Good afternoon.

Alarms are a very simple way of communicating with the user; you close a contact which puts on a light and makes a noise. This simplicity and dependability has led to their extensive use in a range of applications.

I have helped to design the user interface for complex safety critical systems for a long time in a range of industries, and alarms have been an important thread all that time. These days, they are nearly all computerised – generally badly. As such, they are a good way of understanding modern work with computer systems in critical applications.

My recent work has been with Lloyd’s Register, which has taken the view that alarm system design and management is an important part of the safe operation of modern ships. This is certainly true, and I will touch on what we are doing about it later.

(Next slide)

Abstract

Alarm indicators are a very simple and important user interface for many control tasks, and are known to be problematic. Alarms on ships have increased in number and importance. Recent incidents such as Savannah Express, Aquitaine and others have identified a number of important issues in the way that alarm systems support safe and effective work. The state of alarm systems onboard is inconsistent across systems, which also raises a number of issues. A change in philosophy to ‘alerts’ has been proposed recently to enable better prioritisation of messages to users. An ideal implementation of alerts to support current technology and organisation could be envisaged. However, it is likely that only a very few implementations approaching this ideal will be built in the near future. In the longer term, both the technology and the organisation will have changed again, and the role and implementation of alerts may need further examination to support future operations. The prospects of better support to onboard team working, and distributed team working need to be considered, together with the use of new paradigms such as ambient interfaces.

This paper briefly describes the current state of alarm systems, new developments and future prospects in terms of alarms as an important aid to onboard working.
Today, I’d like to tell you a little bit about working with modern alarms, where alarms come from and how that is changing, the problems that occur when working with alarms, and what we might do about these problems.

The caution:

Somebody else’s problems are always interesting, and in the hope of providing entertainment I have picked out some shipping incidents. It is a shame that shipping gets a generally poor press, because it is actually astonishingly successful, and I must emphasise that the incidents I have picked out are not representative of the industry, although they are illustrative of how things go wrong when they do.

So, next, I’d like to define the current terminology for alarms so we know what we are talking about. The terminology is recent, and represents a distinct opportunity for better categorisation of these very simple messages to the operator.
Alert –

We are moving away from talking about alarms to talking about alerts. This may not sound much but it is a big conceptual step forward.

Alert is a term that is used in the aviation sector and has recently gained acceptance for shipping.

It is a message or annunciator (alarm, warning or indication) displayed visually and/or audibly to the crew intended to draw their attention to the existence of an abnormality, fault or condition and to identify it.
Alarm - Alert associated with a condition requiring immediate recognition and immediate human response to prevent human injury or damage to the ship, its essential machinery or the environment.

Next slide:

(22 March 2006 64,054 gt. Panama flag container M/V Hyundai Fortune (built 1996) suffered major explosion & massive fire in aft on-deck container stacks. Entire after end of ship completely involved in fire. Crew has abandoned ship, picked up by Dutch Navy frigate HNLMS De Zeven Provincien<< Webfeature. M/V Hyundai Fortune in position 12-39N 047-22E (Gulf of Aden). Numerous (60 to 90) containers blown over the side, forming a debris field about 5 miles long -- many of which are drifting around the vessel. "Photo analysis shows what appears to be a significant section of hull plating blown out above the waterline on the port side, under the house and aft deck. If this is accurate, might have been an explosion inside a tank, as opposed to an explosion in a container."

Captain Wade Armstrong, Master, USNS Rappahannock (T-AO 204) On Station in the Gulf of Aden)
Warning

Warning - Alert associated with a condition requiring immediate awareness and subsequent human response.

Indication - Alert associated with a condition requiring awareness and which may require subsequent human response.

Condition - The state of the ship, its personnel or equipment, with an associated level of hazard.

Status - Indication of a parameter associated with equipment control and functionality.

Next slide.

(M/V Republica di Genoa capsized during loading March 8 in Belgian port city Antwerp. No injuries were reported. The cause of the capsizing of M/V Republica di Genoa, a roll on/roll off vessel of the London-based Grimaldi Lines, was not immediately clear. Port of Antwerp Captain Jan Persi said the 215-meter-long (705-foot-long) vessel slowly rolled onto her starboard side in a dead end dock early in the morning. He said the ship began taking on water and that the Capt. ordered his crew to evacuate. The white & yellow vessel lay resting on its side, part of her hull above the waterline in the dock. Karel Verbeke, head of Grimaldi Belgium said about 300 containers & cars were on board when the ship rolled over. Shipping in & out of the Verrebroek dock was halted.

Container Weights & Overall Vessel Balance Are Critical To Ship Stability. We Don't Know About Antwerp, But Containers Are Not Actually Weighed At All World Terminals. They Just Read The Bill of Lading. (?)

According to a local newspaper with "good information" the cause investigation should look into the recent of bunkering of the vessel. However, another source talks about technical problems with the helling (?surely heeling) & pump systems of M/V Republica di Genoa." )
The pioneering ergonomist Jo Huddleston coined the phrase “the angry fruit salad” to describe alarms.

Traditionally, alarms are indicated in flashing red, warnings in flashing yellow, and other indications are in a range of bright colours.

Alarm panels have moved from traditional indicators with light bulbs to computer screens of indications, and alarm indications that can appear as part of integrated display formats.
In cognitive terms, the function of an alarm is to alert the unaware operator of the approach of limiting conditions by triggering automatic re-allocation of attentional resources. As Bob Taylor of the UK Ministry of Defence has pointed out, the problem is to design warning systems that switch attention without disrupting the primary task. If human information processing resources had been sufficient to maintain situation awareness, warning systems and other forms of automation would not have been necessary.

This brings us to an important point; if the alarm is about something that is so darn important, the operator should have been in a position to give the parameter sufficient attention not to need the alarm. It could be argued then, that many alarms are, by their very existence, the result of inadequate overview displays.

A recent incident investigation ruled that the presence of an alarm did not relieve the operator of the responsibility of monitoring the parameter, so a “surprise surprise” approach to alarms is inappropriate.

Bob Taylor words to go with Larssen cartoon: Warnings The function of warnings is to alert the unaware operator of the approach of limiting conditions by triggering automatic re-allocation of attentional resources, i.e. the machine monitoring the pilot. Attention shifts can occur automatically to certain salient stimuli which have reflexive control over attention allocation, as well as under internally motivated control. The problem is to design warning systems that switch attention without disrupting the primary task (Fig. 4). If human information processing resources had been sufficient to maintain situation awareness, warning systems and other forms of automation would not have been necessary.
Shipping has become very safe. There has been a growth in ways of making sure of this. The provision of defined alarms from type approved equipment is an important part of a protective barrier to maintain the safety of the ship, its crew and the cargo. Alarms form part of the safety assurance provided by Regulation, Classification and Safety Management.

Personally, I thin that the crude simplicity and sheer noisiness of alarms forms part of their attraction in a safety assurance context; they are hard to miss and should be easy to understand and act on. Failure of the crew to respond seems a legitimate ground for censure.

However, we know (I think from the Braer incident) that tired watchkeepers can sleep through even very loud alarms.

The assurance shown here is not without value. However, on its own it is a static and incomplete view of a dynamic system with multiple information flows. The implementation leaves much to be desired – this is true in many sectors other than shipping.
Where do alarming indications come from?

TOP Tankers Inc.

Other ships, rocks, buoys

Other people

Ship systems (design)

Loud distracting messages come from an increasing number of sources. These fail to meet the needs of safe and effective operation in different ways, and will require different resolutions.

Other ships can set off alarms via a range of sensors, such as collision alarms from the radar. False alarms and distracting alarms are a real problem here.

Other people may assume that the people on the ship have nothing better to do than answer faxes, emails and mobile phone calls.

The systems on board are fitted with alarms; some of these are statutory requirements – fire alarms would be a good example. Others are specified by the manufacturers of the equipment in order to protect the equipment or system integrity.
Ships have too many alarms now, and are getting more and more.

External alarms are being generated from more traffic, and more types of sensor – the relatively recent introduction of the Global Maritime Distress and Safety System and the Automatic Identification System have added dramatically to the number of spurious and distracting alarms.

Communication with the shore has improved dramatically in technical terms in the last few years; this has turned the whole industry into a 24/7 operation, but the information flow with the (ever smaller) crew has not been managed in terms of distraction from the primary task.

Ship systems are becoming dramatically more complex and integrated with ever increasing numbers of alarms. The increased use of commercial equipment means that many of these systems have not been designed by people who understand the ways of the sea or the sea-going life.

Rather than give a lecture on good practice and its shortfalls, I will highlight a few points from a few incidents. Each of these incidents is complex, and I am aware that I am cherry picking points out of context.
The Herald of Free Enterprise sailed with her bow doors open and capsized on March 6, 1987, killing 193 passengers and crew. Among the many factors that led to this was a possible need for remote indications of bow door status.

In 1999 the Norwegian high speed ferry Sleipner lost orientation for some 20 seconds while going in full speed along her regular route between Stavanger and Bergen. The result was that she grounded on a rock and 16 persons lost their lives. A heading change of 30 degrees went unnoticed, while both operators were fiddling with the radar.

Royal Majesty is perhaps the best known alarm problem; the ship went from navigation by GPS to dead reckoning when someone pulled out the antenna cable. This triggered a series of aural chirps similar to those of a wristwatch alarm (the total duration of the series is 1 second) and a display of SOL (solution) 22 and DR on a liquid crystal display; the display measures 3 inches high by 3.5 inches wide.

Postaccident examination revealed that the fathometer alarm was set at 0 meters. According to the navigator, the alarm was normally set at 0 when the vessel was in port or in a harbor to prevent the alarm from being continuously

Incidents such as these tend to lead for calls for more alarms; individually there might sometimes be some merit in the calls but collectively, the approach is bound to fail.

Next slide
Alarms and incidents 2

Some ships carry hazardous chemicals and need to have some process plant onboard. The Coral Acropora had a near miss in 2004 with vinyl chloride monomer; alarms and their overrides did not provide the situation awareness or protection expected.

The Berit ran aground in 2006 – notoriously after the 2/O was distracted for over 40 minutes – rumour has it he was texting on his mobile phone all this time.

Alarms only work if they have been set and are looked after; poor management meant they did not perform their function. The watch alarm panel is highlighted; this may have been disengaged.

Next slide

Coral Acropora. The cargo surveyor began filling his sample cylinder from the designated tank sampling point. After a few minutes, the cargo alarm klaxon sounded on deck. The chief officer walked around the tank dome and, using a local control, stopped the klaxon from sounding. He assumed the alarm indicated that the cargo pump had tripped, but he could not be certain without going to the cargo office. A few moments later, the klaxon sounded again. The chief officer then noticed a large cloud of white vapour advancing down the deck towards him. He quickly ran aft, taking hold of the cargo surveyor and pulling him with him, hitting the emergency shutdown (ESD) button as he passed by. They managed to reach the shelter provided by the accommodation before the cloud overtook them.

Berit Watch Alarm control panel highlighted. The grounding of Berit occurred because the 2/O failed to make an alteration of course in accordance with the navigational plan. The 2/O was distracted for over 40 minutes prior to the grounding, missing the required waypoint. The investigation has been unable to prove or disprove the reported cause of the distraction and there may be other explanations why the 2/O failed to monitor the ship’s progress adequately. The OOW failing asleep was considered, but was thought improbable given that fatigue was unlikely with his watch routine, and with the lack of comfortable chairs on the bridge. Steps had been taken on Berit to ensure an OOW stayed alert by the provision of a watch alarm. However, there is some evidence that the key to activate the system was not always removed, therefore permitting those on the bridge to disengage it. Berit was also fitted with an electronic charting system (ECS). In this case, too great a reliance was placed on the basic information provided by the ECS, and the full functionality of the system was not employed. With no depth or no go areas, cross track error or waypoint alarms set on the ECS, the system was essentially passive, requiring no interaction with the OOW. The paper charts did not have regular positions marked, even though they were the primary means of navigation onboard. Fixes were recorded in the log, but these positions were only derived from the GPS. Good navigational practice requires that positions are cross-checked by independent sources. In this accident, with little demanded of the OOW, he became easily distracted and missed the required alteration of course.
Savannah Express is a big ship; she hit the linkspan at Southampton Docks in 2005. The engine has no camshaft; it is under software control. The alarm log listing for the 17 seconds up to the failure is shown. Individually and collectively, these alarms did not provide the crew with the diagnostic information they needed.

Next slide.

Savannah Express 1. Alarms when arriving at the Nab Tower All times UTC + 1

07:29:15 – Lub oil pressure The relevant guidance information provided for this alarm is as follows: Cause: Most probably a failure in the cabling to the sensor or a failure of the sensor, or missing sensor power supply ….. Effect: Reduced supervision quality; one sensor out of three is unavailable. Although this information gives the correct direction in which to begin fault finding, it also effectively supports the advice given to the chief engineer by the MBD service engineer in Singapore, and does not indicate that an engine shutdown could occur as a result of sensor failure. The chief engineer was aware that three suction pressure sensors had already failed, which had not caused any operating problems. As such, this information provided by the alarm system was probably not considered to be relevant for locating the cause of the shutdown. It should be noted that the alarm information only makes reference to two sensors, and not four. It is probable that this information page was not updated to reflect the requirements of the larger 12K98ME engine.

07:29:21 – Inlet pump 4 and pressure deviation The relevant guidance information provided for this alarm is as follows: Effect: no effect As with the previous alarm, the engineers were aware of the three pre-existing failed suction pressure sensors which had no detrimental effect on the operation of the system. However, this alarm does specify pump number four, which had the remaining working pressure sensor and should have prompted the engineers to consider the possibility of this sensor failure being the cause of the shutdown. The limited guidance information indicates that this alarm will not cause any problems, and clearly does not indicate that an engine shutdown could be imminent.

07:29:22 – Pump inlet pressure low The relevant guidance information provided for this alarm is as follows: Effect: If lub oil pressure further decreases, a non-cancellable shutdown could be carried out to protect engine driven pumps from cavitation. This alarm does provide the indication that a shutdown could occur as a result of low oil pressure. Unfortunately, the guidance appears not to have been acted upon, especially when taking the previous alarms into account. This alarm occurred about 7 seconds after the initial warning that there was a fault on the hydraulic system.

07:29:23 – Shutdown This was the signal to each of the twelve CCUs to stop fuel injection as a result of low hydraulic control pressure.

07:29:27 – Hydraulic pressure deviation from set point ECU- B/AThe relevant guidance information provided for this alarm is as follows: Cause: ….. Another possibility is that it could be caused by either one or more malfunctioning engine driven pumps …….. Effect: If hydraulic pressure is lower than ECS computerised setpoint and continues to decrease, hydraulic pumps cannot deliver enough oil to maintain pressure. If pressure drops below 145 – 150 bar, ECS likely to carry out a shutdown. Suggested action: Check hydraulic pressure on MOP. This guidance clearly states that a shutdown could occur if the pressure drops below a certain point. However, a shutdown had already started by this stage of the alarm list.
We have been asked to set out recommendations for research and practical application. I will use these headings to indicate some ways in which we can make progress.
Recommendations - Research

- Condition Based Operation
- Social system information flow
- Commercial, contractual perceptions
- Ambient, socially aware, displays
- Overview displays inc. ecological
- Display management e.g. ‘scalable fabric’, frame
- Better audio (e.g. spatial modulation, 3D)

This is a long list, and each item could be a whole talk, but I will try to give enough information to indicate the nature of the research required.

Condition based operation is a move to integrate online and offline information systems so as to provide the various stakeholders in a system with the information they need to make effective decisions. Progress has been made on the technical front; more is needed, but critically for this audience, work needs to be done on how information flows between the various stakeholders, and what information they really need.

Many of the problems with alarms are brought about by legal, commercial and contractual practices, and the perception of risk and liability; there is some very interesting social science here to understand how such behaviour might be changed.

Ambient displays offer the potential to do better than the angry fruit salad; shown is a Canadian research project called the AuraOrb which takes an ambient approach and uses turn taking in an interesting way; there is real potential in this area of research.

Better ways of giving a full presentation of the situation that is compatible with human attention is axiomatic to progress.

There are new and better ways of managing display space that offer real potential.

Audio information could be improved more than a little, and there is some interesting research on directionality.
In terms of current practical application, there is a great deal that can be done more or less now very affordably.

Reducing messages from shore is a matter of putting some corporate information management in place; this is not difficult technically or procedurally, but it does require the will to do it.

Alarms are seen as having a single destination by and large; however, they arrive in a specific social context, and it is not hard to see how more can be done (beyond alarm transfer systems) to have alarms support teamwork, including Bridge Resource Management, but not restricted to it.

For most alarms, there is established good practice that could be followed to good effect; shown here are guides to aviation, nuclear and process control sectors, and guidance from Lloyd’s Register for alarms on ships. Just do it.
Thank you for your attention. If I may, I should like to mention the maritime ergonomics special interest group of the ergonomics society, which is aimed at improving the use of ergonomics in the maritime sector.
Aquitaine

Java Sea mair215

Intermittent failure xxx

The crew’s lack of attentiveness to the routine checking of the critical oil-fired thermal heater alarms indicates a general lack of system awareness, and without manuals covering operation, maintenance and emergency procedures for the thermal oil system, they were not able to adequately familiarise themselves with the system.
Aratere near grounding

the Chief Officer made a comment to the Master that the vessel was moving to starboard of the programmed Ants Track. Very shortly after this, the Chief Officer acknowledged an alarm from the IBS. At the time of his interview, the Chief Officer could not recall which sensor system had alarmed. However, he did not think it was the DGPS alarm sensor system, which had been installed following several previous losses of the DGPS position fixing signal on earlier passages. The Master, who confirmed hearing the Chief Officer’s observation and the alarm, assumed it was the 30-second alarm warning the bridge team of the vessel’s approach to the next WOP (Position WOP).

The alarm system on Aratere’s IBS alerted the navigation officer both visually and aurally to sensor information failures or XTE errors. The alarm system, however, fell short in that it did not warn a navigation officer that the IBS had changed its programmed steering mode, by way of an aural alarm. It simply indicated visually on the conning information display unit (Figure 6), that the IBS was in a different mode of operation. Nor did it warn the officer that the vessel was on a different track to that already programmed into the system. In short, there was nothing to warn a watch-keeper that human intervention was required for Aratere to alter course – in this incident, to prevent a grounding. In an attempt to ameliorate this shortfall, Interislander had installed an additional alarm system to alert the watch-keeping officer, by audible means, that the GPS link was suspect and therefore positions might be unreliable (this is one of the more common reasons for a steering mode change). However, in this incident, neither the Master nor the Chief Officer thought it was the GPS alarm that had sounded.

Q. Is it possible that the Master and Navigation Officer missed a navigational sensor alarm and the vessel moved into a different steering mode, such as from automatic track keeping mode to course keeping mode? Alternatively, could the IBS move from one steering mode to another without the watch-keeping officer knowing? It was reported that the vessel was in automatic track keeping mode at the time of the incident. The navigation officer(s) can only miss such alarms if the alarm buzzer is defective and the blinking alarm indication on the conning display screen is ignored or not noticed. A change in steering mode is possible when, for example, a sensor fails (GPS, speed log, etc.). In such case, audible and visible alarms are given. The autopilot can change its mode automatically, but this happens only following an error causing a navigational sensor alarm (including audible 4 signals). The steering mode can also be changed manually on the AP2000 operating panel by the navigation officer. There is no extra alarm after a sensor alarm has sounded when the autopilot changes mode. Alarms are only given in relation to the reasons that may cause it to change mode namely, what sensor has failed.

Q. Could an alarm be programmed into the IBS to alert the navigation officer when passing a WOP? Software wise such alarms could be implemented but we will do this only if required by IMO/SOLAS regulations.

Q. The bridge team referred to the cross track error as being the distance off the programmed track. Is any error displayed on the conning information display unit that the vessel has gone past the WOP, in terms of distance? No. Software wise such alarms could be implemented but we will do this only if required by IMO/SOLAS regulations.
Alarms and incidents 6

Red Falcon

Two days before the accident, a loose securing bolt was discovered on the charge air cooler of the aft engine, and further loose bolts were subsequently found. The company’s engineering superintendent made the decision that it was safe to continue to run the engine, on reduced power as necessary, until it was operationally convenient to undertake a permanent repair. However, once clear of the Cowes fairway, the master elected to desynchronise the Voith Schneider units, which meant that both units were operating but had to be controlled independently. The master desynchronised the Voith Schneider units from the forward centre control panel and silenced the audible alarm, which had sounded to indicate the units were now desynchronised. The master silenced this alarm by turning a key which was permanently located on the panel.

This decision enabled the forward engine to be run at full power while the aft engine could be run at reduced power as per the engineer’s requirements. In this configuration, the master expected to be able to make the maximum speed for the passage and hopefully to make up some of the lost time. An AB was then placed on the wheel and the master advised him that, with one of the engines operating on reduced power, more helm than normal may be needed to keep the vessel on course. The master, as was usual, remained on the bridge throughout the passage. The chief officer came to the bridge as the vessel entered Southampton Water, and he took over the steering from the AB. He also took over the conduct of the vessel at that point. He was not informed that the Voith units were desynchronised. As the vessel approached Town Quay, the chief officer began to reduce speed by adjusting the pitch setting on, what he believed to be, both of the Voith units. In fact he was only adjusting the pitch of the aft unit, and failed to notice that the forward unit was still operating at full power. Thus, although the vessel’s speed reduced slightly, she continued to approach the linkspan at a much higher speed than usual.

With Red Falcon very close to the linkspan, the chief officer informed the master that the speed was not reducing as expected, whereupon the master suddenly remembered that the propulsion units were desynchronised. The master quickly put the units back into synchronisation, but not before contact with the linkspan occurred. After the impact, the master took over the conduct of the vessel and positioned her to permit access by the emergency services. The MAIB investigation has identified a number of key safety issues, including: • The unnecessary risks associated with operating with the propulsion units desynchronised; • Inadequate indication for operating in the desynchronised mode; • Ineffective bridge handover procedures; • The need for a safe speed of approach to Town Quay.
AuraOrb is connected to EyeReason (Shell et al., 2004), a personal communications monitor that keeps track of all interactions between its owner and her computing devices. User attention for a focus device is tracked by having all devices within the user’s scope report the status of their embedded eye contact sensor. Alternatively, devices may report engagement upon detection of user presence or input. Because EyeReason knows which devices the user owns, it can determine the identity of an onlooker simply by correlating patterns of eye contact across the devices. When a user is logged into his workstation, this is reported to his EyeReason server. When the user looks at this workstation’s display, this is also reported to his EyeReason server. When a user’s AuraOrb subsequently reports eye contact, EyeReason checks to verify whether eye contact was simultaneously lost with owner’s workstation display, thus establishing access rights to the information displayed on the orb. The following scenario illustrates AuraOrb’s functionality and progressive notification levels: ambient, semi-foreground and foreground. AuraOrb is connected to EyeReason (Shell et al., 2004), a personal communications monitor that keeps track of all interactions between its owner and her computing devices. User attention for a focus device is tracked by having all devices within the user’s scope report the status of their embedded eye contact sensor. Alternatively, devices may report engagement upon detection of user presence or input. Because EyeReason knows which devices the user owns, it can determine the identity of an onlooker simply by correlating patterns of eye contact across the devices. When a user is logged into his workstation, this is reported to his EyeReason server. When the user looks at this workstation’s display, this is also reported to his EyeReason server. When a user’s AuraOrb subsequently reports eye contact, EyeReason checks to verify whether eye contact was simultaneously lost with owner’s workstation display, thus establishing access rights to the information displayed on the orb. The following scenario illustrates AuraOrb’s functionality and progressive notification levels: ambient, semi-foreground and foreground.
The Ambient Concept

pull | ambient | push

Time consuming interaction | Screenless integration | Instantaneous integration

Products
Technology
Computing
Commerce
My Devices
Information Cognition

**pull**
Pull actions engage specific, user's focused attention.

**ambient**
Ambient objects present information without demanding user's attention.

**push**
Push objects interrupt a user and demand their full attention.

Key:
- Blue: stimulus
- Green: attention
Approaches to safety management

**Central Supervision**
"Safety despite human error"
Feed-forward control
Minimising uncertainty
Procedures, planning, automation

**Autonomy**
"Safety through human action"
Feedback control
Coping with uncertainty
Complete tasks, lateral cooperation

(After Grote)

Balance through loose coupling
Hexagon system – a research project at the Open University.

SUGAR the OLPC user interface, and the frame with
### Overview displays

<table>
<thead>
<tr>
<th>Command Priority</th>
<th>Status</th>
<th>Time to Restore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fight</td>
<td>Red</td>
<td>1 hour 35 minutes required to restore</td>
</tr>
<tr>
<td>Move</td>
<td>Red</td>
<td>1 hour 35 minutes required to restore</td>
</tr>
<tr>
<td>Float</td>
<td>Green</td>
<td>No time required to restore</td>
</tr>
</tbody>
</table>
the RoboDeNiro AwareBot (cf. Figure 1b) can lift its hat when another user logs in; it can rotate its body when new email has arrived; and the user can press its arm in order to log into the system.

Ambient Interfaces: Design Challenges and Recommendations
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Other pictures from work by MIT (Ishii et al)
Scalable Fabric
Scalable Fabric [17] provides task management support by spatially organizing shrunken versions of windows into tasks in the periphery and enabling window management on a task level. Users interact with windows in a central focus area of the screen in a normal manner, but when a user moves a window into the periphery, it shrinks. The window “minimize” action is redefined to return the window to the user-chosen location in the periphery, rather than hiding the window. Placing a set of windows near each other in the periphery dynamically creates a task composed of them. Clicking on a minimized task’s name restores all its windows into the central focus area. This is the equivalent of switching rooms in the Rooms system [7]. Clicking again on the focal task’s name minimizes all its windows to the periphery. Windows from all tasks are visible at all times (either in the focus area or as shrunken, peripheral windows), enabling easier task switching. Scalable Fabric provided the baseline comparison within our study. In a previous study, Scalable Fabric was found to perform as well as Windows [17] and was qualitatively preferred. Comparing our three new interfaces to Windows would not have been a fair comparison, as they introduce task management support in addition to abstraction. By comparing them to Scalable Fabric, which uses a simple abstraction technique (i.e., scaling or shrunken windows), we gained additional insights about abstraction.

Change Borders
We chose to visually represent changes with Change Borders, colored borders that appear around peripheral windows or Clippings when the system detects that the window content has changed. The borders are red while changes are happening (i.e., window pixels have changed recently) and green when changes are complete (i.e., no window pixels have changed for a certain period of time). We added Change Borders to both Scalable Fabric and Clipping Lists, as described below.
Condition based operation
Localised changes

Palladium Technology trackball the company came up with. It's translucent, and colored LEDs underneath are used to indicate alarm states. When everything is cool, it glows green. But if some system moves into warning territory (whose very sophisticated parameters you can set in SiMON), it goes to yellow. Finally, if alarm status is reached it throbs red. It strikes me as way better than an audio alarm on the bridge, neat looking, and an idea that could come down to us little people. A solid green trackball indicates normal operation. A pulsing yellow trackball indicates an abnormal condition (such as rising oil pressure or jacket water temperature) that should be checked out. A quick-flashing red trackball calls attention to a critical condition requiring immediate action. Audible alarms can be acknowledged and silenced with the click of a button on the trackball panel. The backlit trackball can be dimmed for night-time operation.
Calm Technology

- Utilize a user's periphery
- Come to center only when necessary
- Enhance peripheral reach to keep people tuned in to surroundings without demanding attention
Stopping this threat and other forms of weapons of mass destruction (WMD) from making their way across the world's oceans is a challenge for the U.S. Navy and Chief of Naval Operations Adm. Mike Mullen. Mullen acknowledges that inspecting each container entering the U.S. is not practical and is seeking the cooperation of friendly navies, international organizations and even shipping companies to garner the kind of intelligence that would allow a WMD-laden container to be identified and intercepted long before it hits the country's shores. One of the mechanisms for making that happen is the "Thousand-Ship Navy" (TSN), a metaphorical term for combining efforts on an international scale to halt or divert the movement of threats on the high seas.
Condition-based control, operation
Online-offline integration

- It's going to happen anyway

- Offline tasks are now the high workload periods (e.g. airline pilots on the ground)

- Offline tasks done in isolation from online are distracting and badly designed (e.g. some offshore facilities)

- Understanding where limits come from can be high importance and urgency in unexpected situations (which are what we keep operators for)

- Offline systems and data can sneak through safety cases

- Setting appropriate limits gets the most out of the system.