**GSF 2007**
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**NAVIGATION SYSTEMS**

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| Charles Bibby | Servowatch Systems |
| Andy Gifford | Telemar Yachting |
| Ole Morten Husøy | Marine Technologies LLC |
| Dave Pickering | Servowatch Systems |

**Chairman— Martin Redmayne**
Hello it's getting a better morning. My coffee has worked. This is a double session, Navigation Systems followed by Broadband Satellite Communications.

To my right are three ageing navigation experts; you can tell by their hair. And one young buck who's going to talk about a brand new piece of equipment. And then we'll open up the debate. I believe one of you is going to do an introduction for Charles, is that right?

**Dave Pickering** Servowatch Systems
Thank you Martin, you just stole a bit of my thunder with the lights, but never mind. Good morning ladies and gentlemen. When I was approached by The Yacht Report to submit a paper for this year's event what we really didn't want as a company was just to demonstrate another company's view on automated solutions. So today Charles will give you an insight to some of the innovative technology that he and others have been developing to enhance navigation systems for the future. The data fusion in computer vision presentation has evolved on the back of our ship's integrated information management system developed for the RNLI in the UK. This was probably one of the first true integrated bridge systems which incorporated radar, conning, communications etc on multi-function workstations. So if Charles would like to get up and present, hopefully you can see some of this new technology and the purposes it may adapt to in the yachting industry.

**Martin**
Charles, is your hair all your own?

**Charles Bibby** Servowatch Systems
It is, yes. Hello everyone, so I'm going to talk to you about data fusion and computer vision in marine environments. I'd like to begin by trying to set the scene a little bit for the rest of the presentation. So typically you have these sorts of tasks for the crew on a boat. You've got navigation, collision avoidance, security and possibly search and rescue. And you have these general situations. And basically what you find is that there's relative difficulty in priority of the tasks based on which situation you're in. So in deep ocean, obviously everything's relatively straightforward. However as you approach land navigation becomes more challenging and so does collision avoidance and security until eventually when you get to anchorage really you're not worried about anything other than security, and that's a really serious issue. Basically what we're actually trying to do is to put together a system which will give the crew a better situational awareness of what's going on around their own ship so they can customise the system to get the information that's most relevant to the task that they're carrying out at the time. So an outline of the presentation—I'll very quickly talk about some previous work—so this was the integrated bridge system that Dave was talking about. This was a project that I helped to do for the RNLI and then I'll move on to some current work, which I'm doing at Oxford University at the moment, under a PhD programme, which is funded by Servowatch. In particular something called simultaneous localisation and mapping which sounds a bit of a mouthful but it's a

technique used by the robotics community in situations like for instance exploring Mars or going into deep mines where you haven't got GPS information etc. And then I'll talk a little bit about active cameras, PanTil cameras, and computer vision, so you're doing processing on the incoming video data, and then how you can actually fuse this information together, so how you can incorporate the visual information into the SLAM system, and I'll finish with some conclusions.

So the SIM system, the ship's information management system—we were approached by the RNLI who were designing their new class of lifeboat and this is a 15-metre boat with 2000hp in it. And it's designed to operate at full speed in all weathers. Basically the problem is that it's just physically too much for the human skeleton to take, so you can imagine as the boat leaps off one wave and crashes into the next, the shock on the human spine is incredible, so the RNLI's solution was to use floating spring damper seats so the crew members are actually strapped into their seats at all times when they're operating at full speed especially in severe weather, and the seat's very similar to a suspension system on a car. And this is where we came in, because basically the bottom line is that the crew need to be able to operate the boat without leaving their seats at any time. So this is really where the demand came for us to build an integrated bridge system because it was required, the crew can't actually move around the bridge and look at separate systems, they need to be able to operate the boat from the constraints of their seats. So to give you just a very brief introduction, I'm not going to talk too much, because I know that Ole and Andy are going to talk about integrated bridge systems. Here you can see the operator sitting in one of the seats on the lifeboat and in front of him he's got a workstation. And basically the setup on the boat is you've got 6 workstations, you've got 5 workstations in the wheelhouse, which is the permanent crew position, this is where they sit when they go out on a shout, and then you've got an upper steering position which is for approaching the casualty and for also mooring the boat up at the end of the day. And basically the way the boat would normally be operated is that the crew would stay in their seats and they would do their typical tasks but obviously things can change, so as they approach a casualty some of the crew might need to go off and assist with that casualty, so what the system then allows you to do is the other crew members can take on their roles. And it means that you've actually got 6 levels of redundancy, so you can potentially operate the boat from a single workstation. So if everyone were involved in the rescue, you could have one person sitting in one of these seats operating every single system on the boat. So here you can see, in the guy's right hand he's got a tracker ball, this is to control the workstation in front of him, and he's got the throttles for the lifeboat. And then in his left hand he would also have a joystick, which is to control the rudder. And then in front of him he's got the workstation screen where all the information is brought through so there's this chart, radar, CCTV, fire systems, engines, everything on the boat is brought through to these workstations. So it's at this point, when I finished this particular system that I started to try and think about where we could take this in the future. And something about that system is, you're only really doing sensor selection, so for instance on that boat they've got three GPSs, and if the first one fails the system will automatically pass down to the second, and then to the third. And this is fine if you've got independent sensors, but what you find is, you start to measure the same things from multiple sensors. And what I've been looking at is ways to actually fuse that information together. So the technique I used to do this is something called simultaneous localisation and mapping or SLAM. This comes from the robotics community and the idea is that if you put a vehicle or robot in an unknown environment and it's got a suite of sensors on it, those sensors will have some limited range. The system then goes about building a map of the environment around it and using that map to work out where the robot is. And you can imagine this is basically a chicken and egg type problem, because if you've got a map then it's quite easy to

work out where you are, and if you know where you are then it's quite easy to build a map. But doing the two things at the same time is difficult. So to give you an intuitive idea of what I'm talking about, imagine you've just arrived at Amsterdam central station, and maybe you walk down to the Square. You stop at the square for some lunch, possibly go to the Van Gogh museum for some culture, you might find yourself in the red light district, and then early evening possibly find yourself back at central station. And I'm sure we've all had this feeling at some point—when you end up somewhere that you've been before and it's like now I actually understand the layout of the city a lot better. And that's basically because you've been making mistakes all day about the distances and directions that you've walked. And what SLAM system can do for you, it can actually take into account that new information and then update previous estimates of where it thinks all the objects are. Which is what I've illustrated here. So I've actually got a little simulation here which just shows you a SLAM system running, so if I pause it here and explain what's going on, you see you've got the red triangle, this is the true vehicle location, you've got the green dots, these are the true object locations, and then you've got the blue triangle and the blue dots. This is where the system thinks the vehicle is, and where the objects are in the world. And the ellipses that you see round these are 95% confidence regions and what this means is that the system thinks there's a 95% chance that the true vehicle or object location lies within that ellipse. Now this is really really important because it means the system actually has some idea of the uncertainty in its estimate, so you can imagine if you start to think about things like collision avoidance, uncertainty plays a big factor and you wouldn't want to miss a potential collision because of uncertainties in your sensors. What you'll actually see as the robot comes around and sees the first object, you can see it's now updated the map and this is basically what we're talking about with the central train station example. So now it's got a much better idea of where the objects are in the world and you can see those ellipses have shrunk, which means that the system is now more certain of where everything is. The idea is to use SLAM to fuse information from different types of sensors. A question that I'm often asked is well, we have GPS and compass, so why do we need a SLAM system? And the answer is that if you just had GPS and compass a SLAM wouldn't really buy you much. Because they give you complementary information. One's giving you position, one's giving you heading. However on modern boats, once you start to take into account all these other sensors, so radar, AIS, thermal imaging, normal vision, underwater sonar, you've got all this sensor information coming in and traditionally they'll run in separate systems, even if it's in an integrated bridge system you've still essentially got—the data is separate. And what SLAM will do for you, it'll actually fuse this information together in an optimal way. It also takes into account relative positions between objects, which is quite important, and the end result is you end up with a system which gives you advanced situational awareness which would be more typical of a military style system. So now I'll show you a video of this system working. Here I've just taken some radar data—this is from Portsmouth in the UK—this was actually taken with an experimental radar which I borrowed from someone in Oxford. And now you can see the SLAM system applied to this raw radar data. Just to explain a little bit about what you're seeing—you've got the white triangle in the centre of the screen, that's your own ship position; you've got the green raw radar data that you just saw, on top of that green radar data you've then got blue ellipses—and this represents those 95% confidence regions that I was talking about. So this is where the system thinks there's a 95% chance that there's a stationary object at that location. You've also then got the guys with the yellow tails—so these are the dynamic objects. This system automatically works out what's stationary and what's dynamic. In traditional radar tracking systems you would typically have to draw a polygon about large stationary structures because the system would just treat it as a dynamic object. This system actually incorporates the stationary objects and uses it to help estimate the own ship's location and gives you a better estimate of the

velocity of the dynamic objects that you're tracking. If I let the system run for a little bit longer what I've actually done to show how powerful the system is, in this particular experiment I've left out GPS and compass information. So all I've done at the very beginning is to tell the system where the boat was at the very beginning of this run and then it's using the information from stationary objects to work out your own ship's location as well as tracking all the dynamic objects. And you can see that it's doing a good job because the stationary objects line up well with the pier structure and the hammerhead, for instance. You can see the ship that's going past at the moment obviously wasn't here on the day the data was taken but you can see the two mooring buoys.

So what I'm currently looking at is to bring camera information into this; so to do this we need what we call active cameras, or PanTil cameras. What I've done is build a prototype PanTil camera which is extremely fast, so if you were tracking a visual target on the horizon, the camera system can actually rotate 360° and fixate back on that target within 0.6 of a second. And what this means is that that camera can very quickly jump from one target to the next taking photographs of it so you can begin to build up a visual database of everything that's around your own ship. In order to be able to do this you need to be able to do target detection in the incoming video stream, so pick out interesting things, multi target tracking, if you're interested in more than one thing and also single target tracking. So this would be if the operator were particularly interested in one target, say because it could be a potential security threat. What they would actually do at that point is put the system into a single target tracking load so the system dedicates all its attention to tracking that one target and giving them as much information as possible about that target. So I've got a video here which shows you target detection and multi target tracking—you've got an incoming video stream and it's picking out things that it thinks are interesting, so it's doing classification, and then it's tracking those things. And you can see at the moment, as they leave the side of the screen the tracks are lost, and then when they come back it reinstates a new track and gives it a new ID. When this is actually fused into the SLAM system that I was talking about before, as these leave the field of view it will actually keep track of it in that SLAM system so you've got an identifier essentially with each interesting object. We then also have a single target tracking mode so imagine the PanTil's doing its very best job of tracking the target, there's still going to be some motion left in that image, so by visually tracking the target you're interested in it's possible to then get a stabilised view of that target, which is what you're seeing now. So this is inside that green box that you just saw. And I apologise a little bit for the quality of this video because this is just me with a handheld video camera—I went out to take some footage to try and test the system. If it were actually working on the PanTil system then it would be doing a better job of keeping the target in the centre of the screen. But you can see it's able to track the target as it goes through rapid zooms etc and passes behind other objects. So the overall concept is then to go back to that SLAM system and use it to fuse in visual information, so what you're now seeing is that data you saw earlier augmented with visual information. So every now and then you'll see a purple box appear—this is a stationary picture that's been taken of a stationary object; you can also see the yellow boxes so this would be the camera actually tracking and you've got a live video of the dynamic objects that you might be interested in. So in conclusion, I've shown you how SLAM can be used to fuse information from many different types of sensors, how you can augment navigation data with visual information. A big question for me is with all this information, exactly how do you show it to the operator? And I think the answer is that customisation really needs to be in there, so the operator has some way of being able to ask the system questions. For instance, I'm interested in the 5 fastest dynamic objects, I'm interested in the object that's going to come closest to my own ship, I'm interested in objects that the camera system is seeing but the radar system hasn't seen, etc. The possibilities are endless. Thank you.

**Martin**
Charles, thank you. Andy, your words of wisdom. I just realised the 3 of you reminded me of the radar dome of *Boadicea*, actually.

**Andy Gifford** Telemar Yachting
I think the biggest thing to recruitment into this industry is if a young guy like Charles looks at the people on the panel it would scare the hell out of me. Good morning, I'm Andy Gifford with Telemar Yachting, here today to debate the use of new technologies and attempts to create the platform. I'm going to try not to read too much PowerPoint because we've all been PowerPointed to death. One of the things that the IEC reported, though, and this has to go on a PowerPoint, is why is there a problem on a bridge today? What are we trying to do, and something called IEC622.88, which is the move towards task oriented presentation, which is something that Charles mentioned there. And it was reported back to the IMO in 2002 that basically we've mandated so much equipment on board that we're all confused and overloaded. The solution to this is not bigger bunks for the crew, not better crew mess but the solution for this according to IMO is that mariners need task orientated presentations. So let me just spend a few minutes here to give you an idea of where we are in the integrated bridge system world, with task oriented presentations. In the beginning there was radar and ACTIS, and from there of course we go to chart radar, we go to ACTIS with radar overlay. None of this is new but one of the words that Charles used before, was moving into the multi-function environment. And this is where we firmly are today. If anyone walked around Rotterdam and took a look at the various bridge manufacturers that are aboard there, Sperry, Raytheon, etc, they would see that the multi-function workstation is the buzzword of the day. So what we do is we take this multi-function workstation and to make it useful we fuse the data into this system and you can see here the standard things; conning, radar, charts, all available to one operator in one area. The architecture of the system is based on common software, common hardware and has a common look. And of course for a yacht it's available in a kit format so it doesn't have to have a console or a stand with it. What this allows us to do is to change our design approach. In the standard bridge, as was talked about before, there's a station for everything and so the mariner moves back and forth to control what it is he wants to control and see the data. In the information here, using the Sperry Marine Vision Master we have a multi function workstation so the mariner can stay in one spot. This is nothing exciting, this is what everybody's moving towards, what is interesting and what is exciting and it's what Ole's going to talk a little bit about now, is when we add value added services to the bridge, so we allow people off site to be able to see what's going on, and we allow various applications to come in. So now instead of just evaluations and benefits for the mariner we now have benefits to the management company as well. So here's some benefits for the system here—we have common hardware and I won't bore you to death with all the items on here, but as you can see, common hardware allows us, as the integrator, to have common drawings, common diagnostics, common spares etc. So benefits for all. The benefit of integrating into the system? The common installation commissioning, user training, human interfaces, perhaps one of the best things is that targets are shared across the system so that a target on the radar has the same number on the ACTIS, which is the same number on the AIS etc. And of course remote diagnostics have come into this. Operator training requirements are pretty easy, now we've caught up with this world somewhat and we have I-Help installed in the system so the operator can actually move around the screen and interrogate the screen and ask what's going on. One of the things I find from Captains these days is they don't want to send the crew off on a one week training course especially when he's going to leave three months down the road so they want to have some of this help built in. There's also online

help and then of course classroom and simulator. Here's a typical look at a common user interface—as you can see, on each screen the chart, radar, ACTIS, all set up the same way, the same information etc. And here's a few highlights on total watch here. The use of a multi-function workstation task oriented configurability, redundancy of all navigation, and of course console all electronics kits configurations. Thank you.

**Martin**
Andy, thank you. Ole?

**Ole Morten Husøy** Marine Technologies LLC
I'm going to go a little further than Andy and go a little into the details of what he was mentioning. Multi-function workstations, yes, that is a common term but what is hidden behind that term is often very varying from system to system. Since last time I was here I've been visiting quite a few yacht yards and I've had the opportunity to open the cabinets and see what was actually inside. And I find that the most common way of doing things is either with multi-functions, either with multi-broadcasting or video switching. An example as you see there, you will have one CPU, one computer running each application. And then as an operator your user interface will be more or less like changing a television channel. As long as it works, it looks fine, it's grand. The vulnerability of it of course is that if one of, say for example, your ACTIS stations goes down, you've lost your ACTIS throughout the entire system. And I have wondered when I see this, OK there's 4 or 5 monitors and the corresponding number of computers, you have the hardware there, to actually have a fully multi-functional system it's just a matter of doing a little bit with the architecture. If you then download all the applications you have on your vessel on each computer, the processing is done on the workstation independently of the next one, you don't have a client server situation. Which means that from one workstation you can basically run the whole vessel—you can do your automation, you can do your conning, your ACTIS, your radar, you can switch between X amount of radars. When you set up one station and this is what you want, you just multiply and clone these and you can have as many workstations as you feel is necessary for redundancy and flexibility of what you're doing. You have dual networks and you can go down and set up something like this, where all your hardwiring is just down to two I/O boards, they're 100% redundant, and the rest you do by Ethernet, very simple for the yard—we've had installations in the States of systems like this where the yard estimates that it's saving 1200-1500 hours in engineering cable pulling as a total package, compared to putting in the same amount of workstations as stand alone, meaning one conning, two radars, 2 ACTIS, because then the sensors have to be wired to each individual user of that information. One of the biggest benefits by using a system that has the correct protocols on the Ethernet is that you can use remote diagnostics all the way down to sensor level. And this is a big issue when it comes to cost. I primarily work with the offshore industry where we have ships down in West Africa, Brazil, difficult to get people in, difficult to get spare parts in. We can just call the vessel up and you can go down a 56kps line which is an ordinary mobile telephone, log in, and the people who have written the software for this vessel are then available in the head office. They can go down through the networks, through the switches and modems, down to the sensor level, do fault finding, identify it, tell the owner this is what's wrong. You want us to send you a new spare part? Yes, OK, tell us your next port of call, give us a call when you get the part on board. They get the part on board, call us back up, log back in and we can guide them on the telephone to connect the unit. As soon as it's online we can download drivers, software, and quality control that everything's up and running, just like that. And there's no issue with paying €10,000 for somebody to come on board, set a dip switch, change a card, and go back home again. And if you start looking through the different bills you're getting for service for a whole year, I

know that it adds up. I've been working 19 years on the other side of the table. So the possibility is there, the hardware is basically in place in most of your yachts, it's just a matter of doing a little bit with the architecture, you'll have a redundant and flexible system and you have a possibility to do remote diagnostics. Thank you.

**Martin**
Ole, thank you. Short and sweet.

**Ole**
For once!

**Martin**
I didn't want to say that. I've already offended you about your lovely locks.
OK, we've got 20 minutes for a bit of a discussion, I have a few questions on my table here which I want to fire at the panel, but if any hands are going up straight away please fire away. OK guys—this is a pre-submitted question from an integrator friend, client. Also to get as educational as possible—are there any new IMO regulations coming into force which may impact the superyacht market that we need to talk about?

**Andy**
If the vessel's IMO compliant then it comes in and affects the superyacht market. But basically what's happening is all the people who manufacture the products, they're building for 80% of the market, as the gentleman who spoke the first day mentioned. 80% of the clients want a good solid basic package, and that package has been built for the merchant marine shipping and so that's where it's coming from. And so the people who build those packages are building them by default to IMO code. The latest with IMO codes—next year is going to be the next radar regulations released, the following year will be ACTIS, and the following year after that will be integrated navigation system followed by integrated bridge system. If you jump online and just put in Yahoo or Google IEC62288 you'll find--

**Martin**
Can you say that slowly please

**Andy**
Are you saying I have an accent or something?

Alright. No. 62288. Then you'll be able to go online and follow wonderful groups of regulations etc, the IEC website will not send it to you unless you're a member with a password, but if you go to the US Coastguard website they have a lot of the MSCs and IMO documentation on there, and you can just download it in PDF format.

**Martin**
OK. What about models being sold in the market today that don't meet those standards. What is your advice to the market?

**Andy**
For me it's a budgetary issue and depends who's driving the market. If the client is the yacht builder, then normally they're looking for a cost-conscious budget. And it's not going to be an IMO-approved bridge. If it's a vessel that's done with the project team we normally submit two proposals, one that's an IMO approved bridge and one that's a non-approved but perhaps a little more cost-conscious, and we let them decide, and give them the benefit of the pros and cons for example the bridge that

we explained you can have service for that in 34 different countries around the world. So if service is important to you, then that might be the way to go.

**Martin**
Yes, Ole, please?

**Ole**
A comment to that, when it comes to costs. What I saw visiting these yards is that the package is already in place, I could easily go in there without any extra cost and make this an IMO bridge. It's just a matter of doing a little bit different in the architecture and how you do the information and the redundancy of it, it wouldn't cost any more. I just don't think the owners and the yards are aware that yes, I've got 4 or 5 monitors here, I could have these multi-function with 5 ACTIS which means you can go paperless, and you have the redundancy and flexibility of it, without it costing any more. They're just not aware of the possibility.

**Tork**
A question on the SLAM system by email: Is it actually an available product at this time or is it still in development?

**Charles**
Oh yes, it's still in development.

**Tork**
Timescale?

**Charles**
Depends on how hard I work. One or two years.

**Martin**
He's a student, for God's sake. At Oxford University. Say no more. Anything else out there please? Thank you very much, the reliable Simon Jackson, chart expert.

**Simon Jackson** Riviera Charts
I just thought I'd put some points that came up the week before last at an e-navigation conference in London which are germane to this. The first is that there is clearly an impetus both in Europe and in the USA to include eLoran in any GNSS solution which means we can have a lot more confidence than we could with a GPS-only provision of navigation information. The second is a line being put forward particularly by the Nautical Institute, but it's having an input to the national things for the IMO, is the proposal that for any of these electronic displays there should be some form of S mode. Because like every car having its switches in different places, every radar display, every other display, has its switches in different places. The intention of this would not be to limit manufacturers in providing all sorts of wonderful capability, whatever they think the market would build but it would mean that pilots, officers of the watch, whoever, confronting a bridge display would know that there's at least one mode where all the range rings are of the same sort, all the labels are of the same sort, latitudes and longitudes are read out in the same set up of numbers. There seems to be a certain amount of traction with that.

The last thing that came up at this conference that I don't think I've seen suggested anywhere else but I think bears consideration in this industry and generally, is a question of digital Poloris. With all these wonderful aids the idea of looking out of the window and taking bearings and things is disappearing. If one had a digital Poloris even at the basic level, where you could take a bearing and then input it to the

navigation system this seems a way ahead. You could even develop that, with the technology that's already there for head up displays so that the information you have from your electronic digital list of lights could appear alongside a bearing so you had confidence which light you were taking a bearing on. A last word of caution came up with the ACTIS—you can go to the paperless bridge—you can only go to the paperless bridge with two things. One is the ACTIS and the other is the ENC. The problem is that at the moment a significant part of the world is not charted, let alone charted to a standard that can be turned into ENCs. The paper I gave at this conference was arguing that the great and glorious world electronic navigational chart database, the WEND, which is this great notion of a Star Wars type hydrographic picture, will never exist.

**Martin**
Simon, thank you. Any comments?

**Andy**
Spoken like a true supplier of paper charts! Apart from that, I understand what you're saying there, and I'm not out to say that electronics is not a wonderful thing, because we've proved through e-navigation over and over again that normally what the electronics is showing when functioning correctly, is correct. And what happens is the human element makes a wrong decision and actually causes the incident. And as early as 1928 when the US Navy first looked at e-navigation we had a situation on the West Coast where they actually had radio signals for the first time and it told them they were 8 miles further north than they thought they were. And the Captain on board said: no, I'm here. And he turned left, and he sank 6 ships. 6 ships were sunk because he didn't believe the e-navigation. It was a human error problem.

But to address some of the things that you said there. That's why IEC62288 is out there. It's looking at having the radar buttons in the same place. When you look at the Raytheon integrated bridge system and the Sperry Marine integrated bridge system they both have a button on the top right—you click on the top right, it has a little drop down menu, and you select what you want. When you walk on the bridge and there's a lot of information there, there's one fixed button that allows you to turn the charts on or off. So they are moving in this direction. There was also, I think last year, or over the last 3 years, there's a new word which kind of goes with what Charles was talking about, the SLAM issue. It's something not called ACTIS but called EPDIS, which is electronic photo display information system. And the EU actually coughed up a couple of million euros to do a test up in Northern Europe where they actually ran ACTIS and the photo system at the same time, to see how that worked and how it would relate. So I think the e-navigation issues are pushing in there, and I think things like SLAM etc, all that stuff is definitely coming in the future.

**Ole**
I'd like to have a couple of short comments. It's coming up in legislation also that the radar and the ACTIS and the conning are supposed to have the same information in the same place. So yes, they're definitely going towards—call it the aircraft industry, where you will come on board a vessel and you will see similarities and you would have a very recognisable factor in this. This is coming in legislation. When it comes to this, looking outside to the real world, and transforming that picture into what you see on the electronics, I think we can go a little back to the session that was before this, and had to do with manning. I heard comments here that they want to step down the regulations and let people who are interested go in. I've worked up to Captain in the cruise industry; I was on the world's largest cruise ship, on the *SS Norway*, which is a big steam mama that takes 18 nautical miles to stop. So it's like driving a truck and trailer with no brakes. You just have to find some place to go. We had a new first

officer on board, he came straight from school, done all his simulator training and he wanted to turn on the northern keys of the Bahamas because he says, OK, there's a lighthouse. I said “don’t you find it a little weird that it's moving?” He was wondering a little about that, thought it might be drifting a little bit. I said you sure it's there? He says I've got a bearing there. And he looked out the window and it was there. I said you know, there's 60° between what you're pointing at and what you’ve got here. He wanted to turn. If I hadn’t been coaching him on there, we would have rounded the *SS Norway* straight into the coral reefs. And I think it's a danger that people are now going out with very little training and getting into high positions without going up that ladder that you were talking about. I can't emphasise this enough; I've been 9 years in the cruise industry and towards the end of my career there I saw what was coming out of the schools, what playstation guys had done simulator training, very little deck time, and could not put the reality into what they saw in the electronics. And what Andy said is correct. Very very rarely are the electronics wrong. It's the human factor that’s dangerous.

**Martin**
Thank you Ole. Any more questions out there please?

**Tom Henson Webb ANT**
A question really for Ole. Regarding the integrated bridge you mentioned. Now Andy showed the Sperry system, which is the state of play for most of the big boys at the moment. You mentioned a system which is using all workstations that are identical. And you mentioned type approval. Now as far as I'm aware at the moment, the limits you can go to with a type approved system is the likes of the Sperry, the Raytheon and this type of thing. How do you get around type approval on the bigger vessels where you're using systems where you're trying to run various programmes all on one platform?

**Ole**
Systems like that have been type approved since 97/98. The first one I know that got type approval is now called L-3 Valmarine, but it was called HiTech at the time. You got the highest class in Germanischer Lloyds and DNV on the Sterner vessels, they have 5 multi-function workstations, there were 29 CRTs in the beginning, now there are 23" TFTs. And they are multi-function. You can have radar, ACTIS, conning display, they also use this when they are unloading and loading on the tankers, the chief engineer or the first engineer, whoever is responsible for the cargo handling. When they're alongside, they put up the automation system on the same monitors and they do the cargo discharging while the chief officer takes two monitors and does the stability calculations. These have—within the EU and the Ajax group, there is no problem. These have been around for almost ten years with this technology, as I explained, with full type approval. They have DNV AW class on this.

**Tom**
So you're actually talking class approval rather than type approval. You’ve not got a wheelmark certificate for that equipment. It's done on a ship by ship basis, I take it?

**Ole**
Yes, the only manufacturer that has grounding avoidance system full class on the whole IDS is JRC. All the others do it case by case. You have all the wheelmarked and IEC approved equipment put into a bridge and then the classification companies come each time when you're on the sea trial and it will give the approval, that is correct. Because I think they find it a little bit tedious to make an approval, because then every single item is locked and if you do a little variation you have to do a new type approval again, so there's only JRC today that has the full AW approval.

**Martin**
Does that answer your question, Tom? Any other comments? OK. What can the panel predict to be the new systems on the future superyachts?

**Andy**
For me the new, interesting thing—like I say, the bridge is going to become a commodity. Everyone's going to be mandated to build the bridge in the same way with the same controls as Simon said, with the same things in the same area. What's going to be interesting is, how we use the value added services. As Ole said, a lot of these value added services can be done on 64K but in the next group that are coming up, we're going to be talking about Broadband Communications so we're not limited to perhaps just telemetrics, we can do a lot more. And so the interesting areas I see is things like—we talk about is our vessel green? Well how can a bridge be green? Well a bridge can be green if someone on the shoreside sits there and says look, this is the weather information, this is your route, this is your time of arrival, this is what we can do, if we send you this course and you follow this course you will use X number of gallons less fuel. So we have the ability to have a green bridge. So fuel navigation in routing from a system from shoreside is an interesting option that's coming. Only having the charts, as Simon rightly said, a lot of the charts are not there yet. Active charts, being able to have charts downloaded directly onto your system and copied onto each workstation. This is an interesting area that goes definitely in the commercial market where they don't want to pay for charts before they need to have them. Then what Ole said in his part is I think fantastic. I mean we don't have enough engineers to go on all the service calls. If we can diagnose a service call through a network system beforehand or even have the engineer on board do the change, it saves frustration all around. So I think bridge linking, and how they do things in the aircraft industry, how they help the crew. As we all say, the crew on board doesn't have enough hours in the day. If some of that can now be done by shoreside people who can assist the crew with making better decisions, by not being tired, etc, under the pressure that the crew is—I think these are the new things that are coming for the bridge. So it's not so much the actual radars and the ACTISs themselves, it's actually shoreside support through broadband, through a gateway, into the bridge.

**Ole**
A short comment about how far things have come today. We're now supplying systems that are used for example on oil rigs. They have a problem on the tower, which of course is a lot of money if they have to start drilling. But we've got, not mentioning the broadband that they normally have, a wireless video camera, the chap has a headset, a German company supplied the part—he's sitting online, he steers this chap with the video camera, he goes around and says. "OK, zoom in on that part". And then he tells the operator to do this and that. So they're doing fault identification, visually, by using a combination of pictures and talking to the rig, asking them to do different things, and they can fault find. That's big money. We can transfer this over to anything from a medical on board a yacht, if you have someone seriously injured, use a video camera, send it on your broadband link, you compress it, decompress it on the other side, you can have a medic sitting there, and he's got a live picture and he can sit and talk you through how to do first aid and help him along. Engines—I mean there's unlimited possibilities. The technology is there.

**Martin**
OK. Any questions before I wrap this up? Gentlemen, thank you very much indeed. Can you navigate your way off the stage?