiMAX in port for access and use by seafarers. We knew anecdotally of seafarers having access to portwide WiFi in a couple of ports but we did not have the full picture. As communication with home is one of the top welfare concerns for seafarers we decided to commission this research into the availability of port-wide WiFi and WiMAX for seafarers. Many seafarer welfare organizations provide WiFi in seafarer centres and increasingly onboard ships in port. However, one of the issues we are interested in is the availability of portwide WiFi and WiMAX, or lack of it. The ITF Seafarers' Trust has generously funded the research and the report. The ICSW would also like to thank the ports, shipping companies, and welfare organisations who co-operated with the research.

Providing cheap and easy access to the internet and email is key to not only enhancing the welfare of seafarers but also in their recruitment and retention. Onshore the internet and WiFi are essential parts of our everyday lives. We need them to stay in touch with friends and family, to do our banking and shopping, and to generally enrich our lives. Why shouldn't seafarers enjoy these same benefits, especially when they are in port? Many seafarers cannot get off their ship to visit seafarer centres. With more and more seafarers using laptops onboard there is an increasing need for portwide WiFi or WiMAX to be available to seafarers. We intend to use the report and research to help get the issue of seafarers' access to portwide WiFi or WiMAX onto the agenda of ports around the world.

Roger Harris

Executive Director
ICSW
July 2011

“Providing cheap and easy access to the internet and email is key to not only enhancing the welfare of seafarers but also in their recruitment and retention.”

Preface

This report is based on findings of a research project commissioned by the International Committee on Seafarers' Welfare (ICSW) and funded by the International Transport Workers' Federation (ITF) Seafarers' Trust. The project ran from January to April 2011.

The author would like to thank all those who participated in the research survey and interviews. She owes particular thanks to Johan Deleu of the Port of Antwerp, Yuanheng Kwek of the Maritime and Port Authority of Singapore, Lourens Visser of the Port of Rotterdam, Cor Oudendijk of the Port of Amsterdam, Joseph Chacko of Kandla Seafarer Welfare Association and Jorg Pfautsch of the German Seamen's Mission.

In accordance with the wishes of research participants, some respondents' identities are not specified in order to maintain their anonymity.



Summary

Despite research participants' widespread enthusiasm for the principle of seafarers accessing port-wide wireless networks, interview data suggested these networks to be relatively rare. This impression was supported by the survey data:

- Of ports responding to the survey (n=72; ~10% of ports), 32 percent had port-wide WiFi and 10 percent had port-wide WiMAX. 26 percent of those ports with neither reported having plans for this technology in the future.
- Of those ports with port-wide wireless networks, 58 percent allowed seafarers access to the networks, of which 38 percent gave seafarers access for free.
- The main reason participants cited for not having port-wide wireless technology was a lack of demand, followed by concerns about security and the cost of installing and operating port-wide wireless networks. A concern about security was also the main reason for not allowing seafarers access to existing networks.
- The research found the cost of installing port-wide WiFi and WiMAX to vary considerably dependent upon ports' size and topography, the choice of technology and the existing degree of infrastructure. The research also identified opportunities for generating modest amounts of revenue from port-wide WiFi and WIMAX.
- The research also revealed examples of ports with port-wide wireless networks successfully addressing the security of port and ship information systems.
- Other reasons offered for a lack of port-wide wireless technology included problems finding a commercial partner to provide a WiMAX signal, as well as fears that port-wide wireless threatens the viability of welfare organisations. This latter was explained either in terms of the technology discouraging seafarers from using seafarer centres, or in terms of welfare workers selling seafarers fewer phone cards.
- The research found that a number of welfare organisations viewed technology such as WiMAX as providing an opportunity to better meet the needs of seafarers. Evidence that port-wide wireless technology can add to rather than threaten welfare organisations' revenue were also identified.
- In ports with existing port-wide WiFi or WiMAX, the research identified issues relating to i) the range and reliability of signal strength and ii) seafarers' access to the hardware required to connect to port-wide wireless networks, which both affected seafarers' ability to make use of this technology.
- Overall, the research found a number of practical impediments to the proliferation of port-wide wireless technology and seafarers' access to it, as well as a 'bottom-line' culture among ports in which the needs of seafarers, while not disregarded, were peripheral to port operations and planning.

Introduction

“It is normal to miss your family and to sometimes feel lonely, bored, and depressed at sea, or to not be able to sleep. But somehow by sending an email or making a call, it really helps.”
Filipino wiper

“I feel lonely because I miss my family and sometimes I can’t sleep. But things get better when I call or text them.”
Filipino chief cook

Communicating with home is of paramount importance to seafarers and their welfare. Extensive anecdotal evidence, such as the comments above,² signals the positive effects communicating with home can have on seafarers’ mental wellbeing while away from their family and friends for several months at a time, often working in small crews with limited shore leave. At the same time, improved communications between seafarers and their relatives seem likely to increase their cohesion.

In countries such as the Philippines, from where more than 330,000³ seafarers originate, anxieties about perceived social costs of labour migration are widespread among politicians, scholars and the public at large. Correspondingly, the Philippine state and communication companies promote improvements in communication technology as benefiting the Filipino family (Madianou & Miller 2011: 2,16-17), as well as the wider society and nation (Swift 2010: 77-8). It follows that beyond the Philippines, similar levels of optimism surround communication technology and its potential to lessen the social costs of separation among migrants’ families, including those of seafarers.⁴

“Communicating with home is of paramount importance to seafarers and their welfare”

At present, seafarers’ access to the internet and phones aboard ship is both limited and expensive. In his extensive study of port welfare services, Kahveci (2007: 27) cites just 16 percent of seafarers (N=3527) having access to emails onboard, even though seven out of ten seafarers felt access to email to be important. 40 percent of officers had access to email, compared to just 3 percent of ratings, although this access was usually restricted to work usage. Those who were able to access email for personal use were often limited in the length and number of emails they could send and some had to pay to send and/or receive emails. A lack of privacy in the use of email was also a common complaint, as was the fact that access to email for personal use was often dependent upon the goodwill of the captain.

Given the limited availability of email at sea, Kahveci reports seafarers using satellite phones as their main method of communicating with home, which are expensive, followed by personal mobiles (primarily for texting) when in range of a signal (ibid.: 30). If able to go ashore while in port, seafarers can take advantage of varying communication facilities in seafarer centres. While some centres only provide phone cards for use in the nearest public phone box (Kahveci 2010: 38), others are equipped with computers linked to the internet, or with WiFi signals to which seafarers can connect using their own wireless-enabled devices. It is not clear what percentage of seafarers sail with personal laptops; one welfare worker interviewed during this research in the port of Antwerp, Jorg Pfautsch, estimated almost all officers to have laptops compared to 20-30 percent of ratings, although he and others considered this number to be rising.

A new development affecting seafarers is mobile WiMAX, a wireless network technology that differs significantly from WiFi in the way in which it operates (see box i). A small minority of welfare organisations have begun to take mobile WiMAX technology on ship visits so that crew can connect to the internet via their personal computers without having to come ashore. While there is potential for growth in the number of welfare workers taking mobile WiMAX onto ships in this way, the numbers of seafarers benefiting from the technology would remain modest.

2. Source: author’s onboard research, February 2007.

3. 330,424 seafarers were deployed from the Philippines in 2009: www.poea.gov.ph/stats/statistics. Last accessed March 2011.

4. While several studies examine the social effects of labour migration in the countries such as the Philippines, few focus on the role of communication technology. An exception is the recent work of Madianou and Miller (2011), which examines the effects of mobile phones on relationships between Filipina migrant mothers and their children in the Philippines. Their findings urge caution in assuming normative models of relationships or technology, since although mother felt mobiles to partially reconstruct their role as parents their children were more ambivalent about the consequences of transnational migration.

In contrast, WiMAX or WiFi that covers the entire area of a port, including its waters in which ships are harboured, has the potential to reach many more seafarers, enabling them to connect to the internet and communicate with friends and family via email, social networking sites and applications such as Skype™. **As well as offering vast improvements to the lives of existing seafarers and their families, this technology would also make seafaring a more appealing career choice among younger generations for whom internet access is embedded within day-to-day life.**⁵ It follows that improving seafarers' access to the internet is critical in addressing the global shortage of officers.⁶ Other significant uses and benefits offered by port-wide WiFi and WiMAX are listed in box ii).

Aims & objectives

Given the potential uses and benefits of port-wide WiFi and WiMAX, particularly for the welfare of seafarers, this research is intended to investigate:

- i) The extent to which port-wide WiFi and WiMAX exist or are planned for the future among ports.
- ii) Whether seafarers can access existing port-wide WiFi and WiMAX and whether it is free for them to do so.
- iii) Reasons inhibiting the uptake of port-wide WiFi and WiMAX in ports where it does not exist and there are no plans for its installation.

ICSW intends to use the research findings to advocate for seafarers to access port-wide WiFi and WiMAX at little or no cost. Specifically, the research is intended to:

- i) Increase awareness of port-wide WiFi and WiMAX and of the benefits they offer to seafarers' welfare in particular.
- ii) Produce case studies about existing port-wide wireless networks with a view to encouraging other ports to improve their wireless provision.
- iii) Contribute to improvements in the operation and use of existing port-wide wireless networks by highlighting reported problems.
- iv) Encourage welfare organisations and shipping companies to help seafarers benefit from port-wide wireless networks.
- v) Promote discussion of seafarer welfare in relation to port activities.

Research methods

This research combined an online survey of port authorities with semi-structured interviews with a selection of individuals, mostly representatives from port authorities and welfare organisations. Initial archival research into WiFi, WiMAX and their use in ports informed the design of the online survey, as did semi-structured interviews with representatives from the Ports of Antwerp and the Maritime and Port Authority of Singapore, where port-wide WiFi and WiMAX respectively were known to exist. A database of email addresses for port authorities and other related bodies, such as relevant government departments, was compiled from the membership of the International Association of Ports and Harbours and from the World Shipping Directory. In total, the survey was sent to 1163 email addresses, of which 414 were inaccurate or opted out and therefore yielded no results. 73 responded to the survey, equivalent to a response rate of 9.8 percent. Of these, five responses were removed from the survey because more than one port representative had replied to the survey, thereby duplicating data and falsifying its statistical outcome.

“As well as offering vast improvements to the lives of existing seafarers and their families, this technology would also make seafaring a more appealing career choice among younger generations”

5. As promoted by Doris Magsaysay-Ho of Magsaysay Maritime Corp, an advocate of port-wide network technology. See *Lloyd's List*, 10 & 20 August 2010.

6. BIMCO/ISF predict a shortage of 60,000 officers by 2015, equivalent to a gap between supply and demand of 15 percent.

The survey asked respondents whether their ports had (or had plans for) a port-wide wireless network, whether seafarers could access it and at what cost. Where ports lacked port-wide wireless networks the survey questioned respondents about their reasons for not having such technology. In cases where ports had port-wide wireless networks but seafarers were unable to access them, the survey investigated reasons for this lack of access.

In cases where survey responses showed ports to have wireless networks covering all or part of the port, or plans for port-wide wireless networks, further information was requested via email and/or phone, provided respondents had consented to taking part in further research. A selection of welfare organisations, shipping companies and seafarers, based on the author and ICSW's networks, was then contacted to provide further perspectives on existing port-wide wireless networks. The online survey and phone, email and face-to-face interviews were conducted solely in English, which is likely to have contributed to the relatively low rate of response to the survey.

Box i)

How does WiMAX compare to WiFi? ⁷

Although both network technology that transfer data using radio waves, WiFi and WiMAX differ in the way in which they operate. WiFi is a wired network that creates Local Area Networks (LANs) within which users can connect wirelessly, most commonly in order to access the internet (although it has other uses including closed-circuit business networking). WiFi has become widely used as an affordable means of connecting to the internet within close range of a WiFi access point. On average, WiFi typically offers a maximum range of 50m indoors and 100m outdoors. In contrast, WiMAX provides wireless reception at higher broadband levels over greater distances. Many expect WiMAX to replace broadband accessed through phone lines, cable and DSL, thereby popularising broadband access in the same way that mobile phones have transformed telecommunications. Since WiMAX uses transmitters rather than fixed lines to carry its signal, several users can connect to a transmitter even if buildings, shipping containers, trees, etc. block it. This makes WiMAX particularly useful in ports lacking fibre networks that are difficult and expensive to lay.

WiMAX is available in two spectrums of frequencies, 'fixed' and 'mobile', with mobile WiMAX – the lower frequency – having the most commercial interest to date and forming the basis of future WiMAX revisions. Fixed WiMAX is estimated to have a range of up to 50km although mobile WiMAX's range is considerably less and averages 6-7km.

WiMAX – pros

Since WiMAX, unlike WiFi, does not require a wired internet input into each antenna, it is quick to install across a large area at a low cost.

Since WiMAX, unlike WiFi, allocates users a constant allotment of broadband access, connection quality is often better than that of WiFi.

WiMAX allows multi-user connectivity.

WiMAX has an in-built Quality-of-Service mechanism that allows 'mission-critical' services to run smoothly even if there is a lack of resources.

WiMAX - cons

Since WiMAX, unlike WiFi, is an ISP-based system, it cannot be used for private networks.

High-frequency WiMAX requires a spectrum license, unlike WiFi.

Making full use of WiMAX requires specialised hardware and dedicated antennas.

Although WiMAX can deliver higher data rates (up to approximately 70Mbps) over large distances, it can still be slow in comparison to cable and satellite internet, especially as the number of users and distance from an antenna increases.

Since WiMAX and WiFi use radio waves, they can both suffer from interference from other radio-wave based systems.

Box ii)

Uses and benefits of port-wide WiFi and WiMAX⁸

Social networking and entertainment:

Communication: email, broadband video and voice calls

Video-on-demand, web-surfing

Distance learning

Productive applications:

More seamless ship-to-shore communication – easy access to company intranet and employee information, etc.

E-navigation

Online database access and information downloads (for ship repairs, maintenance, etc.)

Software upgrades

Security and surveillance



7. The content of box i) is partly informed by: Hunter, H. 'WiFi vs. WiMAX', VoIP News, San Francisco, CA: <http://www.voip-news.com/feature/wifi-vs-wimax-050806> and by www.coolgadgets.org/what-is-wimax (both last accessed March 2011).

8. Source: Kan (2010).

Research Findings

Existing and planned port-wide wireless technology

Interview and survey comments showed several port authorities to support the principle of allowing seafarers access to the internet via port-wide wireless systems, as the following comments suggest:

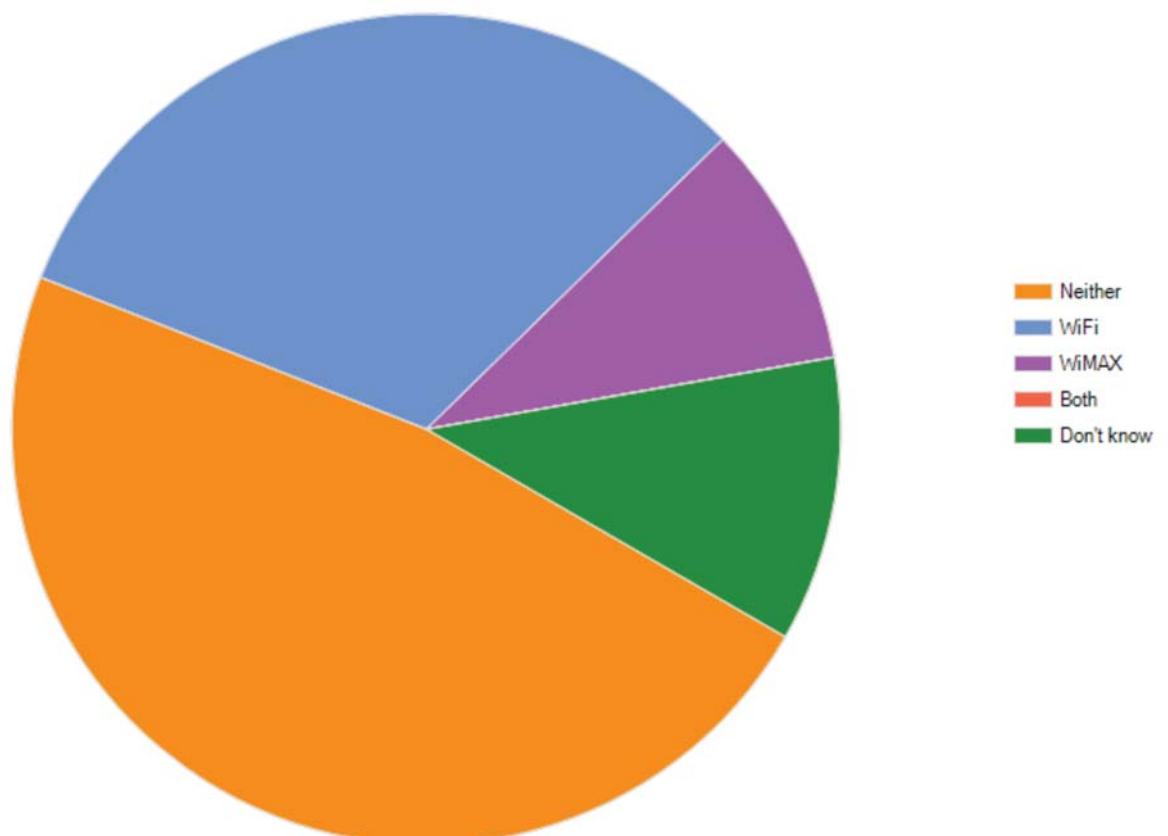
“It would be very positive for seafarers if they could have access to WiFi in our ports.” [Port authority name supplied]

“The seafarers can use the internet at the seamen’s mission. It would of course be good if they could use also the WiFi when they are onboard. We have to look at that.” [Port authority name supplied]

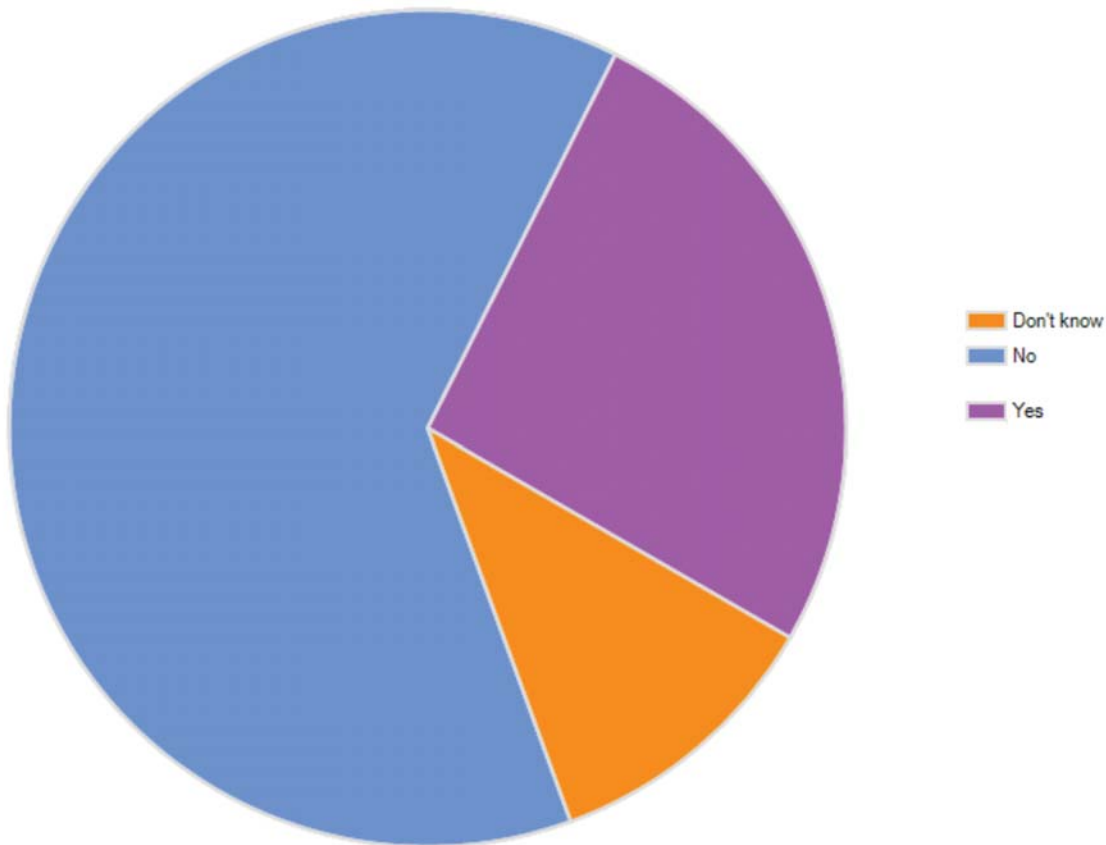
Despite these enthusiastic examples, the interview data suggests port-wide wireless networks to be rare. It seems likely that ports’ lack of familiarity with this technology discouraged survey recipients from engaging with the survey, thereby contributing to its relatively low rate of response. Of ports responding to the survey, 32 percent had port-wide WiFi and 10 percent had port-wide WiMAX. 26 percent of those ports with neither reported having plans for this technology in the future. Of those ports with port-wide wireless networks, 58 percent allowed seafarers access to the networks, of which 38 percent gave seafarers access for free. Although these figures reflect relatively low numbers of ports, they offer encouraging signs that some ports are furthering seafarers’ welfare by allowing them access to this technology. Taken in conjunction with the interview data, the survey data represented below informs this report’s discussion of the benefits and issues surrounding port-wide WiFi and WiMAX in relation to seafarer welfare. It is hoped that the report will equip the wider industry to then take this discussion forward.

Do you currently have port-wide* WiFi and/or WiMAX?

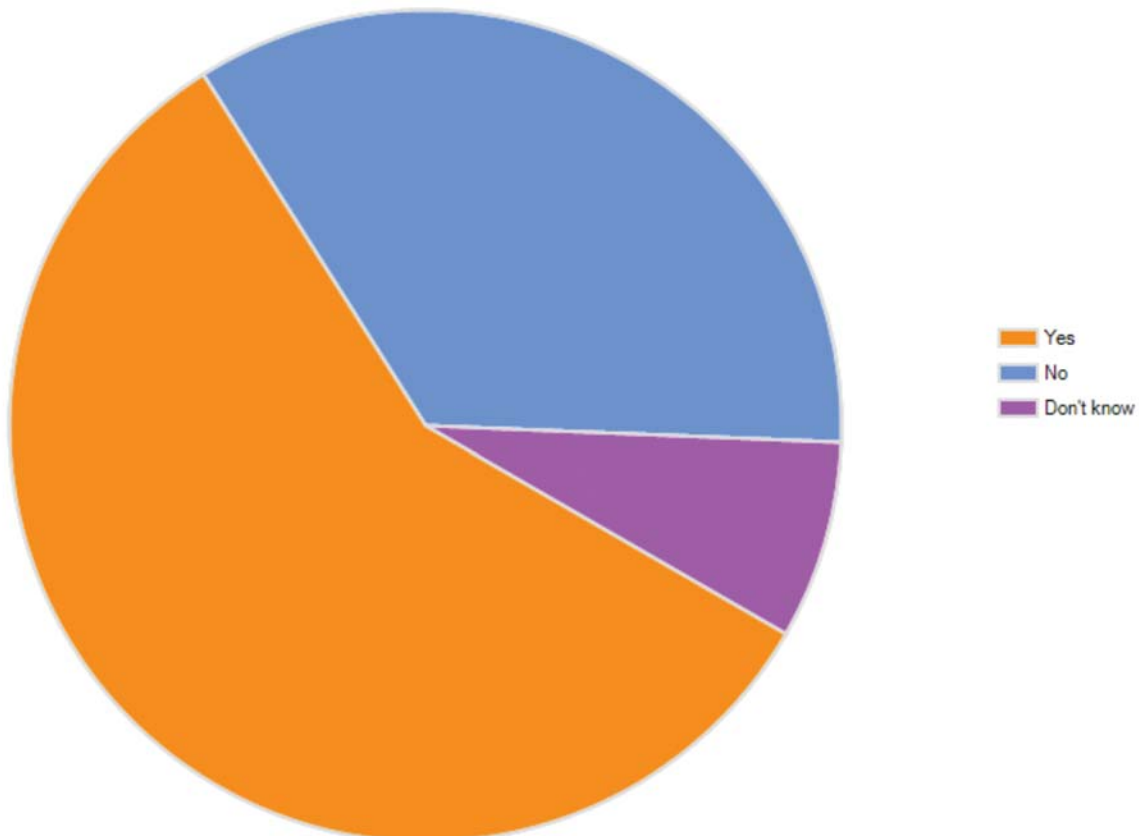
***‘port-wide’ assumes that coverage will not be the same in all parts of a port.**



Have you plans for a port-wide WiFi and/or WiMAX in the future?



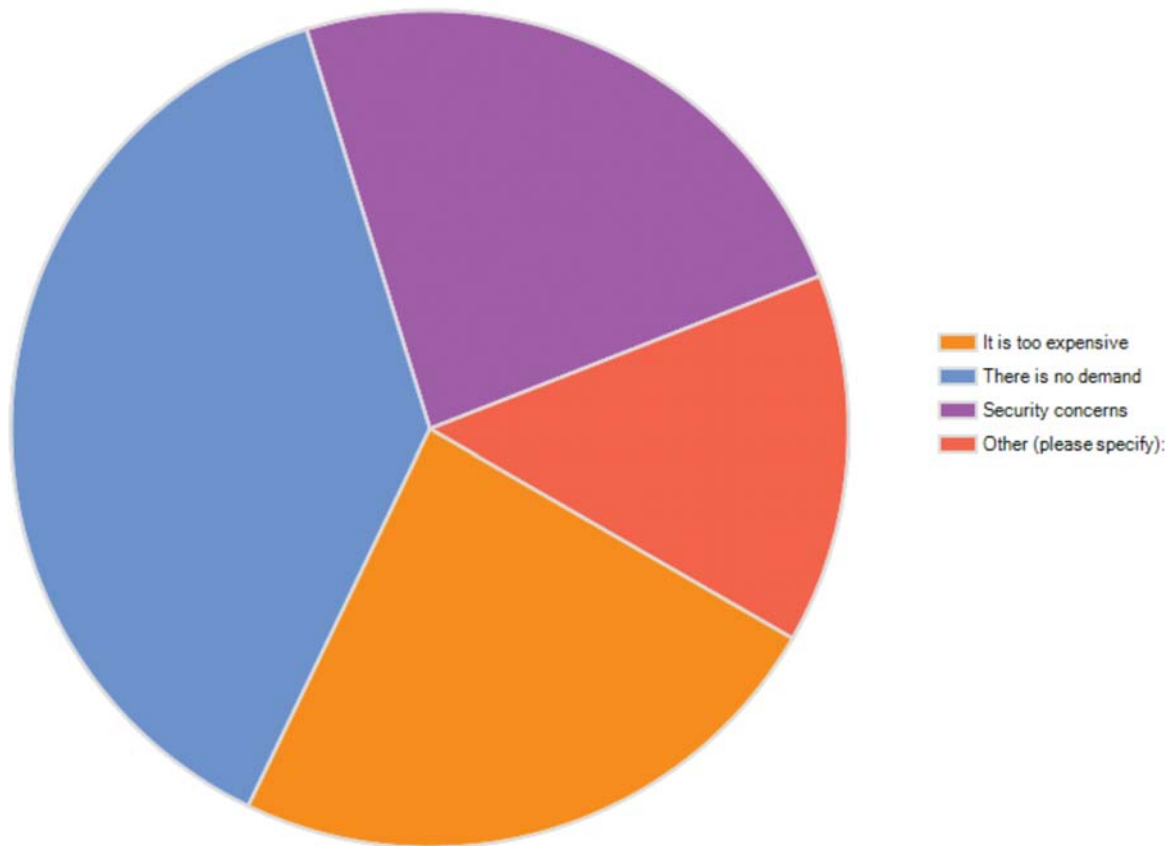
Can seafarers use the port-wide WiFi and/or WiMAX to use the internet?



Reasons for lacking port-wide wireless technology; reasons for not allowing seafarers access to port-wide wireless networks

The following diagram shows survey responses to a multiple-choice question asking for reasons why ports lack port-wide WiFi or WiMAX:

What are the main reasons? Click all that apply.



i) Demand & cost

The main reason respondents gave for not having port-wide WiFi or WiMAX was a lack of demand. 'We are not against it' said an IT manager at Associated British Ports, 'it's just never come up'. These comments relate to a second main reason respondents offered for lacking port-wide network technology: 'it is too expensive'. Several port authorities interviewed were unable to justify the cost of establishing port-wide WiFi or WiMAX since they could not see how such an initiative would deliver revenue in return. Consequently, these respondents felt a port-wide wireless network would only result if sufficient demands were made of ports. To quote from an employee at the British Port of Felixstowe:

"We have over 800 acres here; the cost of establishing a network would be colossal. We prefer to keep our frequencies for business use; providing a port-wide network for seafarers' use would have to be forced upon us. I've not heard of British ports offering such a thing".

The following comments indicate others' concerns about expense:

"We have a vast area here in Rotterdam with a number of propagation issues: buildings, large ships and mountains of coal and ore, etc. To have port-wide WiFi would be a vast investment with doubtful added value. I doubt it would bring equivalent increase in traffic; it's not a strong business case."

Lourens Visser, Head of Information Division, Port of Rotterdam, Netherlands

“We would need revenue on the back of it [port-wide WiFi/MAX]; we have to think of the bottom line. We were approached by a company in London interested in providing a network service to the public in the port but it turned out to not be worth their while, given the limited number of potential subscribers”.

IT manager, Port of Tilbury, UK

“There would be a minimal cost involved in setting it [a port-wide wireless network] up. With potentially more capital and ongoing maintenance costs (to address the management of traffic and content to non-port traffic), we would need approval of senior management, as it is definitely not driven by core business requirements.”

Mark Brennan, IS Manager, Port of Taranaki, New Zealand

Respondents’ concerns about the cost of port-wide wireless networks are justified. The Port of Rotterdam estimated that a port-wide WiFi network would cost in the region of EUR10m (although this estimate may have decreased in the two years since it was obtained by the port), while in New Zealand, the Ports of Auckland’s partial WiFi network cost NZD0.5m and port-wide WiFi in the Russian Port of Vladivostok cost USD30,000. The cost of installing and operating a port-wide wireless network varies between ports and is largely influenced by a port’s area and topography, which partially determine the extent of wiring and number of antennas required, and by the type of wireless technology involved. Inevitably, installing and operating a port-wide wireless network is a considerable investment and includes the cost of infrastructure, building permits for antennas, relevant software and maintenance costs.

However it is worth noting that port-wide wireless technology does not lack potential for generating revenue, even if it is modest in comparison to the cost of network installation. For the Port of Antwerp, Belgium, providing port-wide WiFi at no cost to all port users including seafarers (see box iv) is a marketing device that helps the port compete as a public company. As such, the port’s WiFi is expected to increase the port’s overall profits, although its success in doing so is presumably difficult to measure. In more tangible terms, the research survey suggested ten ports to be charging seafarers and possibly other users for access to their wireless networks (see below). In the Port of Vladivostok seafarers have been able to connect to the internet via port-wide WiFi operated by Port Telecom co ltd since 2005. To date, seafarers have required a log-in and password from a Port Telecom office in order to use the system (and it is therefore unclear how many seafarers are able to use the system) but the company has imminent plans for seafarers to be able to both pay for and access this information via SMS on their mobile phones. In Singapore, seafarers and other users will pay to use the port-wide WiMAX after the system’s trial year (see box v), while Pieter Bakker of the Ports of Auckland speculated that were the port to offer port-wide WiFi, it ‘would need to install software and receive payment for internet access’.

“Port-wide wireless network technology does not lack the potential for generating revenue”

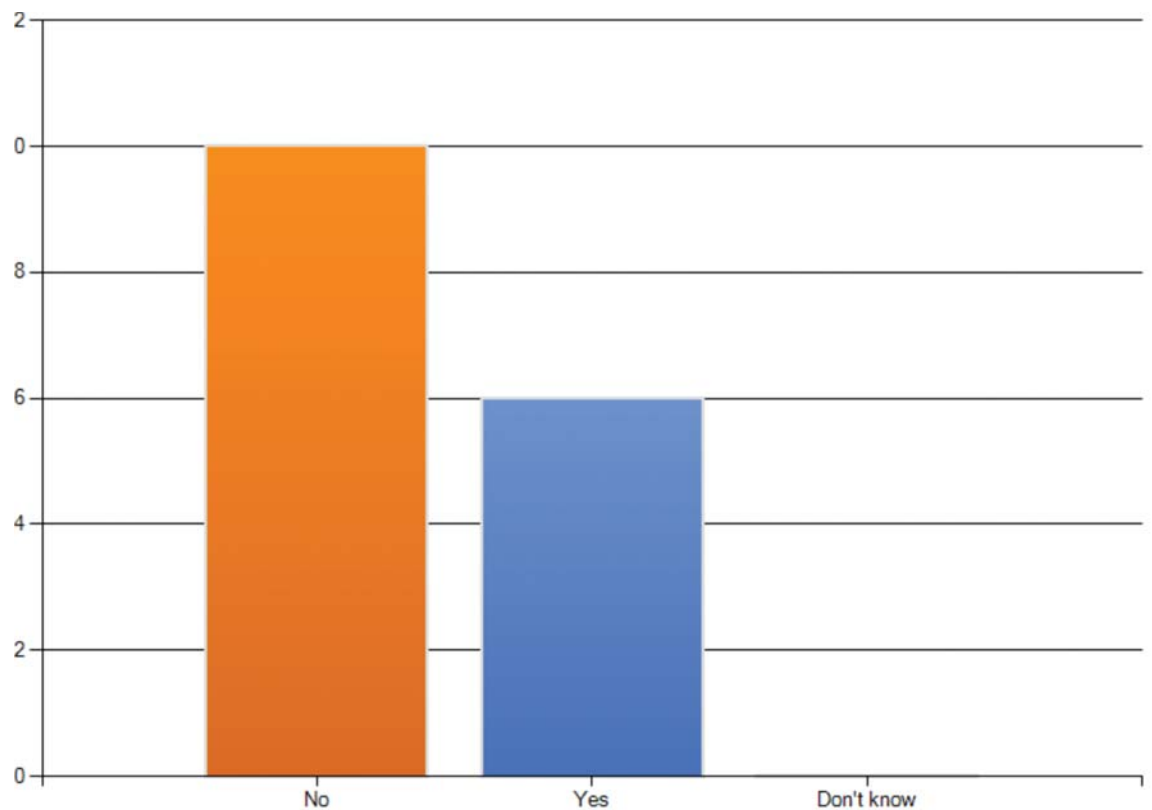
The following chart provides survey responses to the question of whether seafarers are able to access the internet free of charge via existing port-wide WiFi and WiMAX networks:

Box iii) provides comments from Cor Oudendijk of the Port of Amsterdam, Netherlands, who suggested a further way in which a port-wide wireless network can contribute to the bottom line of ports: by reducing the fees ports pay to port agents.

ii) Security concerns

The third main reason respondents cited for not providing port-wide WiFi or WiMAX was security concerns: fears that a port-wide network would compromise the secure handling of ship and port information systems. The following comments indicate respondents’ concerns:

Is it free for seafarers to use the internet?



Box iii)

WiFi and the Port of Amsterdam

From 2001-05, the Port of Amsterdam had a wireless, antenna-based WiFi system that it used exclusively for communicating with its patrol and emergency vessels. Due to signal interference from obstacles and a large numbers of WiFi users in the port and surrounding apartments causing bandwidth overloading, the port found its WiFi network unsatisfactory and switched to using a Universal Mobile Telecommunications System [3G] that used dongles, which has proved more reliable.

“We still think WiFi might be the future”

At the moment, seafarers cannot access the port’s WiFi network, ‘but we are eager to see how they can’, said the port’s Cor Oudendijk. ‘Our primary interest is facilitating more regular and frequent contact with the ship captains and enabling them to make contact with pilots and compulsory port authority information systems, although it should be possible that other seamen can make personal use of the WiFi in the near future’, he added. ‘We are also following developments in WiFi and WiMAX closely as we see the efficiencies and possibilities they offer’. At present, ships’ agents are responsible for connecting captains to port authority information systems but with port-wide WiFi, speculated Oudendijk, this middle-man role would be removed and the fees paid might be reduced accordingly.

‘This means that the port related costs will go down, which is a positive commercial aspect. We could then accommodate the needs of the crew with their private laptops. We still think WiFi might be the future.’

Cor Oudendijk, Port of Amsterdam

“The only issue keeping us from doing this [installing port-wide WiFi/MAX] is security.” [Port authority name supplied]

“It's not a good idea to have WiFi or WiMAX in port area for security reasons.”

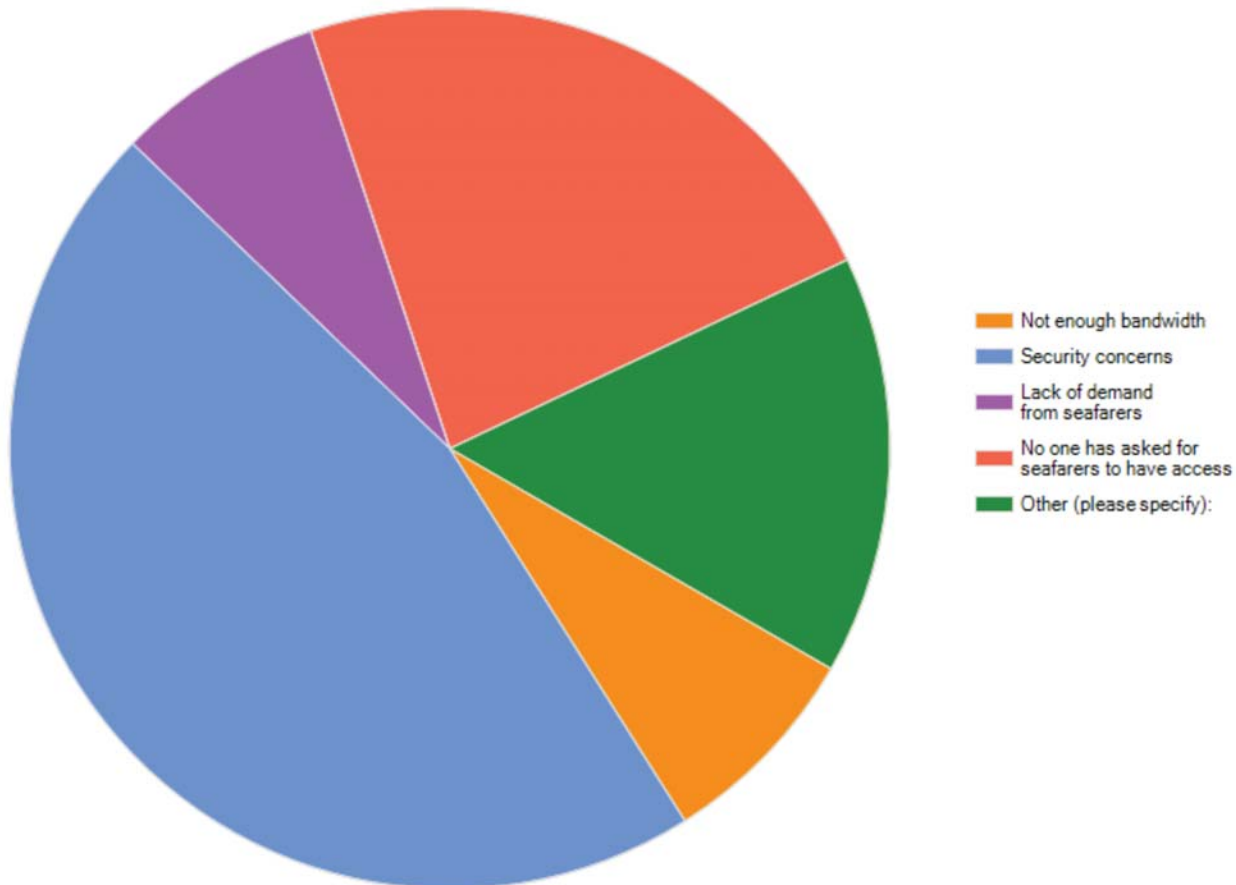
Sabah Ports, Malaysia

“Security reasons do not allow non-employee access to the network.”

Port of Tilbury, UK

Security concerns were also the most common reason for those ports with partial or port-wide wireless network to not allow seafarers access to it. The following diagram provides survey responses to a question that asked why seafarers are not able to access existing port-wide WiFi and WiMAX.

What are the main reasons? Click all that apply.



Two examples from New Zealand provide further insights:

“At this stage we have an infrastructure that can only host those security checked to be on our network. The Ports of Auckland have had port-wide WiFi for almost a decade, which is used to facilitate communication between container handling equipment (CHE) and host systems. Since the system has suffered interference from other WiFi networks from nearby apartments, as well as attacks on the system that prevent access, we do not provide access to non-port workers for fear of attack from hackers in nearby apartments wanting to use the network for free, which would compromise the core purpose of the WiFi: CHE connectivity.”

Pieter Bakker, Ports of Auckland

“We have partial WiFi coverage, for internal port company use in areas where wired infrastructure is not available. Were we to open this out to users outside of the port company, there would be potential for internet access abuse, such as downloading illegal content, which would potentially fall back on the port as the provider of service and could lead to a loss of the port's internet access.”

Mark Brennan, IS Manager, Port of Taranaki

“The Port of Antwerp provides an example of a port that has secured its wireless network”

The security concerns expressed in the comments above are twofold: concerns about the security of port and ship information systems and secondly that ports would be held responsible for any downloading of illegal material via the wireless network they provide. In most national jurisdictions if not all, WiFi providers are not responsible for any illegal downloading by its customers, although employers can be liable for illegal downloading by employees. Port authorities therefore need to be clear about the nature of their relationship to the potentially multiple categories of people using their wireless networks as well as the legislation applicable to these relationships in cases of illegal downloading.

The Port of Antwerp, where port-wide WiFi has been operating for over two years (see box iv), provides an example of a port that has secured its wireless network by taking the following measures. The success of the port at doing so implies other ports could achieve similar levels of security by taking the same or equivalent steps:

“Security is definitely a concern with WiFi networks. There are two reasons why it is not a problem in our setup. Firstly, our infrastructure allows to make ‘virtual networks’ that are not connected at all to the company network; the only ‘way out’ is directly to the internet. Even for the internet access itself, we have a completely separate connection with an independent service provider. The company internet connection is not used by the WiFi users. The second reason why security is not a problem is that for our own ships, connection to the corporate network is not only encrypted on WiFi, but also uses end-to-end IPSEC VPN tunnels (a special security protocol). During 2011 security will be enhanced even further by authenticating every individual PC that wants corporate network access.”

Johan Deleu, Port of Antwerp

Box v) provides a case study of WiMAX in the port of Singapore. Here, the WiMAX signal is provided by a telecommunications commercial partner for use by individuals, such as seafarers, and also by businesses and other organisations operating in the port area. Users are responsible for securing information via security software on individuals’ devices and security protocol such as VPN tunnels in the case of businesses, as used by the Port of Antwerp.

iii) Threat to port welfare organisations

Another concern research participants voiced about port-wide wireless technology was that it posed a threat to seafarer centres, either because the technology discourages seafarers from using centres or because centres’ welfare workers sell seafarers fewer phone cards. The following comment made by a spokesman from a New Zealand ports is illustrative of participants’ fears:

“The port fully sponsors the seaman’s mission where access to the internet is provided. Whilst we have not dismissed WiFi throughout the port, I am concerned that it would stop seafarers from venturing ashore. This would then give cause for the mission to close its doors and we already struggle for support from the seafarers”.

Jon Moore, Northport, New Zealand

Given the inevitability of technology’s continuous development, a small minority of port welfare organisations are responding to port-wide network technology not as a threat but as an opportunity to better meet the welfare needs of seafarers, particularly since limited shore leave means seafarers are often not able to make use of seafarer centre facilities in the first place. The following quotation from Kahveci’s (2010: 39) research into port-based welfare workers for seafarers supports this position:

Box iv)

WiFi in the Port of Antwerp

For over two years, the Port of Antwerp has provided free WiFi that covers the majority of its harbours and surrounding area. The port chose WiFi over WiMAX primarily because few if any consumers, including seafarers, own laptops that are WiMAX enabled since WiMAX technology is not yet widely available to consumers at an affordable price. In contrast, almost all laptops in today's market include the hardware enabling them to connect to WiFi networks without needing additional devices. Providing port-wide WiFi is a marketing tool offering value that helps the port compete as a public company.

The port asked WiFi technology companies to bid to supply the technology the WiFi network required and then field-tested the range of each company's equipment before awarding the contract to the company Fabricom with its subcontractor KMC offering with Inspiair, a niche WiFi technology from Israel. The WiFi system runs along the port's existing fibre and power cable network connecting 23 access points each with multiple directional antennas. The average cost of constructing these points, including that of obtaining the permits they require in Belgium, totalled approximately EUR5-6,000 per antenna. This was the largest cost in establishing the WiFi system.

The port's WiFi network provides varying signal strengths, a map of which is available on the port's website enabling users to see the strength of the signal in their location, along with a handbook containing information about the WiFi network.⁹ The port recommends the use of a small, mobile antenna, which can be plugged into a standard USB or Ethernet port on a computer in order to boost the signal. Such an antenna, including the power-supply unit it requires, typically cost between EUR20 and EUR100. The WiFi system can support up to an estimated 1,000 users at any one time although on average, 20 to 60 people use the system simultaneously. Anyone on land or aboard ship within range can access the network free of charge by first supplying a username and password in order to register (some web pages that can be accessed without registering are listed on the registration page). User registration is a legal requirement that signals a 'business relationship' between the port and its WiFi users, which prevents the port falling into the category of Internet Service Provider, which entails separate legal requirements.

Approximately 300 users register each month with registration remaining valid for one week. Once registered, users are able to use up to 200Mb of data per day. Users are able to access any website available through a standard web browser but are restricted to a speed of 512Kbps of data at any one time, so as not to attract too much traffic and restrict others' usage. This means that the running of applications such as Skype™ and YouTube™ is often slow and fragmented. The system's focus is on providing access to the internet rather than on also supplying webpage content.

The port's plans for the future of its WiFi network include improving coverage and speed in areas where current coverage is insufficient. The port also intends to monitor developments in WLAN [wireless Local Area Network] technology – especially 802.11n [a wireless networking standard] – to see if a complete network upgrade would be beneficial.

Johan Deleu, Port of Antwerp



“Providing port-wide WiFi is a marketing tool offering value that helps the port compete as a public company”

9. www.portofantwerp.com/portal/page/portal/POA_EN/Havenhandboek/WIFI-network. Last accessed March 2011.

“The WISEPORT network offers improved communications, operational efficiencies and new business opportunities when at sea within Singapore port waters”



Box v)

WiMAX in the Port of Singapore

In April 2008, the Maritime and Port Authority of Singapore (MPA) launched its WISEPORT trial project, which provides mobile WiMAX connectivity throughout the port and up to 15km at sea off the southern coast of Singapore, where shipping traffic is heaviest. Under a three-year trial, the MPA anticipates the project's commercial launch by the end of 2011. Singapore is the first WiMAX seaport.

The WiMAX signal is transmitted wirelessly from base stations of which there are currently six along the southern shorelines of Singapore. The WiMAX network will then cover the southern waters of Singapore. Further base stations will be established to expand the network according to demand.

The WISEPORT network offers improved communications, operational efficiencies and new business opportunities to individuals and organisations when at sea within Singapore port waters. WISEPORT enables onshore activities to be replicated offshore, including regulatory filing, electronic data exchanges and access to internet-based applications, which avoids the high costs involved in offshore communication via satellites. The network also enables live coverage of port waters for security purposes. Moreover, WISEPORT has improved the welfare of seafarers who now have a simple, low-cost means of accessing VoIP [Voice over Internet Protocol – such as Skype™ services, video conferencing and the internet.

The WISEPORT project was initiated under the Infocomm@SeaPort Programme, a joint initiative by the MPA and Infocomm Development Agency (IDA), with QMax Communications Pte Ltd (QMax) being the network service provider. WISEPORT started off as a research and development project with a vision of commercial deployment in the near future. MPA provided some of the project's initial funding while QMax is the network service provider that operates at the 2.3Ghz frequency through which the WiMAX network runs.

Seafarers aboard ship can connect to the WISEPORT network in one of three ways: 1) by plugging a USB dongle directly into an onboard computer; 2) by using an external modem attached to an onboard computer to which other computers can then connect, or 3) by placing an external antenna onto the vessel's roof attached by cable to computer(s) inside the vessel.

Yuanheng Kwek, Assistant Manager (R&D), Maritime and Port Authority of Singapore

Box vi)

WiMAX in the Port of Kandla

Welfare workers from Kandla Seafarers Welfare Association used to take USB sticks and two laptops aboard ships for seafarers' use until telecommunications company, SOMA, established a WiMAX network in the city of Kandla that included the port area, which launched in April 2010. The Kandla Seafarers Welfare Association was the first organisation to use the network. Having paid for the WiMAX equipment and router, its installation, a deposit and subscription costs – all of which totalled some INR9,300 – welfare workers were then able to take the equipment with them on ship visits. By connecting the equipment to a ship's WiFi router, mess rooms and adjoining cabins become a WiFi zone within which an estimated 20-25 seafarers can connect to the internet via their laptops using a pass code. Chacko recalled episodes he witnessed during ship visits:

“Once I saw a seafarer stand and lift his shirt to show his wife on screen as she inquired after his health.”

“During a ship visit I met a Filipino cook who hugged me and started crying. When I asked the reason he said he married, joined the ship and a few months later was blessed with a baby. Our WiMAX system meant he could see his child for the first time.”

“When my staff was winding up for the day, they saw a seafarer telling his wife and son that they had to stop talking soon. This made the son wail and so the staff stayed on aboard for two more hours so the seafarer and his son could talk to their hearts' content.”

“When visiting the 22 Filipino crew of M/V Seapace, I was touched watching the assistant steward chatting with his wife via his mini computer and then lifting the screen so he could kiss her.”

Joseph Chacko, Administrator & Treasurer, Kandla Seafarer Welfare Association

“Our WiMAX system meant he could see his child for the first time”



“Sometimes there is a problem of not enough seafarers using the telecommunication facilities in seafarers’ centres or clubs. In fact, many welfare workers emphasised that distances between ships and centres made access difficult for seafarers. Others said that not all seafarers come off ships due to lack of shore leave and seafarers preferred mobile communication facilities that could be brought aboard their vessels.”

In the port of Kandla, India, welfare workers have begun taking mobile WiMAX with them on ship visits which enables crew to connect to the internet using their laptops, as outlined in box vi).

Although Kandla is an isolated case study, Mission to Seafarers, which has seafarer centres in 119 ports around the world, is a year into their review of existing wireless technology with a view to equipping their centres with WiMAX. ‘We are very keen that seafarers unable to come ashore to the seafarer centres are still able to communicate with their families’ explained the Mission’s Ken Peters. The Mission is investigating what infrastructure and technology is required, the cost of purchasing and installing such equipment, and whether individual centres would be able to bear the costs alone. According to Peters, the Mission foresees using a log-in system that would allow access to the internet for a limited period (akin to the existing WiFi system in seafarers’ centres), thereby allowing the Mission to charge appropriately for the service in order to compensate for the expected decline in revenue from the sale of phone cards to seafarers.

The Kandla and Mission to Seafarers examples highlight some of the ways in which concerns about the threat of new technology to welfare organisations’ viability can be addressed. These, along with the main advantages of port-wide WiFi and WiMAX to the operations of welfare organisations, are listed below:

i) Shore leave. Port-wide WiFi and WiMAX address some of the problems linked to seafarers being unable to come ashore by allowing them to connect to the internet aboard ship.

ii) Adding value to ship visits. In cases where welfare workers take mobile WiMAX aboard ships, or when they provide information and/or hardware enabling seafarers to connect to wireless networks, they add value to ship visiting beyond the core service of providing pastoral care. This need is included in the recommendations arising from Kahveci’s research (2010: 49):

“Welfare workers for seafarers identified the ship visits they made as being one of the most popular services. However, there is a need to review the purpose of the ship visits and the most effective way of visiting ships. Pastoral welfare workers’ ship visits primarily for the pastoral care of seafarers do not always meet the general needs of seafarers. It is recommended that when visiting ships the broader needs (transport, communications and so on) of seafarers should also be taken into account.”

iii) Port-wide WiFi and WiMAX need not deter seafarers from coming ashore. Anecdotal evidence from welfare workers in ports with port-wide WiFi or WiMAX does not suggest this technology to be deterring seafarers from coming ashore, as noted in the earlier remarks made by the BW Shipping employee in Singapore. For example, Jorg Pfautsch of the German Seamen’s Mission in Antwerp remarked that:

“Plenty of seafarers visit the seamen’s club each day to use the club’s WiFi. Off the ship is more relaxed and they have time to phone home, surf the internet and read the news online.”

“The Kandla and Mission to Seafarers examples highlight some of the ways in which concerns about the threat of new technology to welfare organisations’ viability can be addressed”

iv) Port-wide WiFi and WiMAX need not affect welfare organisations' revenue

from the sale of phone cards. Again anecdotally, welfare workers in ports with port-wide WiFi or WiMAX did not report a decline in sales of phone cards. To quote Pfautsch of the German Seamen's Mission in Antwerp once more:

"In terms of whether the WiFi encroaches on our revenue from selling phone cards, I would say no, not yet: we have still enough phone-card customers."

Some welfare organisations working in locations with port-wide WiFi or WiMAX have been able to sell international phone cards that seafarers use in other ports, as has been the case in Kandla where the Seafarer Welfare Association has started selling these cards alongside investing in mobile WiMAX technology. In Antwerp, the German Seamen's Mission is looking to sell prepaid internet SIM cards to seafarers for use in other ports. These cards use 3G technology to provide internet access via mobile phones:

"We are receiving increasing numbers of requests from seafarers for prepaid internet SIM cards. Since the market for these cards is still small in Belgium, we are not yet able to offer a suitable product at present but we hope this will change by the end of the year. I have in mind a prepaid internet SIM card for selling in the region of USD5-7 with unlimited data download valid for 1-2 days. In time, such a card may replace phone cards." Jorg Pfautsch, German Seamen's Mission, Antwerp

In summary, unless port-wide WiFi and WiMAX become commonplace, welfare organisations look able to continue raising revenue from a range of evolving products, in order to meet the communication needs to seafarers in the ports beyond those that are WiFi or WiMAX enabled.

v) The significance of existing revenue from the sale of phone cards is questionable. In the port of Kandla, concerns that port-wide WiMAX would threaten the welfare organisation's revenue from the sale of phone cards have proved misplaced, not least because such revenue is minimal: '...there is not much revenue in selling the card as we sell at very low cost to the seafarers' said Joseph Chacko of the Kandla Seafarer Welfare Association. 'The people most affected by the WiMAX', Chacko explained, 'are the petty traders renting USB internet sticks to seafarers at prices as high as USD20 per 24 hours of use'.

"Seafarers appear to differ in the ease with which they use the networks, with some not using them at all"

vi) Port-wide WiFi and WiMAX provide their own potential for

revenue generation. By using a system in which seafarers pay for log-in details that expire after a set period of time, welfare organisations would be able to raise revenue as suggested earlier by Ken Peters of the Mission to Seafarers. Given the appeal to seafarers of being able to access the internet aboard ship, revenue raised in this way has the potential to amount to more than that currently earned from the sale of phone cards.

Seafarers' use of existing port-wide wireless networks

In ports such as Antwerp and Singapore, port-wide wireless networks offer seafarers the opportunity to communicate with home via the internet at no cost, without having to go ashore. This marks a significant improvement to seafarer welfare. It is worth noting however that seafarers appear to differ in the ease with which they use the networks, with some not using them at all. This may be the result of seafarers still becoming familiar with the systems that are still in their infancy. Jorg Pfautsch of the German Seamen's Mission in Antwerp reported that for seafarers who use computers relatively frequently, connecting is straightforward while for others it is more difficult. Welfare workers are instrumental in providing seafarers with information they need to connect to the network, along with port agents. Pfautsch also noted, as did the port, that the strength of the signal varies according to:

“...the ship’s proximity to the WiFi antennas, the seafarer’s computer hardware and his location on the ship, with the bridge deck offering the strongest signal. Often cargo handling and cranes interrupt the signal. Few seafarers are using additional antennas to boost the signal.”

In the case of Singapore, feedback was mixed regarding the extent to which seafarers are using the port’s WiMAX network. One seafarer remarked that his colleagues who had recently passed through Singapore reported that ‘all was fine’ with the network (*‘Nakichat ako sa mga upod ko passing Singapore and saying that all fine man kuno with regards sa WiMAX you are asking’*).¹⁰ In contrast, comments from welfare workers and shipping companies suggest many seafarers not to be using the WiMAX network at all. According to Christian Schmidt of the German Seamen’s Mission:

“The comments suggest seafarers to not be benefiting fully from existing port-wide WiFi and WiMAX systems for a number of reasons”

“Most of our ratings are using our centres or going ashore. Some seafarers, who come frequently to Singapore, use a [3G] dongle provided by a company called Starhub, which allows pay-per-day usage at an affordable rate. Some port agents also provide dongles for the crew, such as APL in the Brani terminal [of Singapore]. In these cases, seafarers also pay by the day and then return the dongle to the port worker.”

Leonard Harbottle of BW Shipping supported the impression that seafarers are not fully benefiting from the port’s WiMAX:

“It is my understanding that that it [the WiMAX] really only benefits vessels berthed alongside and within the container port. We also believe that there are some technical IT issues: it is not a simple a case of hooking up your laptop to a system at no cost. We also believe that there is a limit on its [the WiMAX’s] range; this is one of the reasons we are not using it. Our fleet, which primarily comprises tankers, rarely visits the port of Singapore but transits the straits on an almost daily basis and we also do a lot of bunkering, storing and crew changes within and beyond Singapore port waters. Our entire tanker fleet will have a VSAT [satellite] broadband system by the year’s end, which crew can use for free.”

Another BW employee reported similar sentiments:

“From what I gathered from a few of our seamen and port colleagues, none of our seafarers have used the WiMAX while in Singapore or at any WiFi enabled ports, due to inconvenience and a limited number of users at one time per vessel. Normally the system works using a dongle that the port agents provides free of charge to the master; one dongle per vessel. This limits the usage to one laptop, which is usually controlled by the master.”

Although anecdotal, the comments above suggest seafarers to not be benefiting fully from existing port-wide WiFi and WiMAX systems due to a number of reasons that include:

i) Issues with the range and uneven signal strength of wireless networks. This is known to be a problem with WiFi in particular. While the Port of Antwerp is eager to address these limitations as part of its improvement work, it is important that similar measures are factored into the maintenance programmes of other port-wide WiFi networks.

ii) Issues of access to the hardware required for connecting to wireless networks. There are two components to this point: firstly, seafarers without personal laptops are reliant upon limited access to ship computers to communicate with home using port-wide wireless networks. Secondly, WiMAX networks appear to require additional hardware in the form of a dongle, modem or antenna in order for seafarers to connect their computers to the internet via the WiMAX network. In Singapore, port agents are reported to provide every ship visiting the port with a dongle for connecting to the port’s WiMAX. It seems that without additional hardware, seafarers remain

10. The author is grateful to Sanley Abila of the Seafarers’ International Research Centre for passing on this feedback

reliant upon limited access to the internet via one computer controlled by the ship's captain. It is unclear to what extent other seafarers in the port are able to access the hardware necessary to connect their laptops to the WiMAX internet and where responsibility falls for providing this hardware.

The wider problem of improving seafarer access to the internet lies in the limited number of ports with port-wide wireless networks. Although such systems are not without potential for generating revenue, the cost of their installation remains a major deterrent to their proliferation. In ports with an existing degree of wireless infrastructure, such as Amsterdam (box iii), the cost of developing a network through which seafarers can use the internet is significantly lower than that of developing such a network from scratch. However doing so requires both ports' concerns about the security of their information to be addressed (using measures such as those taken by the Port of Antwerp, outlined above), as well as the willingness of ports to incorporate the needs of seafarers into their technology strategies. The spokesman from the Port of Amsterdam described this willingness in box iii), a sentiment shared by some other ports, including Rotterdam:

"We were supposed to be involved in a WiMAX trial along with parts of the emergency services and local government, but the company that was going to provide the signal no longer owned the frequency so now we are looking for a new solution. At present, we use 3G to communicate with our vessels and next year we are changing the mobile signal supplier. There are concerns about the quality of the signal from the new provider and it might be that WiMAX provides a back-up system, or indeed the primary means of communication with the potential of also allowing seafarers access to the internet. I could certainly see how WiMAX could play a marketing role for the port and how we could combine the welfare of seafarers with our own commercial interests. We charge port fees so need to give services in return."

Lourens Visser, Head of Information Division, Port of Rotterdam

The situation Visser outlined raises a further obstacle to the spread of WiMAX technology in ports: the need for a commercial partner licensed to supply the WiMAX frequency in the port area. In the Port of Kandla, welfare worker Joseph Chacko describes the need to keep abreast of new products that would enable seafarers' access to the internet aboard to continue, was the WiMAX signal no longer available:

"The engineer from the current WiMAX provider assured me that they will continue to offer WiMAX. Meanwhile I have found new technology: a new 3G router, DIR-457 by D Link, which costs around INR10,000 (which may come down in price in a few months) and a 3G card which is currently provided by BSNL and MTNL [Indian internet service providers] and will be launched by other providers all over India by December 2010. You insert this 3G card into the router and then carry the same in your pocket onto any ship. Once switched on, the device turns the mess room into a WiFi zone, allowing approximately 16 laptops to be connected to the internet."

"I could certainly see how we could combine the welfare of seafarers with our own commercial interests"

Chacko demonstrates the engagement with changing technology that is necessary for seafarers to be able to communicate with their families via the internet aboard ship. Existing and emerging technology, including WiFi, WiMAX, 3G and 4G, offer varying advantages and disadvantages. Given the differences between ports, the solutions for enabling seafarer access to the internet will vary between ports. What seems likely to assist ports reach solutions suited to their specific needs and characteristics is increased communication between ports, including welfare organisations working within them, regarding developments in technology and experiences of using these technology. This report is intended to begin such a dialogue.

Conclusions and Recommendations

“The research found a number of practical impediments to the proliferation of port-wide wireless technology and seafarers’ access to it, as well as a ‘bottom-line’ culture among ports in which the needs of seafarers, while not disregarded, were peripheral to port operations and planning”

Increasing seafarers’ access to the internet promises to both improve seafarers’ welfare and improve recruitment and retention rates across the industry facing a global shortage of skilled workers. While this research has shown port-wide wireless technology to have considerable potential to help increase seafarers’ access to the internet aboard ship, it has also highlighted a range of issues needing to be resolved in order that their potential be realised.

At present, only a minority of ports appear to have port-wide wireless networks via which seafarers can access the internet aboard ships. Most commonly, ports without this technology cited a lack of demand, followed by concerns about the costs associated with the technology, and security risks surrounding it, as the main reasons for neither having installed it nor having plans to do so in the future. In ports where a port-wide wireless network exists but seafarers are not able to access it, the main reason offered for seafarers’ lack of access was again, concerns about the security of port and ship information systems. Among other concerns that research participants expressed was a fear that port-wide wireless technology threatens the viability of seafarer centres, either because the technology discourages seafarers from using centres or because centres’ welfare workers sell seafarers fewer phone cards. Overall, the research found a number of practical impediments to the proliferation of port-wide wireless technology and seafarers’ access to it, as well as a ‘bottom-line’ culture among ports in which the needs of seafarers, while not disregarded, were peripheral to port operations and planning. Drawing on the discussion of these and other issues in the previous sections, the following recommendations offer a range of measures to help address respondents’ concerns and increase seafarers’ ability to communicate with friends and family while away from home:

i) In ports with existing port-wide wireless networks, many of respondents’ concerns have been confronted and at least partially resolved. It is recommended that communication be increased between ports in order to promote the sharing of knowledge, experiences and concerns about port-wide wireless and other technology benefiting seafarer welfare, possibly administered by an umbrella organisation such as the International Association of Ports and Harbours. This would help ports address concerns about the security of port-wide wireless networks, help them source wireless infrastructure at competitive rates, provide clarity about the law regarding ports’ liability for any illegal downloading by network users, and provide alternative solutions should a WiMAX signal provider no longer operate or when new and improved technology becomes available. Increased communication between port authorities would create a culture of ‘best practice’ among ports in relation to seafarer welfare as well as assisting them in meeting their own information and communication system needs in as efficient a way as possible.

ii) As well as increasing communications between port authorities, it is recommended that port authorities work more closely with port welfare organisations in order to better use available technology to meet both the welfare of seafarers and commercial interests of the port as a shared concern. Additionally, welfare workers appear well placed to provide seafarers with the information and assistance they require when connecting to existing port-wide wireless networks. There needs to be clarity about which organisation(s) should bear the cost of port-wide wireless networks as well as benefit from any revenue they generate.

iii) Following the examples of the Kandla Seafarer Welfare Organisation and Mission to Seafarers, welfare organisations are encouraged to see port-wide wireless networks as an opportunity to better meet the needs of seafarers rather than as a threat to seafarer centres and welfare organisations' revenue from phone-card sales. It is recommended that welfare organisations keep abreast of developments in communication products and other sources of revenue that could replace and/or add to the revenue currently generated from the sale of phone cards.

iv) Although the cost of port-wide wireless technology will be prohibitively high for some port authorities to bear, ports with an existing degree of wireless infrastructure are urged to explore expanding this infrastructure and opening it up to seafarers. It is recommended that the industry consider an incentive scheme by which ports looking to provide seafarers access to port-wide wireless networks at little or no cost might receive assistance with meeting the cost of doing so.

v) Shipping companies and their relevant membership organisations might consider advocating for increased port-wide WiFi and WiMAX, which benefit their crews and provide a cheaper means of communicating for business purposes than satellite technology.

vi) In ports with existing port-wide wireless networks, there needs to be clarity about which organisation(s) is/are responsible for ensuring seafarers have access to any hardware needed to connect to these systems. This hardware includes dongles, modems and/or antennas in the case of WiMAX, and also laptops for those seafarers without their own. Failure to do so means seafarers being reliant upon accessing the system via only one computer, to which the ship's captain determines access.

vii) It is recommended that ports with existing port-wide wireless networks continue to be alert to (or solicit) feedback about their networks' performance and carry out regular improvements and upgrades to their systems. It is also important that where seafarers are required to pay to use networks, the cost is kept low.

viii) Given the limited range of port-wide wireless networks, whether based on WiFi or WiMAX technology, it is recommended that owners and other parties continue to look at ways of improving seafarers' access to the internet beyond port waters.

“Shipping companies and their relevant membership organisations might consider advocating for increased port-wide WiFi and WiMAX, which benefit their crews and provide a cheaper means of communicating for business purposes than satellite technology”

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Glossary

3G – 3rd Generation mobile telecommunications; a generation of standards for mobile phones and mobile telecommunications services fulfilling the International Mobile Telecommunications-2000 specifications by the International Telecommunication Union.

4G – 4th Generation of mobile wireless standards; a successor to the 3G and 2G families of standards.

BIMCO – the Baltic and International Maritime Council

ICSW – International Committee on Seafarers' Welfare

ISF – International Shipping Federation

ITF – International Transport Workers' Federation

IS – Information Systems

IT – Information Technology

SMS – Short Message Service – the text communication service component of phone, web or mobile communication systems.

WiFi – Although not a technical term, the Wi-Fi Alliance has generally enforced its use to describe only a narrow range of connectivity technology including wireless local area network (WLAN) based on the IEEE 802.11 standards, device-to-device connectivity, and a range of technology that support Personal, Local and Wide Area Network connections.

WiMAX - Worldwide Interoperability for Microwave Access; a telecommunications protocol that provides fixed and mobile internet access.



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