Composite Warning System

Builder's Guide

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Executive Summary

This document provides background and technical guidance on the development, deployment, operation and technical maintenance of Composite Warning Systems (CWS).

The author led the national Canadian pubic warning system development program during the 1980's, designed the original Pt. Lepreau Nuclear Generating Station CWS and has more recently managed the following related projects:

-application and update of previous CWS design for the Alberta Emergency Management Agency; and

-development of threat profile, evacuation plan and public warning system benchmark for the Pt. Lepreau nuclear generating station (PLNGS) for New Brunswick Public Safety / NBEMO.

Based on our work in this field over 30 years it is our view that the following are best practices with respect to CWS development, deployment, operation and support.

1. By definition, a CWS includes two or more warning system components which have different types of end-devices. In general, the more components a CWS has the more robust, reliable and effective it is in terms of providing coverage of the target audience. A CWS should have components which are optimal for outdoor warnings (Siren plus possibly either Streetlights or Warden/MLS), optimal for indoor warning (ideally an IWD supplemented by Telephone Dialout) and optimal for vehicles (usually the EBS plus cell/PDA).

2. CWS components such as Telephone Dialout, Cell (voice or text broadcast), screen crawler, IP stream and other components, which touch end-devices which have multiple purposes, should be used only as supplementary CWS components and not as primary CWS components. For example, while it may provide wide coverage, a cell phone is not designed primarily as a warning system component or else it would not be possible for the user to turn down its ring volume or to turn it off entirely.

3. Therefore a CWS must include both primary and supplementary components. Supplementary components should NOT be relied upon to provide primary coverage.

4. The coverage estimation methodology for any given CWS should be highly conservative and should assume total coverage subsummation of each component into the coverage provided by each other component except where it can prove otherwise. For example if a given CWS has Component A which covers 40% of the target audience and Component B which covers 30% of the same target audience, then the coverage provided by Component B will be assumed to be subsumed within the coverage provided by Component A except where it can be conclusively proven otherwise. Therefore the total estimated coverage of A+B = 40%.

5. The emergency manager should use every means at his/her disposal to fully inform residents, occupant workers/students and visitors to the CWS coverage area of the existence, function and importance of the CWS. These means include Web sites, broadcasters, the inside cover of the telephone directory, mail out calendars, information sheets given out at parks and campgrounds, signs are large facilities and in parking lots, information sheets or placards in hotel rooms etc.

6. Sirens should be employed as the primary CWS component intended to provide outdoor alerting coverage. There is no substitute available for Sirens, so any CWS which does not have them is an incomplete – *and under-performing* - CWS which is unable to effectively reach an outdoor audience.

7. Conversely, sirens should NOT be placed so as to cover all of the geography of the coverage area. Rather, Sirens should be placed to cover locations where there are significant concentrations of Person Outdoor Hours (POH).

8. Ideally, in CWS design, Sirens should not be assumed to provide any indoor coverage at all.

9. Since the mid-1980's it has been technically possible to apply machine intelligence to sirens to render a Smart Siren. Generically, a Smart Siren is a siren with a ruggedized on-board computer system and sensor package which is able to sense its physical, radiological and electro-magnetic environment and govern siren activation behaviour accordingly both under EMO control and (in cases of CBRNE attack and in certain other conditions) also function independently and automatically as and when required.

10. Use a transceiver/switch device coupled to street light control equipment to turn street lights on during the day and off at night as a supplementary means of alerting those who are outdoors plus those who are indoors who may be looking outdoors.

11. An Indoor Warning Device (IWD) should be employed to provide primary coverage of indoor residential, small-business and other small-building target audiences. Conceptually, an IWD is a small dedicated device which plugs into, and covers, an indoor 110VAC electrical outlet, containing a unique device identifier code and a modifiable assigned address code plus a battery, a flasher light, a reset button and an alerting buzzer which may be activated by any one or more of the following:

-Cable Module – receives (and sends) signal over coaxial cable owned and operated by the local cable company;

-Radio Module – AM, VHF or UHF transceiver – receives (and sends) signal over the air and is not necessarily required to receive and transmit in the same frequency band;

-Telephone Module – receives signal over twisted pair without the necessity of the line going off-hook and returns signal via the same channel; and

-Carrier Current Module – receives signal over powerline carrier and returns signal via same channel.

>>> This is a dedicated device whose sole (or at least primary) function is to sound an alert tone when activated. Like a smoke detector it cannot be turned down in volume nor turned off and its tone is both immediately recognizable and has an unequivocal meaning.

>>> There is a tremendous opportunity for the electric utility industry to establish a common architecture, including form-fit-function standards, for such a device.

12. Telephone Dialout systems (which are also called Reverse-911 systems) are suitable for populations in the 1000 to 50,000 range and in certain cases in the 50,000 – 150,000

range. Application to higher populations carries a level of risk which rises more than linearly with a rise in population level.

13. Telephone Dialout systems should NOT be deployed for target populations which are too large to permit the system to effectively alert and warn the entire population within a 15 minute cycle time.

14. It is *NOT considered a best practice* to implement a Telephone Dialout system as the primary indoor alerting component of a CWS which must reach a *mass* audience. For this reason, Telephone Dialout systems should be used as SUPPLEMENTARY indoor notification systems, not as the primary indoor system upon which a CWS is reliant.

15. The ubiquity of cell phones is a great boon to the emergency manager, however it must be always remembered that cell phones/PDA's were not designed as emergency public warning system end-devices; if they were it would not be possible to turn down their ringers and it would be impossible to turn them off. It is also noteworthy that many cell phone users (particularly the elderly) carry them only for emergency use – which is use occurring only *they decide it is an emergency* (such as when their car is stuck or out of gas). True too, most cell phone users do not take them along when walking their dog, taking a bath or shower or engaging in many other activities, including sex. Cell phone usefulness as a warning system end-device is also highly captive to the current state of their batteries and for many users the most frequent cause of being unable to be reached by cell phone is a low or dead battery.

16. True too, care should be taken in terms of estimating Cell coverage of the target audience in areas where cell signal coverage is poor or intermittent due to the topography, electro-magnetic signature of the earth or locations of the cell towers.

17. Warden/MLS provides a supplementary warning system capability which augments sirens for outdoor warnings and also pays particular attention to those least likely to receive and understand the warning, such as the elderly, the handicapped and those who do not speak the language(s) in which the warning is given.

>>> The Point Lepreau Warden Service, which was created based on the author's design and recommendation, has clearly demonstrated the viability of a citizen volunteer service, coordinated by the EMO, for providing supplementary alerting and warning capabilities. This measure should be implemented at all nuclear powerplants and in other high-risk areas.

19. Home Security Systems should be employed wherever possible as they are a low-cost, low-risk supplement to Telephone Dialout, IWD and Cell means of alert delivery to residents who are indoors.

>>> Like smoke detectors, Home Security System end-devices are understood by all residents to be single-function devices which not only emit a very loud sound, but are also seen as being fully justified in doing so. Therefore, there is an extremely high probability that anyone who is attracted (or even awakened from a deep sleep) by such a device will pay attention to it. Connecting home security providers into the CWS control path will also provide an additional service to the home security subscribers at virtually no incremental cost to the operator or subscriber.

1.0 Introduction

1.1 Purpose

This document provides background and technical guidance on the development, deployment, operation and technical maintenance of Composite Warning Systems (CWS).

1.2 Company Background

The author leads Workplace Technologies Corporation (WTC), which is based in Long Beach, California, is a strategic technology planning / management consulting firm with expertise in the transportation, communications, defense/aerospace, emergency management and advanced technology sectors. WTC is also active in the home workplace products/services market. The firm has operated since 1994 with clients including Boeing, McDonnell Douglas, State of California, Amdahl/Fujitsu, Ingram Micro, Lear Astronics and many others. WTC has 30 full-time, part-time and associate participants.

1.3 Author Background

The author holds a Masters in Public Administration / Transportation Engineering from Carleton University in Ottawa and is the author of more than 100 professional and technical papers plus five books in the advanced technology field, two of which were published worldwide by McGraw Hill. Experience includes several years as Director Intermediate Informatics with Transport Canada, serving as CIO of two private sector firms and subsequent leadership of co-owned consulting firms since 1990. Most sectoral work has been in the fields of transportation, communications, defense and emergency management.

1.4 Context

1. The author led the national Canadian pubic warning system development program during the 1980's, designed the original Pt. Lepreau CWS and has more recently managed the following related projects:

-application and update of previous CWS design for the Alberta Emergency Management Agency; and

-development of threat profile, evacuation plan and public warning system benchmark for the Pt. Lepreau nuclear generating station (PLNGS) for New Brunswick Public Safety / NBEMO.

1.5 References

Refer to ANNEX A.

2. Composite Warning System (CWS) Backgrounder

2.1 Composite Warning System Definitions

Emergency Management Organization (EMO) – A generic term used to refer to any city, county, state/provincial or federal emergency management organization.

Warning Originator – Emergency manager or other authorized official who is responsible for issuing to both an alert and an accompanying warning message to provide information and instructions to a target audience which may constitute all or part of the public within a given jurisdiction or domain.

CWS Operator – the federal, tribal/first-nation, state/provincial, county, municipal or other government operator, or the institutional or private sector operator, of a Composite Warning System (CWS).

Aggregator – a system, service, channel or Carrier which accepts properly formatted Common Alerting Protocol (CAP) messages from authorized Warning Originators and which employs the content of such messages, combined with machine-resident logic (which is conformant to EMO business rules), to route and deliver such messages to first responders, to public warning systems and/or directly to the public as may be requested by the Warning Originator.

Carrier – a federally licensed public common carrier which provides any one or more of telephone service, radio broadcast, television broadcast, cable broadcast, cable Internet service, satellite Internet service, cellular or satellite telephone service (with or without data capability), pager service, GPS location service or any similar publically accessible, tariffed communications service.

Public Warning System (PWS)- An integrated system of control software and communications subsystems and devices intended to alert and warn a limited or mass public audience of the imminence or onset of any natural or manmade disaster and to (optionally) elicit confirmation (of receipt of warning) from all or part of the same audience. A PWS may include one or more Delivery Systems.

Public Alerting System – another term for a PWS but this term can be misleading because no system is sufficient if it only alerts the public – rather, it must both alert the public and also deliver the warning message thereby providing the public with information about the nature of the threat and the actions they are instructed to take.

Emergency Alerting System (EAS) - A U.S. national public warning system that, together with other emergency notification mechanisms, is part of an overall national public alert and warning system under the jurisdiction of the Federal Emergency Management Agency (FEMA), an agency of the Department of Homeland Security - EAS is a newer version of a national public warning system that replaced the Emergency Broadcast System (EBS) in 1994.

Composite Warning System (CWS) - An integrated PWS consisting of one or more control systems, one or more Control Paths and two or more Delivery System components (each of which has alerting and/or alerting+warning capability) which is intended to alert and warn a mass public audience of the imminence or onset of any natural or manmade disaster and to (optionally) elicit confirmation (of receipt of warning) from all or part of the same audience via one or more of its Delivery System components.

The **Core CWS Components** are those which are under the highest-confidence control of the EMO Warning Originator and which are components dedicated to warning system use so their end-device coverage effectiveness is therefore only minimally impacted by audience behaviour – these components are as follows:

-**Control System** – real-time application software package which monitors and reports the status of all other Core Components – and all Adjunct Components - of the CWS, permits a warning to be planned, demarcated (in terms of Target Audience and/or geography) and

transmitted, while reporting on component-specific, and total, warning system performance and/or effectiveness;

-**Control Path** – the communication channel(s) via which the Control System monitors and controls all other CWS components – this may include any combination of dedicated EMO Originator, utility, Aggregator and/or Carrier communication channels;

-**Siren** – electro-mechanical or electronic warning siren which is capable of generating one or more distinct tones at a defined sound pressure level in order to alert the target (mostly outdoor) audience to seek a broadcast, cable, cell or other source of warning information – some electronic sirens are also capable of emitting voice announcements;

-Smart Siren – electro-mechanical siren with a ruggedized (and hardened) on-board computer system and sensor package which is able to sense its physical, radiological and electro-magnetic environment and govern siren activation behaviour accordingly both under EMO control and (in cases of CBRNE attack and in certain other conditions) also function independently and automatically as and when required;

-**Street Light Controller (SLC)** – a transceiver/switch device permitting EMO control of municipal street lights which are turned on in the daytime and off at night so as to attract the attention of persons who are outdoors or who are indoors, but looking outside;

-**Indoor Warning Device (IWD)** – a small dedicated device which plugs into, and covers, an indoor 110VAC electrical outlet, containing a unique device identifier code and a modifiable assigned address code plus a battery, a flasher light, a reset button and an alerting buzzer which may be activated by any one or more of the following:

-Cable Module – receives (and sends) signal over coaxial cable owned and operated by the local cable company;

-Radio Module – AM, VHF or UHF transceiver – receives (and sends) signal over the air and is not necessarily required to receive and transmit in the same frequency band;

-Telephone Module – receives signal over twisted pair without the necessity of the line going off-hook and returns signal via the same channel; and

-Carrier Current Module – receives signal over powerline carrier and returns signal via same channel.

>>> Any one or more of the above-cited four types of modules could also be configured, for example, to report electrical meter and/or gas meter readings thereby providing not only a means to serve the local utilities, but also a basis for private-public partnerships for the funding, deployment and support of warning systems.

>>> Any community of IWD's (such as those installed in town or suburban district) should be addressable either in terms of all devices within that community or else any sub-set of the devices, defined in terms of geography and/or some other attribute – ex: all devices within a geo-defined evacuation area or all devices whose owners are known to have respiratory problems.

-**Emergency Broadcast System – Warning System (EBS(WS))** – automatic over-ride by the EMO of normal radio, TV and cable broadcasts and delivery of a live, recorded or text-to-speech audio message - while the EBS is used to follow up siren, street light and IWD alerting signals with the relevant information it also serves as an alerting+warning system in its own right, and is called EBS(WS), with respect those who are already listening to a radio or TV broadcast or a cable station.

Adjunct CWS Components are those in which the EMO Warning Originator may have varying degrees of control or confidence of end-device coverage effectiveness, and which are therefore to a greater degree subject to audience behaviour, and may include any of the following:

-**Telephone Dialout** – System capable of initiating calls to telephone subscribers, playing a voice message when the phone is answered and eliciting confirmation of receipt of the alert/warning message;

-**Cell** – System capable of signaling – and ringing - public cellular (wireless) telephone transceiver devices (including Personal Data Assistants (PDA's)) and delivering either a text message and/or an analog or digital voice message – may optionally also include any one or more of the following:

-elicitation of user confirmation of receipt of message;

-GPS or other determination of current cell/PDA geographical location; and/or

-device-based application provided by the EMO which is capable of receiving and drawing user attention to an alert/warning message with or without the ability to also automatically seek confirmation of message currency, applicability and authenticity from other sources and obtain additional relevant information based on the user's current location and/or demographic status (special needs etc.)

-**Pager** - System capable of signaling – and buzzing - public cellular (wireless) analog or digital pager devices and delivering a text message;

-**IP Stream -** System capable of employing the Internet, an Intranet and/or an Extranet to signal any device which is capable of communicating via the TCP/IP protocol (such as PC's, Laptops, Tablets and PDA's), by:

-invoking and enunciating a pop-up window and/or banner and delivering a text message;

-sending pre-composed E-Mails to destination addresses; and/or

-passing messages onto Internet social networks;

-**Web** – Posting of an alert/warning message on a Web site operated by the Warning Originator's organization, by the EMO or any other collaborating organization;

-**Warden / Mobile Loudspeaker System (MLS)** – volunteer civilian warden service, members of which are equipped with vehicles, radio, light bar and public address system in order to patrol a designated zone to provide supplementary warning, confirm that requested shelter-in-place or evacuation instructions are being complied with and assist those with transportation requirements and/or special needs;

-**Facility Warning Device (FWD)** – an IWD or a Tone Alert Radio which is installed at a school, hospital or a large commercial / industrial facility which is capable of performing two distinct functions, usually in parallel:

-advising facility operators of the alert/warning message and asking them to relay it to their occupants; and

-employing facility public address and/or fire alarm systems to attract the attention of facility occupants;

-**Tone Alert Radio** – a weather radio receiver, or other specially equipped radio receiver, which is capable of receiving and decoding an alert message and activating a warning tone

whether or not it is being used to monitor a voice broadcast – depending upon its design and configuration, such a radio may or may not deliver a voice message following the tone

-**SigAlert** – a remotely controllable digital road-side sign which is capable of receiving and displaying text messages to passing motorists; and

-**Home Security System** – a commercial residential or small business indoor security system which is capable of generating an alert tone with or without an accompanying text message.

First Responder Alerting System (FRAS) - An integrated system of software and communications subsystems and devices intended to alert, warn and elicit confirmation (of intent to respond) from, first-responders in all EMO-relevant disciplines. Such a system may also be employed to alert a diasporatic group of resource or service providers, such as requesting high school principals to prepare their schools for use as emergency shelters. In some cases a FRAS installation is referred to as a Civic Notification System (CNS).

Local Warning System (LWS) - An integrated system of control software and communications subsystems and devices intended to alert and warn a public audience which is limited in scope and/or geography (and thus in total number) of the imminence or onset of any natural or manmade disaster and to (optionally) elicit confirmation (of receipt of warning) from all or part the same audience.

Control Channel – the path by which the Warning Originator or Control System activates components and/or end-devices which function as part of a PWS.

Person Activity Mode (PAM) – The current activity of a person which permits us to logically determine which CWS components can reach them.

Person Outdoor Hour (POH) – An activity of any person which has them spending time outdoors – the POH count for a park is the average annual number of people at the park during a given period normalized over the year – POH counts are used in siren placement to ensure that sirens are placed only where people will be outdoors and thus be able to hear them.

Person Warning Year (PWY) – The ability of one CWS component to cover one person for one year

CWS Availability – The percentage of time, measured on an annual basis, that the CWS is actually available for immediate activation.

CWS Reliability – The percentage of times that a command to activate the entire CWS actually results in such activation.

CWS Dispatchability – see CWS Reliability.

2.2 Background on Canadian Composite Warning System Program

During the 1980's, the author led a series of projects known collectively as the Canadian Smart Siren Based Composite Warning System Program which was funded by Emergency Planning Canada (EPC), but participation in which included many other government, institutional and private-sector organizations in Canada and the United States. The objective of the program was to develop and deploy a new national public warning system capable of delivering alert/warning to any segment of the Canadian population with respect to any natural or man-made emergency up to and including nuclear powerplant accidents and also nuclear weapon detonations, whether inadvertent or as an act of war by a foreign power.

Emergency Planning Canada (EPC), the predecessor of the Canadian federal government agency now known as Public Safety Emergency Preparedness Canada (PSEPC), undertook a number of projects which culminated in the development of a Composite Warning System (CWS) program, aimed at developing and deploying a national system useful for any peacetime or wartime emergency.

The first project was a national, conceptual and wartime oriented study addressing the creation of a Composite Warning System (CWS) for public alerting and warning which would have indoor and outdoor components. The study (which was managed by the author) found that sirens were still effective for outdoor warning, but should be placed only where it is possible to prove that people spend sufficient time outdoors so as to make them useful. (During the 1950's sirens had been placed so as to cover the entire geography of urban areas.) It was also found that there were a large number of potential benefits available to developing computer-controlled ‘smart sirens’. An indoor alerting device, activated by some form of radio, electrical carrier-current or telephone signal was also determined to be required since modern construction and insulation methods had significantly increased the attenuation of siren output. Also, there was the need to continue using the Emergency Broadcasting System (EBS) which included the Canadian Broadcasting Corporation (CBC) radio network plus overlay of the emergency voice warning signal onto some commercial stations. In addition to conducting a literature search of over 300 primary sources going back over more than 30 years, the study proposed new operational concepts and a new way of measuring the effectiveness of a (multi-component or 'composite') warning system. It also proposed developing a test site not only to prototype computer controlled 'smart' sirens, but also to test both the actual alerting/warning effectiveness as well as the predictive accuracy of the coverage estimation methodology and related computer simulations.

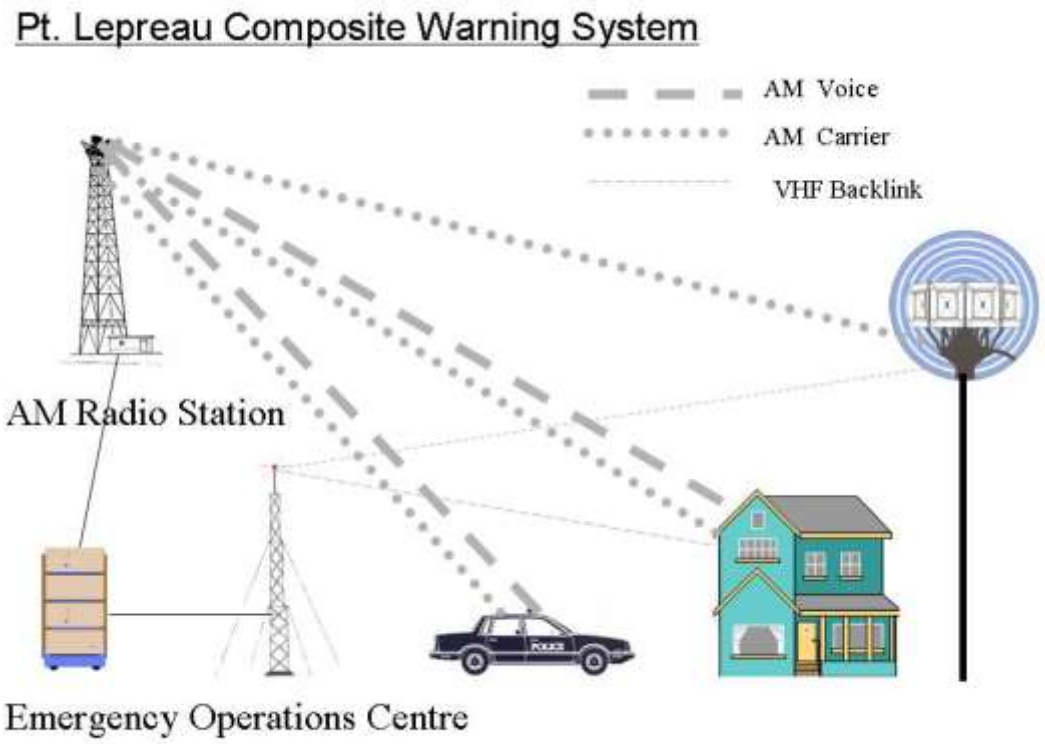
Shortly thereafter, the author directed a large off-site emergency response exercise at the Pt. Lepreau Nuclear Generating Station in the Province of New Brunswick. The exercise, aimed at validating the off-site emergency response plan, involved hundreds of emergency management (EM) professionals and volunteers in many disciplines and drew much media coverage. Whereas the six 1950’s era sirens (operated by the Department of National Defence (DND)) which formed the warning system were not functioning well, a fact much remarked upon by the media, a clear opportunity emerged for a further CWS project. A proposal for a local, peacetime and practical CWS study was duly tendered and very quickly approved. The study involved consideration of literally dozens of technologies for local and long range signaling and control. It was found that although not all the features contemplated for smart sirens were needed in the largely rural coverage area, there was a good case for up to twelve 'semi-smart' outdoor sirens, in an area which also included a large provincial park and campground. It was also determined that an AM radio signaling scheme (based on quadrature phase modulation technology) would be best for activating both the sirens and also in-home alerting devices about the size of a calculator plug-in power pack. A warden-with-mobile-loudspeaker system was also recommended (as a special local measure) due to the distribution of the population and the significant number of seasonal and special-needs residents in the high-risk exclusion zone around the nuclear powerplant.

The intended Point Lepreau CWS design is depicted in FIGURE 1 on the following page.

The area around Pt. Lepreau represented a 'tailor made' location for a national indoor-outdoor CWS laboratory; the population were already sensitized to the need for an improved warning system and there was the widest mix of permanent, seasonal, camper and passer-through personal activity modes. The overall population was small enough to permit meaningful tests of the CWS coverage and full validation - with a computer simulation - of the coverage estimation methodology followed by 100% population sampling. (In order to be able to apply the CWS design nationally, it was essential to validate the coverage estimation method to be used for planning purposes.)

These studies, and various papers produced about them, attracted significant attention in the U.S., Australia, the U.K. and even in the U.S.S.R.. The author received many speaking invitations and some U.S. jurisdictions contacted EPC in this regard. Several other initiatives had been undertaken within the framework of the CWS program, including significant collaboration with several U.S. nuclear utilities, two of them in California, as well as identification of an advanced technology electro-mechanical siren which was intended to form the core of a smart-siren based CWS. Computer equipment for the siren was designed and prototyped at bench level, as were physical protection of the siren and pole, from overpressure and from interdiction, as well as protection of the computer system from electro-magnetic pulse (EMP).

FIGURE 1 – COMPOSITE WARNING SYSTEM



The New Brunswick Emergency Measures Organization (NBEMO) reacted positively to the study report and formally expressed its willingness to enter into a partnership with EPC to provide at Pt. Lepreau both the required coverage and a national CWS indoor/outdoor development test site or laboratory. A joint funding request was duly submitted to Ottawa by NBEMO, but this ultimately became embroiled in various inter-departmental disputes within the Government of Canada (GoC). At that time Department of Communications (DOC) had the technical jurisdiction and mandate for developing new public warning systems and had been studying a system called Crisis Home Alert Technique (CHAT). This system required *advance notification* by broadcast media and/or print media to the citizen to turn on an FM radio, tuned to a special frequency; they would then issue an alert tone if required and deliver the warning message by voice over the same channel. *Unfortunately, this system was of zero utility for any emergency with an unexpected onset and for which this measure of public preparation was simply not feasible! Despite DOC's insistence to the contrary, the CWS coverage estimation methodology was eventually employed to formally establish that CHAT's coverage was 0% in conditions of unexpected emergency.* DND was the owner/operator of the late 1950's vintage siren network installed across Canada but had not been tasked with upgrade or replacement of the system. Nonetheless, EPC had overall emergency coordinative responsibilities, worked with the provinces and co-funded various types of EM capital projects. EPC thus had the responsibility to provide overall leadership with regard to improving our late-1950's technology public warning system (consisting of sirens and the Emergency Broadcast System (EBS) plus ten provincial warning centres). DOC, DND and EPC were unable to agree on how to proceed. Unfortunately EPC did not have the requisite funding or influence to bring about a meaningful change and while they continued to fund exploration and developmental activities related to the proposed CWS program, the incoming Mulroney Government ultimately terminated the entire program during 1984-85. In the interim, NBEMO had elected to go with the part it could most readily afford - the warden/loudspeaker system – and has more recently added a Telephone Dialout system. We continue to believe, however, that outdoor protection in the form of new-technology sirens would definitely have improved coverage.

2.3 Additional Information on Indoor Warning Device (IWD)

After sirens, the second most important part of the CWS is the Indoor Warning Device which is intended to be fed from landline power, but also to have a battery which permits it to operate independently for a significant period of time, likely for 5-10 days in standby mode with any activations during a non-landline-powered period obviously reducing the remaining standby time available.

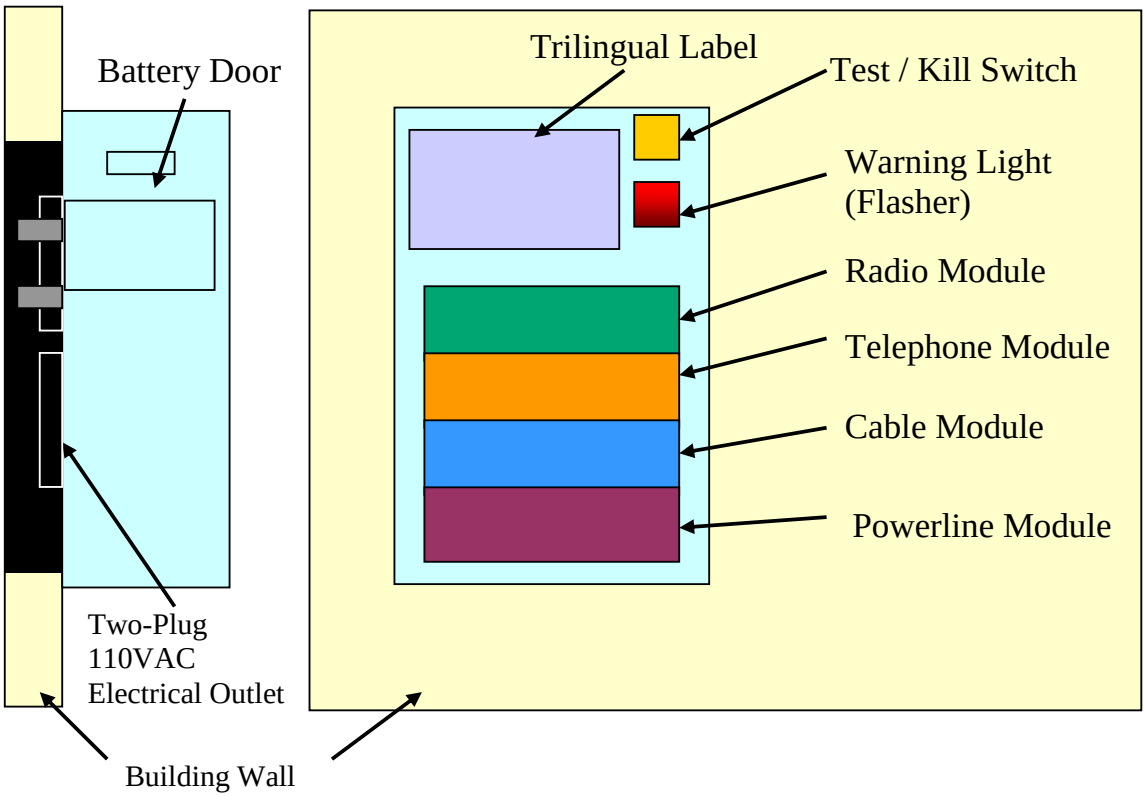
The purpose of the IWD is simple; it is to produce such an unbearably loud, disruptive and annoying sound that its continued operation simply cannot be tolerated and the nearest person will thus be highly inclined to turn it off. In doing so (by depressing a button) the person does two things:

-they come into close proximity with a sign (printed in English, Spanish and French) instructing them to tune to a live broadcast source such as radio, TV or cable; and

-where the IWD is employed in two-way mode, they are also causing the IWD to report, when next polled, that it has been turned off – this advises the emergency manager that the building in which the IWD is located is occupied and that the alert has in fact been received.

Refer to FIGURE 2 below.

FIGURE 2 – Indoor Warning Device (IWD)



Note that the IWD:

-is an open-architecture 'bus' into which up to four individual modules can be plugged, and these modules can therefore come from multiple vendors, providing they are conformant to CWS form-fit-function (F3) specifications; and

-can accommodate any combination of one-way and two-way modules – the latter employ their respective communications channels, as and when polled, to report status of the device, as being one of the following:

-operating in standby mode;

-in receipt of warning signal and thus activated in warning mode;

-re-set to standby mode by virtue of having its button pressed; or
-malfunctioning; and

-is also able to report (where two-way communication is available from one or more of its modules) whether it is operating on landline power or battery.

The wonderful thing about this IWD design is that it positively ends the *"what is the best channel?"* debate.

The author's previous research clearly established that the debate about which was the optimum communications channel (for triggering activation of an IWD) goes back at least to the 1950's, if not earlier. Each of telephone, radio and powerline carrier had their respective proponents and by the 1980's cable proponents had joined them. There were also more exotic concepts advanced including radar, lasers, ultrasonic systems and even the transmissions of LF sound waves via sewers… Our CWS design conclusively terminates the "which channel is best" debate by letting the county or city government select whatever channel (or preferably combination of two channels) makes the best sense in its own operating environment. For example, in an area with many hills and poor electro-magnetic qualities, use of (line-of-sight oriented) VHF or UHF radio as the Primary Control Channel for controlling the sirens, street lights and IWD's would not be advisable. In such a case a signaling system such as AM quadrature phase modulation might be more suitable.

As shown in FIGURE 1 above, the ideal situation is when a signal outbound signaling channel (in this case AM carrier based quadrature phase modulation (QPM)) is used to activate all of the sirens, street lights and IWD's and a different channel is employed for backlink communications.

Also ideal would be the situation where the IWD was populated with at least two modules such that:

-one module functioned in one-way mode; and

-the other module functioned in two-way mode.

>>> There is, in theory, no reason why vendors cannot offer both one-way and two-way modules for each of the four signaling channels identified above, although the particularities of local electrical grid architectures make the employment of two-way carrier current systems more challenging.

2.4 Current Relevance of CWS

How is the past CWS work, most of which occurred over 20-30 years ago, relevant to the nuclear powerplant off-site emergency management environment of today? This is explored in the following sections.

2.4.1 Current Threat Profile

Since the mid-1980's the threat profile is believed to have changed as set out below:

-with the demise of the U.S.S.R. the nuclear attack threat has *diminished significantly but remains very rea*l for the following reasons:

-the Confederation of Independent States (CIS) still possesses a large nuclear arsenal, any portion of which could be accidentally or purposefully directed at targets in North America;

-it is believed that many former Soviet nuclear weapons (ranging from 50KT to 5MT) are at this time unaccounted for; and

-rogue states and terrorist organizations are known to be seeking access to nuclear devices to further their respective objectives;

-chemical and biological threats have *increased*;

-other terrorist threats have *significantly increased*;

-climatic threats have *increased*, in particular hurricanes and tsunamis;

-other peacetime man-made disasters are *relatively static*; and

-other natural disasters are *relatively static*, although climatic changes may favor the increased onset of larger wildfires and may amplify the impact of such fires.

>>> Virtually all of these threats create conditions in which it may be necessary to warn a small, or massive, population of the onset of a threat and to instruct them on how best to protect themselves and their property. As indicated above, it is believed that a CWS can address the full range of threats more effectively than any single-channel warning solution.

2.4.2 Lack of Further Research

Our preliminary scan of the open literature of public warning systems has been unable to identify any indication that meaningful further exploration of CWS requirements or potential CWS implementations followed the cancellation of the Canadian program during 1984-85. Indeed, virtually all further work has concentrated on single-point solutions, most of them drawn from the *'communications'* discipline and thus related to radio, TV, cable and/or satellite broadcasting or else to landline, cellular or satellite telephone and paging services and more recently the Internet. Very few projects have assessed composite (integrated) warning systems which include multiple outdoor, outdoor-indoor and indoor components.

>>> We believe that there are clear and logical arguments why a CWS approach should be further considered and that these are discussed below.

2.4.3 State of Technological Advancement

The original CWS program was bedeviled by problems which might today be easier to resolve, as follows:

-while it was possible to protect the smart siren (including its computer system and pole) from the many effects of a nuclear detonation and thus to maximize the probability of it being able to re-activate to warn survivors of the approach of fallout, providing the various types of nuclear protection was extremely challenging from a technical point of view – *a wider range of EMP protection and other survivability measures is now available; and*

-the choice of the optimal Internal Warning Device (IWD) for use inside building was also extraordinarily difficult and while the final selection (for Point Lepreau) of an AM Quadrature Phase Modulation (QPM) outbound signaling system with the IWD's having a VHF backlink transmitter, combined with cellular VHF receivers was found to be technically feasible, *a much wider range of potentially convenable technologies is now available – it is also recognized that adopting an open-architecture IWD would permit:*

-a range of vendors to propose different solutions, each of which could be added to a multi-bay IWD as a module; and

-this flexibility would permit local EM authorities to select one or more solutions (from among those based on telephone, radio, cable and powerline carrier technologies) to best suit their local operational requirements and economic realities.

3. Unique Aspects of CWS Approach

The following are the unique aspects of our approach to public warning systems.

3.1 Multiple Components

Most public warning system proponents today recommend single-component (albeit multi-track) systems which are intended to do such things as ring home and business telephones, send messages to cell phones and pagers, send E-Mails etc. Unfortunately, such single-component systems are dependent upon a common core; *if that component fails the entire system fails.*

It is in the *mutual re-enforcement* (of multiple components) that a warning system message becomes more credible to everyone it reaches. *It is difficult for someone to ignore two or three components of a system when they are all activating in parallel*. For example, TABLE 1 provides a matrix of Person Activity Modes (PAM) and CWS components. Note that in all cases, the purpose of each of the four components (except EBS(WS) which imparts both alert and warning information) is simply to spur the alert recipient to consult a broadcast (or cable) news source to learn why the CWS was activated.

TABLE 1 – CWS COVERAGE OF URBAN PERSON ACTIVITY MODES (SIMPLIFIED)

Person Activity Mode	Smart Siren	Street Light	Indoor Warning Device	EBS (WS)
Home - sleeping	Nearby siren may awaken and alert residents, although current building construction attenuates up to 30 DB.	Not effective for this person activity mode.	High-intensity indoor device will awaken and alert resident under virtually all circumstances.	Not effective for this person activity mode.
Home - normal domestic activities	Nearby siren may alert residents, although current building construction attenuates up to 30 DB.	Not effective for this person activity mode.	High-intensity indoor device will alert resident under virtually all circumstances.	Resident will be alerted if monitoring live broadcast or cable radio or TV source or Internet streaming source.
Home -outdoors	Nearby siren will provide alert.	Nearby street light will provide alert, if observed.	Not effective for this person activity mode.	Only effective if resident is listening to indoor, portable or outdoor radio or TV.
Street -walking	Nearby siren will provide alert.	Nearby street light will provide alert.	Not effective for this person activity mode.	Only effective if person is listening to portable radio.

Person Activity Mode	Smart Siren	Street Light	Indoor Warning Device	EBS (WS)
Car	Nearby siren may alert driver although current vehicles attenuate up to 40 DB.	Nearby street light will provide alert.	Not effective for this person activity mode.	Only effective if driver is listening to in-car radio.
School -outdoors	Nearby siren will provide alert.	Nearby street light will provide alert, if observed.	Not effective for this person activity mode.	Only effective if teacher or student is listening to portable radio.
School -indoors	Nearby siren may alert staff, although current building construction attenuates up to 30 DB.	Not effective for this person activity mode.	High-intensity indoor device will alert staff who can tune radio and then re-broadcast signal internally. >>> Alternative is use of fire alarm.	Only effective if staff is listening to broadcast or cable radio or TV.
Office Building	Nearby siren may alert staff, although current building construction attenuates up to 30 DB.	Not effective for this person activity mode.	High-intensity indoor device will alert staff who can tune radio and then re-broadcast signal internally. >>> Alternative is use of fire alarm.	Only effective if staff is listening to broadcast or cable radio or TV.
Shopping Center -outdoors	Nearby siren will provide alert.	Nearby street light will provide alert.	Not effective for this person activity mode.	Only effective if person is listening to portable radio.
Shopping Center -indoors	Not effective for this person activity mode due to background music and high ambient noise levels found in most shopping	Not effective for this person activity mode.	High-intensity indoor device will alert staff who can tune radio and then re-broadcast signal internally.	Only effective if staff is listening to broadcast or cable radio or TV.

Person Activity Mode	Smart Siren	Street Light	Indoor Warning Device	EBS (WS)
	environments.		>>> Alternative is use of fire alarm.	
Public Building **- Govt. Office** **- Hospital** **(etc.)**	Nearby siren may alert staff, although current building construction attenuates up to 30 DB.	Not effective for this person activity mode.	High-intensity indoor device will alert staff who can tune radio and then re-broadcast signal internally. >>> Alternative is use of fire alarm.	Only effective if staff is listening to broadcast or cable radio or TV.
Factory or Commercial Premises	Nearby siren may alert staff, although current building construction attenuates up to 30 DB. For any business with a high ambient noise level sirens are ineffective.	Not effective for this person activity mode.	High-intensity indoor device will alert staff who can tune radio and then re-broadcast signal internally. >>> Alternative is use of fire alarm.	Only effective if staff is listening to broadcast or cable radio or TV.
Small Business	Nearby siren may alert staff, although current building construction attenuates up to 30 DB. For any business with a high ambient noise level sirens are ineffective.	Not effective for this person activity mode.	High-intensity indoor device will alert staff who can tune radio and then re-broadcast signal internally or else simply alert those present to tune a radio.	Only effective if staff is listening to broadcast or cable radio or TV. However, many small businesses keep a radio tuned most of the time.
Park **-outdoor Recreational activities**	Nearby siren will provide alert.	Nearby street light will provide alert, if observed.	Not effective for this person activity mode.	Only effective if person is listening to a portable radio.

Person Activity Mode	Smart Siren	Street Light	Indoor Warning Device	EBS (WS)
Arena / Stadium	Not effective for this person activity mode.	Not effective for this person activity mode.	High-intensity indoor device will alert staff who can tune radio and then re-broadcast signal internally.	Only effective if staff is listening to broadcast or cable radio or TV.
Church	Nearby siren may disrupt religious service and/or alert staff, although current building construction attenuates up to 30 DB.	Not effective for this person activity mode.	High-intensity indoor device will either disrupt religious service and/or alert staff who can tune radio and possibly re-broadcast signal internally. >>> Alternative is use of fire alarm.	Only effective if staff is listening to broadcast or cable radio or TV.

Home -shelter in place	Re-activation of nearby siren may alert residents, although current building construction attenuates up to 30 DB.
	
	>>> However, if power is off the interior ambient noise level will almost certainly be lower which will increase the opportunity for sirens to be effective.
		Not effective for this person activity mode.
		
		>>> Also not effective if power is off.
			High-intensity indoor device will alert resident under virtually all circumstances.
			
			>>> Device will contain power-pack permitting endurance of several days, but during an extended shelter-in-place situation battery will ultimately deplete if power remains off.
				Resident will be alerted if monitoring live broadcast or cable radio or TV source or Internet streaming source.
				
				>>> In the event of power being off resident must have battery powered radio.
				
				>>> However, in a shelter-in-place situation the resident is already sensitized to the need to frequently monitor a radio or TV broadcast source.

Person Activity Mode	Smart Siren	Street Light	Indoor Warning Device	EBS (WS)
Other Buildings -shelter in place	Re-activation of nearby siren may alert shelterees, although current building construction attenuates up to 30 DB. >>> If a significant number of people are co-sheltered the interior ambient noise level is likely to be moderate or high, which will reduce the ability of sirens to be heard.	Not effective for this person activity mode. >>> Also not effective if power is off.	High-intensity indoor device will alert staff who can pass on alert to shelterees. >>> Device will contain power-pack permitting endurance of several days, but during an extended shelter-in-place situation battery will ultimately deplete if power remains off.	Staff will be alerted by monitoring live radio broadcast. >>> In the event of power being off staff must have battery powered radio.

It will be noted that in TABLE 1 each Person Activity Mode (PAM) is covered – to some extent - by at least TWO of the CWS components and usually by more than two.

It is certainly conceded, however, that there are cases in which augmenting a CWS with an additional component drawn from FRAS technology would make sense. Here are two examples.

1. FRAS Dial-out System Supplement

In a small community, perhaps with 10,000 or less inhabitants, a FRAS-type (dial-out) system may well serve as a useful adjunct component within a CWS, particularly where there is an extended period of time during which to alert all or part of the population to a pending threat or where it is desired to cover a certain territory first.

>>> As part of the CWS it would be activated at the same time as all other components, thus seeking mutual re-enforcement, at least for those indoors.

2. Cell and Pager Signaling

While FRAS-type cell and pager signaling is not normally seen as a CWS component (for the reasons set out below) there may be cases in which adding them as an adjunct component is nonetheless valid. While people tend to 'tune out' when too many messages are received via their most accustomed signaling channels, one can easily imagine a baseball game being played in a park where the distant wail of sirens (if none are installed nearby) and the turning off of street lights (several hundred yards away) at dusk may or may not attract sufficient attention in and of themselves. The simultaneous ringing of all cell phones and beeping of all pagers worn by those present might well provide additional re-enforcement by causing those present to become more attentive, look around and also pick up the other signals. The ability to provide a text message in such circumstances is of course an asset.

>>> These channels are not, however, seen as primary channels, merely as supplements, not least of which because during an actual emergency they may – or may not – be available. ***True too, cell phones and pagers are NOT designed as emergency warning system end-devices; if they were it would not be possible to turn down their ringers nor to turn them off.***

It should also be noted that the following measures are required to make a multi-component CWS truly effective on an ongoing basis.

1. Public Education

Page 1 of the local Phone Book should contain a schematic and explanation of how the CWS works, educating members of the public to recognize the functioning of each component, as well as to look for more components when they become aware that one of them has been activated, as well as to always seek out a broadcast or cable news source to learn the reason for the warning signal.

2. Public Preparedness

Members of the public must do three things to make a CWS truly effective:

-understand the functioning of each CWS component;

-ensure that their Indoor Warning Device remains connected to an AC power source; and

-keep a battery powered radio and fresh batteries available.

>>> Given the benefits offered by timely warning of any natural or manmade disaster, these are not unreasonable requirements to impose upon the public, whether by public education campaign, municipal bylaw or regulation or even via a national warning systems law.

3. Business, Government and Institutional Preparedness

It is necessary to ensure that, whether they are first warned by an Indoor Warning Device or by a cable or broadcast TV or radio source, that the staff of any large facility will immediately make an announcement of the emergency and then re-broadcast a radio signal over their internal intercom system, where available.

>>> In all other cases, the organization should simply implement its fire plan or other emergency plan as required to alert those currently within their facility. Usually this will involve activating some type of internal fire alarm and/or other warning system.

4. Frequent System Tests

For both operational and technical reasons, it is desirable to test the entire CWS – at least at a whole-county level – on a once-per-month basis. Many Midwestern cities in the U.S. have traditionally run such tests at noon on the last Friday of each month, thereby permitting residents relatively high certainty that the CWS activation is in fact a test and also not inducing a false alarm syndrome.

3.2 Smart Siren Based Nature of CWS

Ideally, the core of the CWS is the Smart Siren.

During recent years siren have tended fall from favor because they (unfortunately) tend to evoke in the mind of the public (and especially the electronic media) images of the Cold War, air raid warnings, people running down stairs into shelters and grade school children hiding under their desks….

The fact of the matter, however, is that no other system yet devised is as effective for warning an outdoor population of a pending threat as a siren. True too, despite the steady increase in sound

attenuation characteristics of domestic and other building construction sirens do retain at least some ability to warn those indoors although we have far more sources of indoor sound today than was the case even one or two decades ago. They also retain a better than nominal ability to warn those in vehicles.

During the 1955-1995 period sirens were almost always placed primarily so as to provide geographical coverage - which is to say they were placed in such a way as to blanket the inhabited terrain with their coverage circles. A major innovation of the author's previous CWS work was the development of the Person Outdoor Hour (POH) concept – this counts the aggregate number of hours which people actually spend outdoors (on an annualized basis) at all of the various types of locations within an urbanized area and then places sirens only where there are significant POH concentrations across the year. Besides vastly reducing the number of sirens required to cover a given urban area, and thus reducing total system cost, the POH methodology also vastly increases the relative effectiveness of each siren.

>>> With an ever higher percentage of Americans spending more and more time visiting, or actually moving to, the southern (sun-belt) states, the percentage of time spent outdoors by the American population has, over the past 20 years actually increased. Thus, in many states the level of protectable POH concentrations is rising, not falling. This fact – in and of itself – argues for the inclusion of sirens in any CWS design.

When the CWS approach was developed during the 1980's there were already many good reasons for integrating a computer system with a siren. The key reasons at that time were to permit the siren to:

-sense its environment and report if it is being tampered with or sabotaged;

-sense whether its cohorts are operating and if so attempt to determine whether they are doing so on an uncommanded basis (and thus report them to HQ) or else because they have been legitimately activated by a signal to which this siren should perhaps also be responding (so the siren asks HQ if it should activate);

-survive a nuclear attack, where located outside the blast zone and the hot-wind zone of highest intensity; and

-sense fallout levels in the post-attack environment and re-activate (with the take-cover warning) as and when appropriate, employing a combination of battery and other power sources (assuming that landline power will not be available).

Developments since 9-11 make perfectly obvious some additional functions which a smart siren could legitimately perform in today's world, including:

-provide broad-scale CBRN sensing and reporting;

-activate automatically in the event key CBRN thresholds are crossed, providing a localized take-cover warning while reporting its reason for doing so; and

-engage in much more sophisticated buddy co-diagnosis with cohort sirens both as a means of systematic, periodic system readiness verification and as an anti-sabotage measure.

>>> Extensive measures were planned and developed earlier to protect the originally designed Canadian CWS smart siren network not only from a nuclear attack but also from hostile actions such as interdiction or sabotage. Much of this work remains classified at and above the Secret level and will therefore need to be the subject of a separate project, to which FEMA and PSEPC would need to be parties.

Many sources have suggested that electro-mechanical sirens are in fact obsolete since electronic sirens can be deployed in more flexible power (output) increments, can provide a wider range of warning signals and also can provide synthesized, recorded or live voice announcements.

Unfortunately, nothing could be farther from the truth. Electronic sirens are in fact totally unsuitable for use in a CWS for the following reasons:

-in order to fulfill the above-cited mission, the entire siren must be protected from the mechanical and electro-magnetic impacts of any nuclear detonation which is otherwise survivable for the siren – it is not possible to protect an activated electronic siren from the effects of an electro-magnetic pulse (EMP); and

-all CWS components (except EWS(WS)) are intended to provide only an alerting SIGNAL to the recipient, who must then obtain a radio or TV (broadcast or cable) news source to learn what is happening – there is thus no requirement to provide voice announcements from the siren which experience has in any event shown are almost impossible to synchronize in such a manner as to prevent echo or reverberation effects among cohort sirens – *while smart siren will indeed be complex, the ability to deliver voice messages is one piece of complexity which is simply not required.*

4. Recommendations for Pubic Warning System Requirements

4.1 Context

The information in this document is intended for use by any member of the public warning systems community.

4.2 Recommendations

4.2.0 Best Practice Recommendations

Based on our work in this field over 30 years it is our view that the following are best practices with respect to CWS development, deployment, operation and support.

<u>CWS Best Practice Categories</u>

Governance

System Design / Construction

Coverage Estimation / Test / Validation

Public Information / Education

Control System

Siren

Street Light

Indoor Warning Device

Telephone Dialout

IP Stream

Web

Pager

Cell

Warden/MLS

Facility Warning Device (FWD)

SigAlert

EBS(WS)

Tone Alert Radio

Home Security Systems

Other

CWS Best Practice Template

Each Best Practice is described in the format set out in the template below.

Category	Best Practice Category drawn from above list.
Title	Title of Best Practice.
Description	Text description of Best Practice.
Rationale	Justification or rationale for adopting Best Practice.
Conformance	Optimum method of enforcing or ensuring conformance with Best Practice.
Reference	Reference materials or authority.

4.2.1 Governance

Category	**Governance**
Title	**GOV-100 - CWS Ownership and Operation**
Description	1. Whereas a CWS has as its primary purpose the alerting and warning of the public it should in most cases be owned and operated by the emergency management organization (EMO) with jurisdiction for the domain in which it is installed. This is due to the fact that public warning is a core function of the EMO which can be neither delegated to those outside the emergency management community, nor shirked. 2. In some cases where a major industry (such as a nuclear powerplant or petro-chemical complex) is the source of a significant threat to the domain in which a CWS is installed it will be expedient for that industry to install and maintain the CWS, particularly where it is capable of mustering a competent technical field force. . 3. In all cases the EMO with jurisdiction for the domain in which the CWS is installed should be the primary operator, however sub-delegation (for example from a county to individual cities within that county) may also be warranted in some cases. 4. At the county and city levels there is also justification for according the EMO with the ability to activate the CWS in all or part of a neighboring peer jurisdiction if the threat has apprehended or real impacts on that jurisdiction.
Rationale	1. Ownership and control of the CWS is the best means of the EMO assuring itself that it remains in optimal operating condition (that it is properly maintained, safeguarded and tested) and is therefore both available and reliable when required. 2. <u>Private-public partnerships (P3) are NOT an appropriate vehicle for funding and operating CWS installations because public warning systems, like military systems, must be designed to mission and not designed to cost.</u> In other words, the CWS must perform a given set of functions with specified robustness, availability and reliability so the key design criterion is to perform this mission. While cost is a factor, and it is acceptable to select the least costly system design among several which are capable of performing the mission, it is not acceptable to trade off performance for a cost decrease.
Conformance	TBD
Reference	

Category	**Governance**
Title	**GOV-101 - Enabling Legislation and Regulations – Duty to Warn**
Description	The optimal situation for any warning system domain is for the government of jurisdiction to enact legislation which imposes upon the emergency manager (and jointly upon him and any major threat source) the duty to warn the public in a timely basis of the advent of any threat to which they should pre-emptively respond.
Rationale	Without a legally-enshrined duty to warn the public has no recourse when warning is late, inadequate or non-existent.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to require emergency managers to warn the target audience of real or apprehended threats.
Reference	

Category	**Governance**
Title	**GOV-102 - Enabling Legislation and Regulations – Duty to be Warnable**
Description	In any jurisdictional domain, the same legislation which imposes a duty to warn should also impose upon each member of the public a reciprocal duty to be warnable, including the following: -know and <u>understand the operation</u> of the components of the CWS; -regularly <u>replace the batteries</u> in any device which may be used to warn including home security system, IWD, cell/PDA and of also smoke detector; -when the alert is received by whatever method(s) <u>tune immediately to a live broadcast source</u> to learn the nature of the threat and the consequent instructions to the public; and -promptly <u>comply</u> with warning instructions.
Rationale	Each member of the public has a responsibility to the government and to their neighbors to be a good citizen in times of emergency. Being a good citizen includes being warnable.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to require members of the public and operators of large educational, health-care and commercial/industrial facilities to be warnable as described in this Best Practice.
Reference	Best Practice – FWD-101 Best Practice – FWD-102 Best Practice – FWD-103

Category	**Governance**
Title	**GOV-103 - Authority to Operate CWS / CWS Operator Role**
Description	There must be clear delineation in emergency plans as to who has the authority to activate the CWS, under what circumstances and within what coverage domain.
Rationale	1. The CWS should only be activated by authorized individuals, for prescribed purposes and within the ambit or jurisdictional reach of those individuals. 2. Severe criminal and civil penalties should be instituted for tampering or interfering with the CWS.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to set out the roles, duties and responsibilities of the CWS operator whether it be a federal, tribal/first-nation, state/provincial, county, municipal, industrial or other entity.
Reference	The following Best Practices detail the roles, rights and responsibilities of the CWS operator. Best Practice GOV-100 Best Practice GOV-101 Best Practice GOV-102 Best Practice GOV-103 Best Practice GOV-104 Best Practice GOV-105 Best Practice GOV-106 Best Practice GOV-107 Best Practice GOV-108 Best Practice GOV-109 Best Practice GOV-110 Best Practice DES-100 Best Practice DES-101 Best Practice DES-102 Best Practice DES-103 Best Practice DES-104 Best Practice DES-105 Best Practice DES-106 Best Practice DES-107 Best Practice DES-108 Best Practice DES-109 Best Practice DES-110 Best Practice DES-111 Best Practice DES-112 Best Practice DES-113 Best Practice COV-100 Best Practice COV-101

	Best Practice COV-102 Best Practice COV-103 Best Practice COV-104 Best Practice PUB-100 Best Practice PUB-101 Best Practice PUB-102 Best Practice PUB-103 Best Practice PUB-104 Best Practice PUB-105 Best Practice PUB-106 Best Practice PUB-107 Best Practice PUB-108 Best Practice CNT-100 Best Practice CNT-101 Best Practice CNT-102 Best Practice CNT-103 Best Practice CNT-104 Best Practice CNT-105 Best Practice CNT-106 Best Practice SIREN-100 Best Practice SIREN-101 Best Practice SIREN-102 Best Practice SIREN-103 Best Practice SIREN-104 Best Practice SIREN-105 Best Practice IWD-100 Best Practice IWD-101 Best Practice FWD-100 Best Practice FWD-101 Best Practice FWD-102 Best Practice EBS(WS)-100 Best Practice EBS(WS)-101 Best Practice HSS-100

Category	**Governance**
Title	**GOV-104 - Access Paths to CWS**
Description	1. There should be multiple access paths to each Control System of the CWS. 2. All access paths must contain sufficient access controls to permit only fully authorized users to access the Control System.
Rationale	It is highly undesirable to permit anyone other than authorized emergency managers to access or control the CWS. Warning systems are, by definition, an obtrusive tool of public policy and they have the capacity – in their own right - to cause confusion, disruption, loss and harm.
Conformance	TBD
Reference	

Category	**Governance**
Title	**GOV-105 - Role and Business Rules of Warning Aggregator**
Description	1. When receiving, validating, transmitting and delivering property formatted CAP messages aggregators are performing a public service and, in doing so, they therefore must act first and foremost in the public interest. 2. It is the role of the Aggregator to: -receive a properly formatted CAP message; -ensure conformance of the message to the CAP standard; -ensure that the Warning Originator is authorized to issue the message; -ensure that the message domain is consistent with EMO authority – for example, ensure that the message targets only the EMO's own CWS and/or a peer-jurisdiction CWS (i.e. ensure that a single town is not trying to warn three counties or that a county is not trying to warn an entire province or state); and -deliver each CAP message to its intended recipient which may be a first responder, another EMO, a CWS, a CWS component or – in certain cases – (directly to) the public. 3. All business rules which are implemented in functional logic executed by the Aggregator must be expressly agreed in advance between the EMO and the Aggregator and tested to ensure that all possible cases and outcomes resulting from the execution of such logic are consistent with the intent of the EMO. *>>> For example, it is unacceptable for an Aggregator or carrier to determine (either in advance or at the time of CWS activation) whether or not a given EMO is authorized to activate the CWS in a peer jurisdiction. This is an emergency management issue, not an Aggregator issue.*
Rationale	The role of the aggregator is only to DELIVER the activation command or signal and/or alert/warning message. The aggregator should not in any manner alter any attribute of such signal or message, nor delay or hinder it in any way, nor mis-route it or route it in an incomplete manner.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to set out the roles, duties and responsibilities of the warning aggregator whether it be a broadcaster, cable carrier, cell carrier, other carrier or other type of operator.
Reference	

Category	**Governance**
Title	**GOV-106 - Format of Message Passed Through Warning Aggregator**
Description	1. The U.S. Common Alerting Protocol (CAP) standard shall be employed by EMO's to pass CWS activation messages to Aggregators in the United States. 2. The Canadian profile of CAP (CAP-CO) shall be employed by EMO's to pass CWS activation messages to Aggregators in Canada. 3. The U.S. CAP standard shall be employed by EMO's in either Canada or the United States to pass CWS activation messages (or advisories) to EMO's in the other country. 4. EMO's in Canada shall not employ CAP messages to attempt to activate CWS installations in the United States. 5. EMO's in the United States shall not employ CAP messages to attempt to activate CWS installations in Canada.
Rationale	This practice is consistent with the employment of international standards for communications, aviation and military operations.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to set out the need for conformance to the CAP standard and applicable profiles.
Reference	CAP Standard CAP-CP Standard

Category	**Governance**
Title	**GOV-107 - Instantiation of CWS in Emergency Plan**
Description	1. The design and operation of the CWS should be fully documented in the all-hazard plans of each emergency management jurisdiction which owns or operates all or part of any CWS. 2. The design and operation of the CWS should also be fully documented in any threat specific plans, such as those for hurricanes or nuclear release events, of each emergency management jurisdiction which owns or operates all or part of any CWS.
Rationale	The CWS is an integral part of emergency planning and management and must therefore be fully reflected in the operational plans.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to require the instantiation of the CWS in applicable federal, tribal/first-nation, state/provincial, county, municipal and private facility plans.
Reference	

Category	**Governance**
Title	**GOV-108 - Legal Protection of CWS Operator**
Description	1. The **Warning Originator** is the authorized EMO official or other authorized official – as well as any employee, contractor, designee or delegate of such official. 2. Where the Warning Originator receives credible information about an imminent or real threat to public safety and security, he acts in good faith in determining that a public warning should be issued and he then employs the CWS to issue such a warning, such official – as well as any employee, contractor, designee or delegate of such official – should be held harmless at law from any and all civil liability or criminal culpability for the operation of the CWS, or any negative outcome arising from its operation, provided only that: -he employed reasonable and due care - and prudence - in determining the target audience (in terms of geography and demographics) and hence which CWS components to employ; and -such negative outcome could not be reasonably foreseen or else the outcome could be foreseen, but the Warning Originator had valid grounds to believe that the public good resulting from CWS activation would significantly exceed the impact of the negative outcome.
Rationale	During an emergency officials are required to take decisions very often based on incomplete - *or even conflicting* – information and the very nature of the emergency will in many cases make it impractical to obtain absolutely certain information before taking the decision to warn.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to provide civil and criminal protection to the Warning Originator person, persons or organizational entity which functions as either or both of CWS operator and/or CWS activator.
Reference	

Category	**Governance**
Title	**GOV-109 - Liability for Mis-Use of CWS**
Description	Any person or persons who in any way attempt to willfully interfere with the availability or operation of the CWS by taking any physical action (interference with landlines, radio, control cabinets, sirens etc.) or by use of electronic means (spoofing, jamming etc.) should be made subject to severe civil and criminal penalties.
Rationale	The CWS performs a very essential public service and therefore should be accorded maximum protection under the statute law.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to provide severe penalties for any type of interference with, or unauthorized access to or employment of, any CWS.
Reference	

Category	**Governance**
Title	**GOV-110 - Standard CWS Terms and Definitions**
Description	A common glossary of CWS terms and definitions should be adopted.
Rationale	This measure readily facilitates communications among CWS designers and operators.
Conformance	TBD
Reference	Chapter 2.

Category	**Governance**
Title	**GOV-111 – Maintenance Recommendation for Outside Equipment**
Description	It is recommended to employ the technical field forces of electrical distribution utilities to maintain CWS outdoor components.
Rationale	Whether or not an installed CWS protects the area around a nuclear generating station, field experience has clearly shown that electric utility field technician forces are ideally equipped to install and maintain CWS outdoor components, in particular sirens and street light control systems. These systems require many of the same electrical, radio and signaling landline skills and expertise – and tools/techniques - as are required to maintain electrical distribution, signaling and control infrastructure.
Conformance	Optional
Reference	

4.2.2 System Design / Construction

Category	**System Design / Construction**
Title	**DES-100 - Employ a Multi-Component CWS**
Description	By definition, a CWS includes two or more warning system components which have different types of end-devices.
Rationale	The more components a CWS has the more robust, reliable and effective it is in terms of providing coverage of the target audience.
Conformance	TBD
Reference	Chapter 2

Category	**System Design / Construction**
Title	**DES-101 - Employ Complimentary Warning System Components**
Description	In selecting CWS components these principles should be considered, as follows: (A) Select candidate CWS components which provide coverage of the highest possible percentage of the population in the greatest number of Person Activity Modes (PAM's) possible. (B) Evaluate and select CWS candidate components based on their relative cost and effectiveness, but also ensure that the collective of the selected components provides estimated 24/7 (annual) coverage of at least 75% of the target population. *>>> The CWS coverage estimation methodology is extremely conservative such that an estimated annual coverage of 75% translates to actual real-world coverage of 90-95%* (C) It should be noted that obtaining coverage of 100% is not technically achievable. (D) Key additional CWS candidate selection criteria include: -geography / terrain / ambient electro-magnetic environment; -population demographics (for example, a largely elderly population will have lower mean hearing acuity and will spend less time outdoors making sirens less effective in areas where they are concentrated); -any other skew of PAM's away from national norms based on the topography, demographics, occupation or recreational habits of the Target population.
Rationale	The very essence of a CWS is to have multiple warning delivery components and the correct selection of components maximizes both the capability and the efficiency of the warning system.
Conformance	TBD
Reference	Best Practice DES-116

Category	**System Design / Construction**
Title	**DES-102 – Cover Outdoor, Indoor and in-Vehicle Audiences**
Description	1. CWS should be selected such that at least one component provides outdoor coverage and at least one component provides indoor coverage. 2. Ideally there should be one core component and one secondary component covering each of the outdoor and indoor audiences. For example siren and street light for outdoors and IWD and Telephone Dialout for indoors. 3. The CWS design should include at least one system which covers persons inside motor vehicles. 4. Any CWS design must include EBS(WS) as the broadcast follow-up for those components which are able to alert, but are unable to warn. (Such components include sirens (unless they have voice capabilities), street light, IWD and FWD. EBS(WS) also provides some
Rationale	People spend time outdoors, indoors and in vehicles so the CWS must provide coverage in all three of these domains.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to mandate 24/7 coverage of people who are outdoors, indoors and in vehicles.
Reference	Refs 13 – 14 / Chapter 2

Category	**System Design / Construction**
Title	**DES-103 - Provide Unified CWS Control System**
Description	A single Control System must be employed to permit the Warning Originator to activate one, some or all of the CWS components simultaneously.
Rationale	It is counter-productive and costly of precious seconds to force the Warning Originator to employ different control systems to manage different CWS components.
Conformance	TBD
Reference	

Category	**System Design / Construction**
Title	**DES-104 - Provide Redundant Control Systems**
Description	Control Systems should be installed at two or more separate facilities which ideally should be on different power grids and at least one of which should not be: -in a flood plain; -located atop a known seismic fault; -in a particularly fire-prone area; and -on the site of a major threat industry (nuclear or petro-chemical).
Rationale	If the threat or threats which cause the emergency, or other factors, take a CWS control system out of action, the Warning Originator should be nonetheless enabled to overcome that problem by activating the CWS from an alternative Control System so as to ensure that he/she is able to warn the target audience.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to require that each CWS have a redundant control system.
Reference	

Category	**System Design / Construction**
Title	**DES-105 - Provide Redundant Control Paths from Each Control System to All Components**
Description	Provide at least two full-duplex signaling paths from each Control System either to the head unit for each CWS component and/or to each CWS end-device.
Rationale	The failure of one control path should not prevent the Warning Originator from activating whatever lies at the end of that path.
Conformance	Standard system engineering practice for high availability systems.
Reference	

Category	**System Design / Construction**
Title	**DES-106 - Match Robustness / Availability / Reliability of Control Systems and Control Paths to Warning System Components**
Description	All of the following should have similar (high}) availability ratings in terms of annual availability which should be 99,9999% as well as similar robustness and operational reliability (once activated): -Control Systems; -Control Paths; -CWS components; and -Backup power systems (generators and batteries).
Rationale	Any part of the CWS which falls below the others in terms of availability, robustness or reliability lessens the dispatchability – and effectiveness - of the entire CWS.
Conformance	TBD
Reference	

Category	**System Design / Construction**
Title	**DES-107 - Employ Common Alerting Protocol (CAP) Signaling to Control CWS Components**
Description	In the United States CAP. and in Canada CAP-CP. should be employed by the Control System to interrogate, test, activate and de-activate each CWS component system – and where possible each CWS end-device.
Rationale	The United States and Canada have agreed to adopt CAP as the standard method of emergency system and device signaling.
Conformance	CAP standard CAP-CP standard
Reference	

Category	**System Design / Construction**
Title	**DES-108 - Employ Dedicated Warning System Components Wherever Possible**
Description	Design the CWS to have a core of primary warning components which are fully dedicated to the alerting or alerting/warning function and whose operation reliably provides an unequivocal message which is not likely to be misinterpreted.
Rationale	Sirens and IWD's are dedicated single-purpose primary warning system components which, like a vehicle siren or a smoke detector, are generally used only for one purpose, a purpose which is entirely familiar to the public and which is thus not likely to be misunderstood or misinterpreted. Furthermore these components are fully design-optimized to the functions which they perform. **CWS <u>components such as Telephone Dialout, Cell (voice or text broadcast), screen crawler, IP stream and other components, which touch end-devices which have multiple purposes, should be used only as supplementary CWS components</u> and not as primary CWS components. For example, while it may provide wide coverage, a cell phone is not designed primarily as a warning system component or else it would not be possible for the user to turn down its ring volume or to turn it off entirely.** **Therefore a CWS must include both primary and supplementary components. Supplementary components should NOT be relied upon to provide primary coverage.**
Conformance	Coverage Estimation / Test / Validation
Reference	Ref 1

Category	**System Design / Construction**
Title	**DES-109 - Leverage Intelligence of End-Devices**
Description	Where end-devices already have, or can be provisioned with, machine intelligence this should be leveraged where possible in CWS design. For example, a ubiquitous PDA application which receives a broadcast text warning message might be capable of also validating that message by also seeking an IP stream CAP message or checking a given Web site so as to provide its user with multiple confirmations or assurances of the validity, accuracy, applicability (to him) and currency of the text message.
Rationale	It is always best to maximize how many CWS components reach a given member of the target audience and where machine intelligence can be employed to supplement human senses and intelligence this is desirable.
Conformance	TBD
Reference	

Category	**System Design / Construction**
Title	**DES-110 - CWS Availability**
Description	1. The CWS control system, the control pathways from each control system to each CWS component and each such CWS component itself should each exhibit annual availability of 99.9999% which is essentially a fully-planned operating regime with the only allowable downtime being programmed maintenance downtime. 2. It should be possible to take some CWS control systems, control pathways and/or CWS components off-line for maintenance without compromising any other control system, control pathway or CWS component(s) as the case may be.
Rationale	Emergencies very often occur at “inconvenient” times so the CWS should be able to operate (albeit in a degraded mode) when some CWS control systems, control pathways and/or CWS components are off-line for maintenance or repair.
Conformance	TBD
Reference	

Category	**System Design / Construction**
Title	**DES-111 - Aggregator Availability**
Description	Where a message aggregator is employed either to feed a CAP message to the CWS control system and/or to deliver a CAP message (or any other form of signal) from the CWS control system to one or more components such aggregator should exhibit annual availability of 99.9999% which is essentially a fully-planned regime with the only downtime being programmed maintenance downtime.
Rationale	Where an aggregator is less available, reliable or robust than the CWS to which it feeds a message there is a possibility that an important activation message will not be delivered at a time when the CWS itself is fully operable. Where an aggregator provides one or more of the paths from a CWS control system to one or more CWS components it will compromise the availability of the CWS if it is less available than the CWS.
Conformance	TBD
Reference	

Category	**System Design / Construction**
Title	**DES-112 - CWS Resilience**
Description	1. The CWS control system, control pathways and CWS components should each be technically resilient in terms of: -resistance to internal failures; and -resistance to inadvertent or purposeful external interference. 2. Each CWS control system, control pathway and CWS component should have an optimal combination of landline power feed, backup batteries, solar cells, generators or other backup power sources. Where possible CWS control systems should receive power from two grids. 3. Where feasible, employ high-availability data centre environmental and redundancy best practices for CWS control systems. For example, at no place in the entire CWS physical and logical architectures should there be a single point of failure.
Rationale	The CWS cannot be utilized to warn the public if it is not available to, and therefore cannot be activated by, the Warning Originator.
Conformance	TBD
Reference	

Category	**System Design / Construction**
Title	**DES-113 - Coverage Targetting Capability**
Description	The CWS control system should permit the emergency manager to select warning system target audiences insofar as it is possible to do so by: -activating only certain CWS components and not others; and/or -selecting a limited geographical area to be covered by all CWS components or by certain components.
Rationale	It is disruptive and dysfunctional to extend the alert/warning message delivered by any, some or all CWS components beyond the ambit of the intended target audience. Warning system operation can, in certain circumstances, lead to undesired population behaviour (such as undesired flight, major traffic jams, panic, competition for resources etc.).
Conformance	TBD
Reference	

4.2.3 Coverage Estimation / Test / Validation

Category	**Coverage Estimation / Test / Validation**
Title	**COV-100 - Target Audience Identification / Stratification**
Description	1. It is necessary to define and describe the target audience(s) in terms of their: -numbers; -locations (distribution across geography and jurisdiction); -demographics (age, gender, languages, etc.) -Person Activity Modes (PAM), which are a combination of: -physical status (in building (by type), in vehicle or outdoors); -activity (drawn from a standardized list) -time (by hour, 24 hour clock); -day mode (week day, weekend day or night); and -weather conditions. 2. It is also necessary to consider those with special needs such as people who are blind or deaf as well as hospital patients and prisoners all of whom require special handling in CWS design. 3. Organization of target audience data into the format described in Paragraph 1 above permits the CWS designer to readily map the estimated coverage of each CWS component to each PAM.
Rationale	The current PAM for any target audience group provides critical information as to how effective each CWS component will be to warn them. For example: -sirens are no longer very effective for warning people who are indoors; -telephone dialout systems are ineffective for reaching people who are outdoors unless they also make calls to all cell numbers and those people carry their cell phones outdoors when engaging in such activities as dog-walking, leaf-raking or reading a book in their backyard; -most people do not take their cell phones into the bathroom when they are taking a bath or shower and many people turn off cell phones during some activities, particularly in their bedrooms; -a person who is using headphones or ear plugs and listening to a local recorded music source is very difficult to warn unless they are facing a TV, PC/laptop or PDA; and

	-many people are sound sleepers who require a very loud tone (at the same level of intensity as a smoke detector) to awaken them while others turn down their cell phone ring volume or else turn off their cell phones entirely when going to bed.
Conformance	TBD
Reference	Chapter 2

Category	**Coverage Estimation / Test / Validation**
Title	**COV-101 - Coverage Estimation Methodology**
Description	The coverage estimation methodology for any given CWS should be highly conservative and should assume total coverage subsummation of each component into the coverage provided by each other component except where it can prove otherwise. For example if a given CWS has Component A which covers 40% of the target audience and Component B which covers 30% of the same target audience, then the coverage provided by Component B will be assumed to be subsumed within the coverage provided by Component A except where it can be conclusively proven otherwise. Therefore the total estimated coverage of A+B = 40%.
Rationale	This method gives full credit to CWS components for the areas where they provide probably unique coverage, but it avoids over-counting the coverage of the total CWS by simply adding component-specific coverages together. It also requires CWS designers to ensure that their design includes: -both outdoor-specific and indoor-specific coverage; -both primary components which are not dependent upon audience behaviour and secondary (supplementary) components which are partially or wholly dependent upon audience behaviour; and -consideration of the PAM behaviour of the target audience.
Conformance	TBD
Reference	Chapter 2

Category	**Coverage Estimation / Test / Validation**
Title	**COV-102 - Coverage Modelling**
Description	The Coverage Estimation Methodology forms the basis for modelling the coverage of the CWS. The hourly coverage of the CWS – through each of the week day, weekend day and night time regimes – and having regard to ambient weather conditions – is the subsummative (fully duplicative) aggregate of the coverage of each CWS component controlled for any part of the coverage accorded by any such component which is provably unique from the coverage provided by all other components.
Rationale	This renders a very conservative coverage estimate and forces CWS designers to include sufficient primary and secondary components to ensure that: -most target audience members are covered by two or more components; and -both outdoor and indoor coverage is provided.
Conformance	TBD
Reference	Chapter 2

Category	**Coverage Estimation / Test / Validation**
Title	**COV-103 - Coverage Testing**
Description	1. Test each component of the CWS individually. 2. Test the entire CWS as a single system. 3. All of the following should be measured and assessed: -logical operation of CWS control system; -availability and function of control paths; -physical functioning of each CWS component; -actual ability of each CWS component to reach its target audience; -actual (versus predicted) degree of multiple-component coverage of each PAM by one or more components; and -collective coverage provided by all CWS components. 4. For testing purposes statistically significant sampling is acceptable.
Rationale	This approach permits comparison of estimated and actual coverage results.
Conformance	TBD
Reference	Chapter 2

Category	**Coverage Estimation / Test / Validation**
Title	**COV-104 - Coverage Validation**
Description	1. Coverage is validated when two or more tests, conducted in like conditions, provide an identical level of coverage (or at least 95% consistent coverage) for each PAM by CWS component and by the full CWS. 2. For validation 100% sampling is required.
Rationale	The only way to absolutely prove that a CWS covers an entire target audience is to operate the CWS and demonstrate/measure the coverage of that audience.
Conformance	Full CWS operation in accordance with the Best Practice for Coverage Test with 100% sampling.
Reference	Chapter 2

4.2.4 Public Information / Education

Category	**Public Information / Education**
Title	**PUB-100 - Web Site Coverage of CWS**
Description	1. Before the point in time at which the CWS is activated the following information should be posted on the Web site controlled by the Warning Originator and/or CWS operator: (A) Which CWS components have been activated; and (B) An explanation of the nature, immediacy and severity of the threat as the recommended (or ordered) actions which the members of the target audience are intended to take. 2. Verify that the posted information is publically accessible over the Internet via the most popular Web browsers.
Rationale	It is counter-productive to activate the alerting components of the CWS before all of the components which have the ability to deliver both and alert and actual warning information have been activated and verified to be performing normally.
Conformance	TBD
Reference	

Category	**Public Information / Education**
Title	**PUB-101 - Phone Book Inside Cover CWS Schematic / Instructions**
Description	1. The inside cover of each hardcopy telephone book, whether distributed by the telephone carrier or by a third party to residences and businesses within the coverage domain of the CWS should, by government mandate, contain the following information: (A) A national–standard diagram illustrating the components of the CWS and portraying the operation of each component; and (B) Instructions as to how to consult broadcast, cable, cell and IP stream components of the CWS if one is alerted by sirens, street lights, IWD or Warden/MLS. 2. Where a telephone company or third-party directory provider makes a telephone directory available in digital form via media distribution or via a Web site or other on-line facility the same information should be provided in that document via the same government mandate.
Rationale	Everyone in society, including young school children, should understand the function, importance and actual operation of the CWS as well as how to obtain warning information if alerted by a CWS component (such as an electro-mechanical siren or non-voice-capable electronic siren or IWD) which is capable only of alerting, not warning.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to require telephone companies and third-party providers of hardcopy telephone directories to carry this information on their inside front covers and electronically via digital media distribution, on their Web site directory or other on-line directory.
Reference	

Category	**Public Information / Education**
Title	**PUB-102 - Handout at Recreational Parks and Campgrounds**
Description	At parks, campgrounds and similar facilities which are in – or near – the territory covered by a CWS, in conjunction with the local EMO, the facility operator should provide visitors with a hardcopy hand-out sheet which contains the following: (A) A national–standard diagram illustrating the components of the CWS and portraying the operation of each component; and (B) Instructions as to how to consult broadcast, cable, cell and IP stream components of the CWS if one is alerted by sirens, street lights, IWD or Warden/MLS.
Rationale	1. Those members of the warning system target audience who are engaged in recreation are, by definition, somewhat distracted from the events occurring around them and are instead focussed on the recreational activity of the moment. 2. Those members of the warning system target audience who are visitors to the coverage territory of a given CWS may or may not be aware of what threats do or could exist within that area. For example, they may or may not be aware that a nuclear powerplant is located nearby or that the area has a high probability of tornados. 3. People who come from very rural areas, other countries and/or who have only a rudimentary understanding of English (or in Canada English and French) may require additional information to enable them to recognize and respond to the activation of the CWS.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to require facility operators within CWS coverage territories to distribute material as described in this Best Practice to all users of their facilities.
Reference	

Category	**Public Information / Education**
Title	**PUB-103 - Calendar Mailer**
Description	Provide annually to each residence and business in the CWS coverage area a pin-up wall calendar with the following information on a portion of the calendar which is visible throughout the year: (A) A national–standard diagram illustrating the components of the CWS and portraying the operation of each component; and (B) Instructions as to how to consult broadcast, cable, cell and IP stream components of the CWS if one is alerted by sirens, street lights, IWD or Warden/MLS.
Rationale	This measure provides an always-visible, reminder of the operation of the CWS. This may be particularly helpful for children who are home alone, or for babysitters overseeing young children, at the time the CWS is activated.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to require the annual provision to each residence and business in each CWS coverage area of a calendar as described above.
Reference	

Category	**Public Information / Education**
Title	**PUB-104 – Annual Public Information Meetings**
Description	The CWS operator – whether it is the local municipal or county EMO, or in the case of a hazardous facility (such as a petrochemical or nuclear plant) the operator of that facility - should hold a well-publicized annual public meeting at which: (A) The operation of the CWS is reviewed and explained; (B) The results of any and all silent (ping) tests, growl tests, partial activation tests and full-scale activation tests (whether or not part of emergency exercises) of the CWS throughout the past year are presented and detailed; (C) Any use made of the CWS over the past year during a real or apprehended emergency is detailed together with presentation of data on the coverage estimated to have been achieved, and whether such coverage was achieved within CWS design cycle time; and (D) Summary information regarding the cost, availability, robustness, reliability and maintenance history of the CWS throughout the past year is presented.
Rationale	The CWS is installed and operated on behalf of the public either with public funds or with funds provided to public authorities by industrial facility operators for the benefit of the public. The public therefore has a right to know how such funds are being expended and the value obtained for money spent in terms of the efficiency and effectiveness of the CWS in-toto and of each of its components.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to require the EMO or other CWS provider or operator to hold an annual public meeting as described above.
Reference	

Category	**Public Information / Education**
Title	**PUB-105 - Frequent Full-CWS Testing**
Description	1. Obtrusive run-testing of the full CWS should be carried out at least annually and ideally no less frequently than once per month. 2. In higher risk areas (such as those prone to tornados or those with petro-chemical or nuclear plants) obtrusive run testing of the full CWS should be carried out weekly, at an appointed time, such as Friday at 1200 HRS.
Rationale	1. It is necessary to operate the CWS with sufficient frequency so as to ensure that the target audience is familiar with the operation of each of its components and to ensure that they are consulting an appropriate information source (broadcast, cable, cell or IP stream) to obtain the warning message. *Conversely, it is also possible to operate a CWS too frequently and to thereby induce "wolf-wolf-syndrome" into the target audience such that they become de-sensitized to its function and/or credibility.* 2. The only means of positively establishing that a CWS remains fully operable is to activate it and monitor the operation of each system, component, channel and end-device.
Conformance	TBD
Reference	

Category	**Public Information / Education**
Title	**PUB-106 - Visitor Information Program**
Description	Each CWS operator should establish a program to inform visitors and temporary residents within its coverage territory of the existence, purpose and operation of the CWS. Means of providing this information include, but are not limited to the following: (A) Web site messages and/or Web pages dedicated to the CWS; (B) Recorded messages available at a special CWS status telephone number; (C) Visitor handouts provided at parks, campgrounds and similar recreational facilities; (D) Visitor handouts provided at tourism offices, hotels and travel agents; as well as at municipal or county government facilities; (E) Roadside signs; (F) Advertisements, possibly as part of a regular official notices section carried in local newspapers; and (G) Advertisements in local tourism magazines such as are provided in hotel rooms.
Rationale	1. Those members of the warning system target audience who are visitors to the coverage territory of a given CWS may or may not be aware of what threats do or could exist within that area. For example, they may or may not be aware that a nuclear powerplant is located nearby. 2. People who come from very rural areas, other countries and/or who have only a rudimentary understanding of English (or in Canada English and French) may require additional information to enable them to recognize and respond to the activation of the CWS.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to require each CWS operator to maintain a visitor information component (as described above) s part of its public information program.
Reference	Best Practice PUB-103

Category	**Public Information / Education**
Title	**PUB-107 - Large Facility Liaison Program**
Description	In addition to placing Facility Warning Devices (FWD) at large educational, institutional, health care and commercial/industrial facilities an ongoing program of liaison is required to be implemented by the CWS operator in order to ensure that the current operational staff and duty managers at each such facility understand the operation and significance of FWD warnings and are both capable and willing to play their part during an exercise or actual activation of the CWS. This program should involve the following components: (A) Visitor handouts; (B) Calendars; and (C) A meeting, held no less frequently than every two years, with facility management and/or operational staff to review the overall operation of the CWS plus their role (if any) in relaying the public warning to the occupants of their facility as quickly as possible.
Rationale	1. Occupants who are deep inside large facilities are in many cases unable to be warned via any other means than either: (A) An FWD which is directly connected to an internal alarm tone, bell or klaxon (with or without a voice capability); or (B) A public address system announcement providing both the alert and the warning message. 2. At large facilities cell, pager or similar devices may be required to be turned off (as in meetings) and/or they may provide very poor reception due to local interference.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to require each CWS operator to maintain a large facility visitation component (as described above) as part of its public information program.
Reference	Best Practice PUB-102 Best Practice PUB-103

Category	**Public Information / Education**
Title	**PUB-108 - Door Hanger Reminder Tabs**
Description	It is recommended that the CWS operator should also annually provide to each residence and small business located in the CWS coverage territory a door-hanger tab which contains: (A) A national–standard diagram illustrating the components of the CWS and portraying the operation of each component; and (B) Instructions as to how to consult broadcast, cable, cell and IP stream components of the CWS if one is alerted by sirens, street lights, IWD or Warden/MLS.
Rationale	This measure provides an important supplemental reminder to the target audience of the existence, purpose and operation of the CWS.
Conformance	TBD
Reference	

4.2.5 Control System

Category	**Control System**
Title	**CNT-100 - Unified and Unitary Control of All CWS Components**
Description	Each instance of the CWS control system should be enabled to activate the entire CWS.
Rationale	A CWS cannot provide its designed target population coverage unless all of its components can be activated simultaneously.
Conformance	TBD
Reference	

Category	**Control System**
Title	**CNT-101 - Ability to Operate Each Component Individually**
Description	Each component of the CWS should be capable of being commanded to operate individually, without activating any of the other components. An important caveat is that the EBS(WS) must be activated if any other component is to be activated. Otherwise, the target audience would be alerted but unable to receive a warning message.
Rationale	It should be possible to target certain audiences, or activity modes, to deliver a customized warning message. For example, the advent of a severe thunderstorm may cause an emergency manager to want to issue an alert and warning only to those who are outdoors. In such a case selecting just sirens, streetlights and EBS(WS) would be appropriate.
Conformance	TBD
Reference	Refs

Category	**Control System**
Title	**CNT-102 - Ability to Operate Whole CWS or Selected Component(s) for a Targeted Geography**
Description	1. It should be possible to operate the whole CWS so as to cover for only a sub-set of the total geography. 2. It should be possible to operate one or more CWS components so as to cover only a sub-set of the total geography. 3. The Control system or an accompanying system, should permit the emergency planner to compute the coverage when only some CWS components are employed and/or only a specific part of the total coverage geography is actually targetted.
Rationale	In order to employ a CWS effectively for selective (partial-audience) warning, it is necessary to know as closely as possible the size and characteristics of the target audience(s).
Conformance	There is not yet a known conformance standard or test.
Reference	

Category	**Control System**
Title	**CNT-103 - End-Device Interrogation**
Description	When a CWS-dedicated end-device (such as a siren, IWD, cell phone etc.) is interrogated by the Control System there should be distinct return signals for each of the following four distinct cases: (A) Signal received, but not interpreted; (B) Signal received and correctly interpreted; (C) Signal received and correctly interpreted followed by an unsuccessful attempt to activate; and (D) Signal received and correctly interpreted followed by successful activation (the device is now operating correctly).
Rationale	1. It is important to know if a commanded device has received a signal. **2. It is extremely important to be able to distinguish between <u>non-receipt of signal</u> (i.e. nothing was received by the end-device so therefore nothing is returned to the control system - which must always be assumed when nothing comes back) and <u>inability to operate</u> (signal was received and interpreted, but the device is for some reason unable to operate.)**
Conformance	Live test demonstration.
Reference	Various ISO and ANSI networking standards.

Category	**Control System**
Title	**CNT-104 - End-Device Tamper Alarm**
Description	Each CWS-dedicated end-device such as a siren, IWD, street light control etc. should be capable of informing the emergency manager whenever the device is tampered with, disconnected or deprived of its landline power supply.
Rationale	This will allow problem remediation or tamper interdiction, as required.
Conformance	TBD
Reference	

Category	**Control System**
Title	**CNT-105 - End-Device to Target Audience Mapping**
Description	Where possible individual CWS dedicated end-devices should be mapped to specific target audience sub-sets to support partial use of the system.
Rationale	For example, use of sirens and street lights is appropriate to alert an outdoor target audience.
Conformance	TBD
Reference	

Category	**Control System**
Title	**CNT-106 – Fail Soft Capability**
Description	The Control System should fail soft by reverting to a less capable automated mode, or even a manual mode, rather than failing completely and denying access to or control to the CWS components.
Rationale	The system should be designed to maximize the degree of control accorded to the emergency manager in all circumstances.
Conformance	TBD
Reference	

4.2.6 Siren

Category	**Siren**
Title	**SIREN-100 – Person-Outdoor-Hour Placement of Sirens**
Description	1. Place sirens where there are significant concentrations of Person Outdoor Hours (POH) which are distributed relatively evenly throughout the year or at least grouped into temporal concentrations (such as seasonal use of a park or weekly use of an outdoor arena). 2. Do not place sirens so as to simply cover geography. *>>> A **Person Outdoor Hour (POH)** is a measure of the activity of any person which has them spending time outdoors for one hour – the POH count for a given park is the average annual number of people at the park during a given period normalized over the year – POH counts (one person at the park for one hour equals 1 POH) are used in siren placement to ensure that sirens are placed only where people will be outdoors and thus be able to hear them when they are activated.*
Rationale	1. Note that Siren output (DB) measurements are NOT a surrogate for siren population coverage. Siren population coverage is calculated as follows: -Person Outdoor Hour annual count within coverage circle normalized as a percentage coverage of total annual target population hours; plus -maximum of 20% of the residential indoor population with 0% for those who are sleeping and bathing; plus -0% for those who are inside all other structure types; plus -0% for those who are inside vehicles. 2. Since the 1950's, the capability of sirens to cover indoor target audiences has been steadily eroded due to the following causes: -higher outdoor ambient noise levels due to more motor vehicles, more aircraft, more industries and denser traffic patterns; -residential and light commercial construction includes thicker walls with higher insulation value resulting in higher DB attenuation; -much wider use of carpeting which further attenuates siren tones; -more, and louder, audio sources including recorded and broadcast voice and music, appliances and air conditioning, heating and humidity control equipment; -increased use of headsets which are usually connected to non-broadcast Sources;

	-higher probability of music generated by indoor (non-broadcast) systems which cannot be overcome by the siren signal; and -lower public consciousness of sirens and what their tones imply. **3. While estimating siren coverage of residential indoor populations at 20% (of such populations) may still be generally reasonable, by far the best approach is to assume that sirens provide 0% indoor coverage except in those specific cases where it can be conclusively proven otherwise.**
Conformance	Acceptance of this Best Practice would require revision of FEMA-REP-10.
Reference	Chapter 2

Category	**Siren**
Title	**SIREN-101 – Smart Sirens**
Description	Since the mid-1980's it has been technically possible to apply machine intelligence to sirens to render a Smart Siren. Generically a Smart Siren is a siren with a ruggedized on-board computer system and sensor package which is able to sense its physical, radiological and electro-magnetic environment and govern siren activation behaviour accordingly both under EMO control and (in cases of CBRNE attack and in certain other conditions) also function independently and automatically as and when required. Smart Siren Functions can include Automatic Audio Re-Orientation Fault Squawking / Self-Reporting CBRNE Condition Reporting Reciprocal (Buddy) Diagnosis / Reporting Tamper Reporting Automatic Local Re-Activation Scenarios Nuclear Chemical Earthquake High Wind Smart Siren Benefits include: Flexible Activation (Condition / Location) Instant False Alarm Containment / Control Very High Availability / Self-Test-Reporting Local Condition Sensing / Monitoring / Reporting Selective Re-Warning (Automated / Manual) Sabotage Resistant / Tamper Warning **Maximum Life Saving / Injury Reduction**
Rationale	Operational flexibility, availability and maintainability are all increased by applying machine intelligence to sirens.
Conformance	TBD
Reference	Refs 13 and 14. Best Practice DES-110

Category	**Siren**
Title	**SIREN-102 – Siren Output Measurement**
Description	Measure sound pressure level on-beam, on plane and at a distance of 100 ft from the siren bell or horn.
Rationale	1. Sound pressure level measurements provide a basis for determination of the coverage zone of a siren for purposes of covering those who are outdoors and within that zone. 2. Sound pressure level measurements do NOT provide, either directly or indirectly, a surrogate for the indoor coverage provided by any siren.
Conformance	1. Must achieve 70 DBC in areas where population is greater than 2000 persons per square mile. 2. Must achieve 60 DBC (absolute) or at least 10 DBC over measured ambient level in areas where population is less than 2000 persons per square mile.
Reference	Best Practice SIREN-100

Category	**Siren**
Title	**SIREN-103 - Siren Mounting Pole Design**
Description	Mounting poles of high-tensile steel should be employed such that the pole will flex under high wind conditions while the siren remains attached to the pole.
Rationale	This maximizes siren survivability in the case of high winds or a nuclear detonation.
Conformance	TBD
Reference	Refs 13 and 14.

Category	**Siren**
Title	**SIREN-104 – High Placement of Siren Control Box**
Description	Siren electrical/electronic control boxes, and their attendant antennae, should be placed on the pole at a level which is above human reach.
Rationale	This will reduce the temptation for human tampering and will also reduce colonization of the control box by insects, birds and rodents.
Conformance	TBD
Reference	

Category	**Siren**
Title	**SIREN-105 - Siren Electrical Provisioning and Protection**
Description	1. Sirens should be provisioned with landline AC power. 2. Landline power should be used to trickle-charge the storage battery. 3. For electronic sirens it is desirable to operate from battery while simultaneously increasing the draw from landline AC power. For electro-mechanical sirens it is in many cases desirable to operate directly from landline AC power when it is available. 4. A solar cell or other secondary power source should be used to trickle-charge the battery.
Rationale	It is required for each CWS component to have a backup or standby power supply to ensure sufficient availability.
Conformance	TBD
Reference	Best Practice DES-110

Category	**Siren**
Title	**SIREN-106 – Siren Placarding**
Description	Sirens should be placarded to indicate their purpose (to alert the population to tune to a live broadcast signal) as well as to warn any would-be (physical or electronic) tampers of severe penalties.
Rationale	This will help both to explain the purpose of the CWS as well as to ward off potential tamperers.
Conformance	TBD
Reference	

Category	**Siren**
Title	**SIREN-107 – Siren Type Selection Criteria**
Description	1. Sirens can be divided into two broad types: (A) Electro-Mechanical sirens which generate tones via combinations of moving rotors and casing physical architecture; and (B) Electronic sirens which use a tone generator, amplifier and speaker which in some cases can generate not only tones but also voice messages. 2. Industry and other data reviewed in preparing these Best Practices, along with commentary from various siren operators, was by no means entirely conclusive, and various vendors and operators make conflicting claims, however the following statements are believed to be substantially correct. (A) Where only one tone or a small number of tones is required, either an electro-mechanical siren or an electronic siren will provide adequate service, all else being equal. (B) Where a larger number of tones is required and/or it is absolutely necessary to make voice announcements (such as at a large outdoor industrial facility where workers for functional or security reasons may not be carrying cell/PDA devices) electronic sirens offer voice capabilities which are simply not available from electro-mechanical sirens. However, a large amount of research and development work has been undertaken over the past 30 years in efforts to combat the echo, interference and cross-cancelling impacts of multiple electronic (voice-capable) sirens in the same area carrying the same voice announcement simultaneously. This work has not been entirely successful and these types of interference problems persist. Therefore, electronic sirens which are configured to deliver voice announcements should never be placed close proximity to each other in areas where there are many tall buildings, the geometry of which can serve as a form of echo chamber, exacerbating such interference. (C) Electro-mechanical sirens are, in general, simpler and more robust in their physical design and construction, and their electrical design, having fewer components as compared to electronic sirens – for an equal or closely comparable rated sound pressure level output, this results in a longer service life as well as lower capital and maintenance costs, all other things being equal. These differences between electro-mechanical and electronic sirens are accentuated in difficult operating environments such as those with prevalent or frequent salt air, fog, dust, ash or very fine ice pellets. Electro-mechanical sirens are also more inherently resistant to incursions of insects, birds and rodents. (D) Where a siren and its control system must be hardened so as to be nuclear-survivable (i.e. to operate before, during and after a nuclear detonation) it is necessary to select an electro-mechanical siren because it is not practical to fully protect an electronic siren from the adverse impacts of an electro-magnetic pulse resulting from a nuclear detonation.

	(E) In general, stationary and fixed directional or omni-directional sirens are preferable to rotating sirens because the latter require additional componentry – and complexity – which can add to capital and maintenance cost and also lower reliability. *What you do not have cannot break.* (F) All else being equal, omni-directional sirens provide acoustic coverage which is easier to plan, test and validate than that provided by directional sirens. The exception, of course, is rotating directional sirens. (G) In general, for sirens of the same or closely comparable performance profile (in terms of sound pressure level output, directionality and endurance) the electrical supply requirements of electronic sirens are lower than those of electro-mechanical sirens - so in locations where landline electric power is prohibitively expensive, difficult to provision or totally unavailable (i.e. where the siren must rely heavily or totally on a secondary power sources such as solar and on a backup battery power source) electronic sirens are preferable. (H) Local topography, type and scale of building construction and ambient climatic/weather conditions impact the acoustic profile of any given siren. Sound pressure level propagation modelling enables sirens of differing directionalities and output levels to be considered and compared as candidates for a given pole location resulting in selection of the optimum type of siren for that location. (I) Electronic sirens are more susceptible to vandalism and sabotage, particularly if hard solid objects (balls, pucks, rocks etc.) or water are used as an intrusive agent. Electronic sirens are also more susceptible to negative impacts of water incursion as a result of sheet (or horizontally oriented) rain, freezing-rain, sleet or ice pellets during severe storms.
Rationale	Selection of the optimum type of siren for a given service requirement will minimize capital and operating costs, assure maximum possible availability and reliability and optimum population coverage.
Conformance	N/A
Reference	

Category	**Siren**
Title	**SIREN-108 – Siren Test Intervals**
Description	1. Recommended interrogation / test intervals for sirens are as follows: (A) Interrogation testing conformant to Best Practice CNT-103 at least once per day, and ideally more often if operationally practical; (B) Silent test at least weekly or monthly; (C) Growl tests at least quarterly; and (D) Full activation test at least once per year. 2. In cases where the full CWS, or at least the siren component of the CWS, is tested weekly at a standardized time (such as at noon on Fridays) Parts 1(B), 1(C) and 1(D) above are not required.
Rationale	The best test is a full activation test. It places more stress on the siren system, and more fully proves the satisfactory operation of the system, than any other type of test.
Conformance	TBD
Reference	Best Practice CNT-101 Best Practice CNT-103

4.2.7 Street Light

Category	**Street Light**
Title	**SL-100 – Inverse Use of Street Lights**
Description	Use transceiver/switch device coupled to street light control equipment to turn street lights on during the day and off at night as a supplementary means of alerting those who are outdoors plus those who are indoors who may be looking outdoors.
Rationale	Flashing of street lights has a higher probability of attracting attention, however of some types of street light bulbs are susceptible to early failure if flashed. Also some streetlight control systems are not designed or configured to permit street lights to be flashed.
Conformance	TBD – A national electrical standard for this CWS component is required in both Canada and the United States.
Reference	Refs 13 and 14

4.2.8 Indoor Warning Device

Category	**Indoor Warning Device**
Title	**IWD-100 – Multi-Bus Indoor Warning Device (IWD)**
Description	Conceptually, an Indoor Warning Device (IWD) is a small dedicated device which plugs into, and covers, an indoor 110VAC electrical outlet, containing a unique device identifier code and a modifiable assigned address code plus a battery, a flasher light, a reset button and an alerting buzzer which may be activated by any one or more of the following: -Cable Module – receives (and sends) signal over coaxial cable owned and operated by the local cable company; -Radio Module – AM, VHF or UHF transceiver – receives (and sends) signal over the air and is not necessarily required to receive and transmit in the same frequency band; -Telephone Module – receives signal over twisted pair without the necessity of the line going off-hook and returns signal via the same channel; and -Carrier Current Module – receives signal over powerline carrier and returns signal via same channel.
Rationale	This is a dedicated device whose sole (or at least primary) function is to sound an alert tone when activated. Like a smoke detector it cannot be turned down in volume nor turned off and its tone is both immediately recognizable and has an unequivocal meaning.
Conformance	TBD
Reference	Chapter 2

Category	**Indoor Warning Device**
Title	**IWD-101 – Application of Indoor Warning Device (IWD)**
Description	IWD should be employed to provide primary coverage of indoor residential, small-business and other small-building target audiences.
Rationale	1. The design and intended role of the IWD is targetted, and dedicated, to coverage of persons who are indoors. 2. Only those indoors are likely to be alerted by an IWD.
Conformance	TBD
Reference	Best Practice DES-114 Best Practice COV-101 Best Practice COV-102 Best Practice COV-103 Best Practice COV-104 Best Practice COV-105

4.2.9 Telephone Dialout

Category	**Telephone Dialout**
Title	**TEL-100 – Application of Telephone Dialout System**
Description	Telephone Dialout systems should NOT be deployed for target populations which are too large to permit the system to effectively alert and warn the entire population within a 15 minute cycle time.
Rationale	Trusting a Telephone Dialout system to, for example, warn 3 million people (in a contiguous metropolitan area) to take cover within five minutes is very unwise because this is simply not technically feasible despite the claims made by many "*Civic Notification System*" Vendors. Telephone Dialout systems are suitable for populations in the 1000 to 50,000 range and in certain cases in the 50,000 – 150,000 range. Application to higher populations carries level of risk which rises more than linearly with rise in population level.
Conformance	Vendor performance claims of this type should be greeted with demands for field trial proof under realistic operating conditions.
Reference	

Category	**Telephone Dialout**
Title	**TEL-101 – Recognize PSTN Vulnerabilities in CWS Design**
Description	It is *NOT considered a best practice* to implement a Telephone Dialout system as the primary indoor alerting component of a CWS which must reach a *mass* audience. For this reason, Telephone Dialout systems should be used as SUPPLEMENTARY indoor notification systems, not as the primary indoor system upon which a CWS is reliant.
Rationale	1. Historical events have clearly shown that during an apprehended *or real* emergency situation any single or combination of the following factors may partially – *or totally* – impair the effectiveness of a Telephone Dialout system: -slower calling progress – an inability to process and complete outbound calls at the designed performance level due to line access and/or internal software issues; -overload of the PSTN and/or cellular telephone systems due to a sudden increase in call volume which may result in either a situation of degraded PSTN performance or even a total collapse of service; -potential for flow control to be imposed on the PSTN by telecom carrier or government officials who may not be considering the impact of such actions on CWS performance; -tendency of some residents to ignore telephone calls, particularly those received during the 1700-2100 HRS window during which most telemarketer and survey polling calls are made; and -the Telephone Dialout vendors are usually located in a different area code than the target audience – within any area code, and again within any (prefix) exchange – the number of circuits available within that domain exceeds the number of external circuits – this creates a telephone network structural limitation in terms of how many lines into a given area code or exchange an external party can obtain – recent developments in digital telephony (including the rise of VoIP) reduce but, do not remove, the impact of this limitation. 2. Experience has also shown that many types of emergency events, such as hurricanes, tsunamis, tornados, snow storms, ice storms and others, may significantly impact PSTN, cellular radio, microwave and even satellite infrastructure. In some cases, as shown in the Fukushima nuclear accident, a seismic and/or climatic event may either cause and/or exacerbate an event at a risk-posing industrial facility while simultaneously interfering with emergency communications between: -the EMO and first responders in the field; and -the EMO Warning System originator and the target audience of the CWS.

Conformance	TBD
Reference	Best Practice DES-113 Best Practice COV-100 Best Practice COV-101 Best Practice COV-102 Best Practice COV-103 Best Practice COV-104

4.2.10 IP Stream

Category	**IP Stream**
Title	**IP-100 – Maximize Paths to End-Devices**
Description	Maximize the number of logical and physical paths which the emergency alert/warning message travels in order to maximize the chances that at least one such message will reach each user who is a member of the target audience.
Rationale	It is better that a person receives on their PDA all three of a text message, a tweet and an E-Mail rather than receiving none of the above.
Conformance	TBD
Reference	

4.2.11 Web

Category	**Web**
Title	**WEB-100 – Post Message Before CWS Activation**
Description	Post a clear and unequivocal alert/warning message before the CWS is activated.
Rationale	If a person hears a siren or sees a text message and then finds no information on the EMO's Web site they will in all likelihood discount the credibility of the alert and not further seek warning information.
Conformance	TBD
Reference	

4.2.12 Pager

Category	**Pager**
Title	**PGR-100 – Minimize Text Message Length**
Description	Minimize the length of the text message intended for transmission to pagers.
Rationale	Various pagers are capable of handling differing text message lengths and a lowest common message length must be employed to ensure that all pager users receive both the same message and a complete message.
Conformance	TBD
Reference	

Category	**Pager**
Title	**PGR-101 – Application of Pager CWS Component**
Description	1. Pager capabilities should be taken advantage of wherever they are available. 2. Care should be taken in terms of estimating Pager coverage of the target audience in areas where pager system signal coverage is poor or intermittent due to the topography, electro-magnetic signature of the earth or locations of the cell towers.
Rationale	It is folly to design a CWS to provide 99.9999% availability to deliver a message to an end-device which may be available 30-50% of the time and then to assume that all such coverage flows through to the user of such end-device. Realistic assumptions must be made about both cell technical coverage and cell user audience behaviours.
Conformance	TBD
Reference	Best Practice DES-113 Best Practice COV-100 Best Practice COV-101 Best Practice COV-102 Best Practice COV-103 Best Practice COV-104

4.2.13 Cell

Category	**Cell**
Title	**CELL-100 – Maximize Leverage of End-Device Capabilities**
Description	Design the cell-targetted alert/warning message package so as to take maximum advantage of all available cell/PDA capabilities, including: -emit a regular or special ringtone; -flash; -vibrate; -receive voice broadcast message; -permit user to receive and acknowledge voice call (technically from the Telephone Dialout CWS component, if present); -receive and display a text message, E-Mail or tweet (technically from The IP Stream CWS component, if present); -browse Web site; and -run an EMO-generated application which could automatically seek out authentication and/or /confirmation of the warning message and also additional relevant information given the user's current location and demographics or special needs.
Rationale	The more machine intelligence can be applied to alerting and warning the user, the better are the chances that this will occur.
Conformance	TBD
Reference	

Category	**Cell**
Title	**CELL-101 – Application of Cell Component of CWS**
Description	1. Cell capabilities should be taken advantage of wherever they are available. 2. Care should be taken in terms of estimating Cell coverage of the target audience in areas where cell signal coverage is poor or intermittent due to the topography, electro-magnetic signature of the earth or locations of the cell towers.
Rationale	It is folly to design a CWS to provide 99.9999% availability to deliver a message to an end-device which may be available 30-50% of the time and then to assume that all such coverage flows through. Realistic assumptions must be made about both cell technical coverage and cell user audience behaviours.
Conformance	TBD
Reference	Best Practice DES-113 Best Practice COV-100 Best Practice COV-101 Best Practice COV-102 Best Practice COV-103 Best Practice COV-104

4.2.14 Warden / Mobile Loudspeaker System

Category	**Warden / Mobile Loudspeaker System**
Title	**WD/MLS-100 – Standing Volunteer Warden Service**
Description	Establish, support and maintain a standing volunteer Warden Service which has a formal structure and mission statement, a Chief Warden, distinctive vests and caps or else full uniforms plus at least the following equipment: -concise version of emergency plan and zone map; -VHF voice/data radio; -mountable light / siren bar with whelp and public address capability; and -authority and equipment to activate or de-activate any field end-device (such as a siren or street light control unit) which is not functioning as commanded by the EMO.
Rationale	The purpose of the Warden Service is to provide supplementary warning, confirm that requested shelter-in-place or evacuation instructions are being complied with and assist those with transportation requirements and/or special needs.
Conformance	TBD
Reference	Ref 14

Category	**Warden / Mobile Loudspeaker System**
Title	**WD/MLS-101 – Application of Warden/MLS**
Description	Due to the relatively high cost of establishing, administering and maintaining a Warden / MLS service it is optimally applied to high risk areas such as those around nuclear powerplants and petro-chemical complexes where it is essential that CWS coverage of the target population be brought up to very close to 100% as quickly as possible.
Rationale	Warden/MLS provides a supplementary warning system capability which augments sirens for outdoor warnings and also pays particular attention to those least likely to receive and understand the warning, such as the elderly, the handicapped and those who do not speak the language(s) in which the warning is given.
Conformance	TBD
Reference	Ref 14 Best Practice DES-113 Best Practice COV-100 Best Practice COV-101 Best Practice COV-102 Best Practice COV-103 Best Practice COV-104

4.2.15 Facility Warning Device

Category	**Facility Warning Device**
Title	**FWD-100 – Selection of Facility Warning Device**
Description	The FWD should be either a Tone Alert Radio or else the same device as is used for the IWD component of the CWS (if employed).
Rationale	An FWD is installed at a school, hospital or a large commercial / industrial facility which is capable of performing two distinct functions, usually in parallel: -advising facility operators of the alert/warning message and asking them to relay it to their occupants; and -employing facility public address and/or fire alarm systems to attract the attention of facility occupants;
Conformance	TBD
Reference	

Category	**Facility Warning Device**
Title	**FWD-101 – Support of Facility Warning Device**
Description	On a regular basis each facility using an FWD should be provided with updated instructions, new batteries and the means of testing the operation of the device.
Rationale	This maximizes the chances that the device will both function and be paid attention to by facility staff.
Conformance	TBD
Reference	

Category	**Facility Warning Device**
Title	**FWD-102 - Application of Facility Warning Device**
Description	Facility Warning Devices should be applied to schools, clinics, hospitals, seniors chronic-care facilities plus commercial and industrial facilities including shopping centres.
Rationale	While some “care and feeding” is required to ensure that the FWD remains connected to the internal PA system or fire alarm system – as well as to ensure the facility staff remain aware of what to do if an alert is received – the high population of such facilities provides a very high yield in return for the emergency manager’s effort.
Conformance	EMO-Facility agreement / Government ordinance
Reference	Best Practice DES-113 Best Practice COV-100 Best Practice COV-101 Best Practice COV-102 Best Practice COV-103 Best Practice COV-104

4.2.16 SigAlert

Category	**SigAlert**
Title	**SIG-100 – Application of SigAlert**
Description	SigAlert road-side signs should be employed to convey two very simple messages: -there is an emergency situation; and -tune to a live broadcast source for further information.
Rationale	Attempts to convey larger amounts of information may result in incomplete comprehension, undue distraction of drivers (with the attendant potential for more accidents, which no emergency manager wants to have during an emergency) or confusion.
Conformance	Enforced in CWS business rules by the road authority owning the SigAlert signs.
Reference	

4.2.17 Emergency Broadcast System / Warning System

Category	**Emergency Broadcast System – Warning System**
Title	**EBS(WS)-100 – Provide Direct (Live-to-Air) Access**
Description	By whatever is the required combination of federal or other legislation, regulations, broadcaster/carrier license conditions, or negotiated agreement the emergency manager must be accorded direct and immediate live-to-air access which can be employed to broadcast to the target audience any of the following: -a live voice message directly from a microphone at the EOC; -a recorded voice message; or -a text-to-speech message.
Rationale	1. It is totally unacceptable to have a situation wherein the emergency manager is forced to beg the programming director, producers or on-air personality for access to live air by trying to convince them of the seriousness of an emergency situation. 2. Such a situation can – *and in some cases doubtless will* – result in the inability of the emergency manager to transmit to the public, on a timely basis, the warning message which must accompany all of the alerting functions of all CWS components. 3. Such a situation also prevents the emergency manager from using the EBS as a warning system - wherein anyone who is already monitoring a live broadcast or cable program is automatically both alerted and warned. 4. This inability of the emergency manager to transmit his warning message to the public on a timely basis can result in increased property damage, injuries and deaths which might otherwise have been avoided. 5. Therefore, the slow but steady drift away from giving the emergency manager direct and immediate access to live-air – *which has been in progress since the end of the Cold War* – must be reversed.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to require broadcasters, cable operators, telephone companies, satellite communications companies and all other common carriers to permit CWS operators direct access to live air or live stream as the case may be.
Reference	

Category	**Emergency Broadcast System – Warning System**
Title	**EBS(WS)-101 – Clear, Concise and Unequivocal Warning Message**
Description	The emergency manager must transmit a warning message which is clear, concise and unequivocal in explaining the nature and extent of the threat posed to the public by the emergency, what actions they are required to take and the true degree of urgency of the situation.
Rationale	Without such information the population may either under-respond or over-respond to the emergency, potentially making the situation worse.
Conformance	TBD
Reference	

4.2.18 Tone Alert Radio

Category	**Tone Alert Radio**
Title	**TAR-100 – Application of Tone Alert Radio**
Description	Tone Alert Radio should be used in three circumstances: -in communities where use of weather radio, marine radio, aviation radio or other dedicated forms of radio is well-established and where Its use can therefore be readily integrated with the use of other types of radio within the residential and small business contexts; -in high-risk areas such as those around nuclear powerplants and large petro-chemical facilities; -as a surrogate for, or in lieu of, an IWD in a large facility such as a school, hospital or industry.
Rationale	Tone Alert Radio provides a very high confidence end-device, but it is expensive to acquire, administer and support.
Conformance	TBD
Reference	

4.2.19 Home Security System

Category	**Home Security System**
Title	**HSS-100 – Link to Home Security Service Operator Head-End**
Description	1. The optimal architecture for including Home Security Systems as a component of a CWS is to establish two or more redundant control channels from the CWS Control System to the commercial home security service operators' head-end facilities. 2. Such channels should include a direct-to-line bypass path at each such head-end facility so that the CWS warning signal does not have to be in any way managed by operators in the head-end facility control room, but rather it immediately activates the alarm tones of the devices installed at all of the residences and businesses in the target area. 3. The ability to include a text message should be exploited where available.
Rationale	Involvement of home security service head-end facility control room operator staffs will both add span time and also introduce the possibility of the alert being prevented from delivery.
Conformance	EMO-Operator agreement.
Reference	

Category	**Home Security System**
Title	**HSS-101 – Application of the Home Security System Component**
Description	Home Security Systems should be employed wherever possible as they are a low-cost, low-risk supplement to Telephone Dialout, IWD and Cell means of alert delivery to residents who are indoors.
Rationale	Like smoke detectors, Home Security System end-devices are understood by all residents to be single-function devices which not only emit a very loud sound, but are also seen as being fully justified in doing so. Therefore, there is an extremely high probability that anyone who is attracted (or even awakened from a deep sleep) by such a device will pay attention to it. Connecting home security providers into the CWS control path will also provide an additional service to the home security subscribers at virtually no incremental cost to the operator or subscriber.
Conformance	Appropriate federal legislation in the United States and Canada should be amended to make it mandatory for residential and commercial security system operator head-end facilities to be interconnected with, and fed alert/warning message by, CWS operators.
Reference	

ANNEX A - References

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ANNEX B – Modelville CWS Coverage Estimate

1. Purpose

This ANNEX provides a nominal baseline for CWS coverage estimation using a hypothetical small town with a population of 5000.

2. CWS Components

The following CWS components are included.

Primary Components

1. **Siren** (placed only where there are significant Person Outdoor Hour (POH) concentrations)

2. **Streetlights** (inverse use – turned on in day, off at night)

3. **Indoor Warning Device (IWD)** (small device which plugs into a standard 110VAC outlet - stand-alone or piggybacked onto an intelligent gas/electric meter with operator's choice of one-way or two-way RF, telephone, cable or powerline carrier signaling)

4. **EBS(WS)** – Emergency broadcast on radio, TV, cable TV

Secondary Components

5. **Telephone Dialout** (dialout system with special ring, recorded message and ACK capability – counts landline only – falls under First Responder Alerting System (FRAS) category discussed below)

6. **Cell** phone (includes Telephone dialout to cell/PDA, IP stream (SMS/Twitter etc.), text-to-speech and text messaging)

7. **Pager**

8. **IP Stream** (includes non-voice capable PDA's, laptops and PC's - excludes cell phone)

9. **Facility Warning Device (FWD)** (institutional version of IWD, linked to fire alarm and/or PA)

10. **Home Security System** (activated via security monitoring operator firm's head-end)

Tertiary Components

11. **Warden / Mobile Loudspeaker System (MLS)**

12. **Web Site**

13. **Twitter**

14. **Sig Alert**

14. **Tone Alert Radio (TAR)**

3. Basis of Estimate Coverage

1. This is a NOMINAL coverage estimate based on the author's experience in the design and development of CWS, as updated by recent projects and consistent with known Person Activity Modes (PAM's) of the Canadian population.

2. This is a non-winter (spring, summer and fall) case.

3. A MASTER PAM table was developed and then utilized to estimate the coverage of each CWS component based on a normal distribution of PAM's.

4. The following assumptions were employed:

-60% of all persons (of all ages) indoors will have operational cell phones with the following exceptions:

-20% of hospital patients; and

-0% of prisoners.

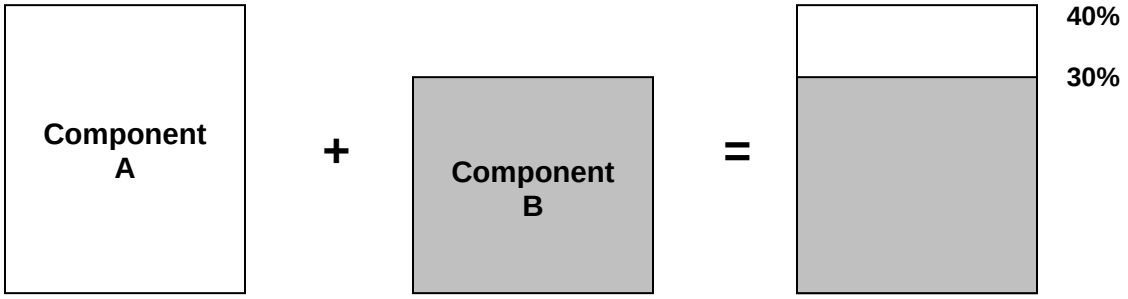
5. **Sirens** are effective for warning 100% of persons outdoors within their coverage areas, but only 20% of persons indoors with the following exceptions:

-0% for those indoors who are sleeping or bathing; and

-0% for those indoors who are watching TV / cable TV / video / DVD.

6. This estimate employs a unique coverage estimation methodology which is extremely conservative and therefore in most cases actually understates the probable 24/7 coverage of a given CWS installation. Where a CWS has two components – A and B – the methodology assumes that if Component A covers 40% of the population and Component B covers 30%, the latter is deemed to be entirely subsumed within the former except where we can clearly prove otherwise. See FIGURE 1..

FIGURE 1 – COMPONENT COVERAGE SUBSUMMATION



>>> Using this very conservative methodology the earlier Canadian CWS program predicted a 74.3% coverage of the national population on a 24/7 basis, which almost certainly translates in to practical, real-world coverage in excess of 90%.

7. The time regimes used are as follows:

NAME	TIME	NUMBER IN YEAR
WEEKDAY	0800-2359 HRS	260
WEEKEND	0800-2359 HRS	105
NIGHT	0000-0759 HRS	365

>>> NOTE: The number of occurrences in the year of each time regime are used to weight the percentage coverages to obtain a weighted annual average.

8. It is assumed that:

-100% of households have cable TV, Internet and a PC or laptop; and

-a maximum of 10% of the population has pagers (this is a very generous assumption).

4. Modelville Coverage Estimate

TABLE 1 provides high-level a coverage estimate using the method described above, rounded to the nearest 10% of aggregate coverage for the CWS primary and secondary components.

TABLE 1 – CWS COVERAGE MAP BY COMPONENT

Coverage	SIREN	S/L	IWD	EBS	TEL	CELL	PGR	IP	FWD	H/SEC
Nominal	**17%**	**8%**	**61%**	**9%**	**31%**	**29%**	**6%**	**9%**	**26%**	**12%**
Mapped										
100%										
90%										
80%										
70%										
60%										
50%										
40%										
30%										
20%										
10%										

COVERAGE NOTES

1. For the optimum (WEEKEND) case 1280/1880 (68%) of the total SIREN aggregate **17%** coverage is outdoor coverage. This equates to 11.5% of total coverage.

2. The next best outdoor system is CELL with 720/1880 (38%) coverage, equating to **11.6%** of aggregate coverage.

3. Therefore those outdoors who do not have a cell phone/PDA constitute at least 6% (17% - 11%) of the total population. In practice this would be almost certainly be at least 10% since the above figures take no account of cell users who, for instance, do not bring along a cell phone while walking outside or else turn it off. **Therefore, the total siren coverage is shown as being only 50% subsumed in the coverage offered by other components because at least half of siren coverage is unique.**

4. Employing the method of totally subsuming the coverage of each component into the coverage provided by all other components, except where we can prove otherwise, this CWS configuration provides nominal annual coverage of at least 70%.

5. It is noteworthy that this entirely modern example (considering all of cell/PDA, pager and IP stream) produces aggregate CWS coverage numbers very close to the 74.3% generated in the original Smart Siren Based Composite Warning System Program from the 1980's. The major differences are:

-cell and pager provide good coverage, but they totally dependent upon the activity mode being engaged in by the target audience members at the time the warning is transmitted; and

-IP stream provides a powerful adjunct by being able to attract the attention of home and office computer users.

6. It is assumed that Home Security System covers only 20% of households.

7. The 12% coverage from **Facility Warning Devices** used in large buildings does not overlap home coverage of other components at all and it also renders some unique coverage. A fuller analysis would be required to determine exactly how much, but it would be safe to say that 10% or more of this coverage does not overlap residential coverage at all.

8. This modal analysis makes clear one of the key strengths of a CWS which includes at least sirens, street lights, IWD and EBS (WS): each of these four principal or core components create a situation where the emergency manager's ability to alert a target audience is MINIMALLY DEPENDENT upon the current behaviour or activity mode of each member of that audience.

9. Conversely, **Cell**/PDA and **Pager** devices make the emergency manager HIGHLY DEPENDENT upon the current behaviour or activity mode of each member of the target audience because:

-virtually all cell and pager users turn the devices off at certain times and in certain circumstances (for instance, most people do not leave their cell phone turned on during sex…);

-virtually no cell and pager users take them into the bathroom when they are taking a bath or shower;

-many cell users turn them off at night or leave them in a room other than their bedroom and thus far enough away to have no chance of awakening them;

-cell and pager devices are highly subject to battery life constraints and anyone who forgets to charge the device overnight will in many cases find it inoperative later in the night or upon rising the following morning;

-even if it is taken into the bedroom, a beeping or ringing cell or pager MAY OR MAY NOT awaken a sleeping person and thus cannot be relied upon to do so (indeed, this is the very reason why smoke detectors emit such a loud sound – *they are designed reliably to awaken a sleeping person – cell phones and pagers are NOT designed to reliably awaken a sleeping person as evidenced by the fact that they have adjustable ringer volume controls);* and

-while it is fine to point out that all of the Telephone, Cell and IP Stream actually do converge to a PDA this is a distinctly double-edged sword because once such a device is turned off, out of power or out of awakening distance, a PDA cannot be reliably counted upon to awaken a sleeping person so all of these three channels are simultaneously neutralized and their collective effectiveness as CWS components falls to 0%.

10. However, an important side-benefit of cell and pager systems during mass audience situations (concerts, movies, sports events etc.) is that if even a few members of the audience receive a warning

message all will soon be warned by cohort observation and by discussion/relay of the message by those who did receive it.

11. It should also be pointed out that deployment of an EMO-generated application to PDA's could be of immense value because it could receive and relay a text or voice message to is user while simultaneously seeking out authentication/confirmation of the warning message and also additional relevant information given the user's current location and demographics or special needs.

5. CWS Total and Component Coverage Estimates

The following pages provide coverage estimate tables for each CWS component.

COMPONENT **SIREN**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	0	20	0	4000	0
HOME - Cooking / Cleaning / Laundry	150	30	500	100	70	14
HOME - Working with PC/Laptop	350	70	50	10	100	20
HOME - Watching TV/Cable	150	30	250	50	200	40
HOME - Watching Video / DVD	20	4	50	10	100	20
HOME - Reading	50	10	100	20	100	20
HOME - Exercising	20	4	50	10	0	0
HOME - Using Cell Phone	150	30	200	40	50	10
HOME - Using Landline Phone	100	20	150	30	50	10
HOME - Hobby Activities	10	2	50	10	50	10
HOME - Conversation / Entertaining	100	20	250	50	100	20
HOME - Outdoors	50	50	150	150	10	10
STREET - Walking - Outdoors	150	150	300	300	50	50
VEHICLE - Driving	400	0	700	0	50	0
SCHOOL - Indoors	720	144	0	0	0	0
SCHOOL - Outdoors	80	80	30	30	0	0
OFFICE - Indoors	500	100	50	10	20	4
COMMERCIAL - Indoors	300	30	500	100	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	30	300	300	0	0
INSTITUTIONAL - Indoors	600	120	50	10	50	10
INDUSTRIAL - Indoors	400	80	50	10	0	0
PARK / FIELD - Outdoors	250	250	500	500	0	0
ARENA - Indoors	100	20	300	60	0	0
CHURCH / CMTY CENTRE - Indoors	300	60	400	80	0	0
TOTAL	**5000**	**1334**	**5000**	**1880**	**5000**	**238**
COMPONENT RAW COVERAGE		**27%**		**38%**		**5%**
COVERAGE PRODUCT BY TIME REGIME		346840		197400		86870
AGGREGATE PRODUCT	631110					
COMPONENT AVERAGE COVERAGE	**17%**					

COMPONENT **STREETLIGHT**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	0	20	0	4000	0
HOME - Cooking / Cleaning / Laundry	150	0	500	0	70	0
HOME - Working with PC/Laptop	350	0	50	0	100	0
HOME - Watching TV/Cable	150	0	250	0	200	0
HOME - Watching Video / DVD	20	0	50	0	100	0
HOME - Reading	50	0	100	0	100	0
HOME - Exercising	20	0	50	0	0	0
HOME - Using Cell Phone	150	0	200	0	50	0
HOME - Using Landline Phone	100	0	150	0	50	0
HOME - Hobby Activities	10	0	50	0	50	0
HOME - Conversation / Entertaining	100	0	250	0	100	0
HOME - Outdoors	50	50	150	150	10	10
STREET - Walking - Outdoors	150	150	300	300	50	50
VEHICLE - Driving	400	0	700	0	50	0
SCHOOL - Indoors	720	0	0	0	0	0
SCHOOL - Outdoors	80	80	30	30	0	0
OFFICE - Indoors	500	0	50	0	20	0
COMMERCIAL - Indoors	300	0	500	0	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	30	300	300	0	0
INSTITUTIONAL - Indoors	600	0	50	0	50	0
INDUSTRIAL - Indoors	400	0	50	0	0	0
PARK / FIELD - Outdoors	250	250	500	500	0	0
ARENA - Indoors	100	0	300	0	0	0
CHURCH / CMTY CENTRE - Indoors	300	0	400	0	0	0
TOTAL	**5000**	**560**	**5000**	**1280**	**5000**	**60**
COMPONENT RAW COVERAGE		**11%**		**26%**		**1%**
COVERAGE PRODUCT BY TIME REGIME		145600		134400		21900
AGGREGATE PRODUCT	301900					
COMPONENT AVERAGE COVERAGE	**8%**					

COMPONENT **INDOOR WARNING DEVICE (IWD)**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	20	20	20	4000	4000
HOME - Cooking / Cleaning / Laundry	150	150	500	500	70	70
HOME - Working with PC/Laptop	350	350	50	50	100	100
HOME - Watching TV/Cable	150	150	250	250	200	200
HOME - Watching Video / DVD	20	20	50	50	100	100
HOME - Reading	50	50	100	100	100	100
HOME - Exercising	20	20	50	50	0	0
HOME - Using Cell Phone	150	150	200	200	50	50
HOME - Using Landline Phone	100	100	150	150	50	50
HOME - Hobby Activities	10	10	50	50	50	50
HOME - Conversation / Entertaining	100	100	250	250	100	100
HOME - Outdoors	50	0	150	0	10	0
STREET - Walking - Outdoors	150	0	300	0	50	0
VEHICLE - Driving	400	0	700	0	50	0
SCHOOL - Indoors	720	0	0	0	0	0
SCHOOL - Outdoors	80	0	30	0	0	0
OFFICE - Indoors	500	0	50	0	20	0
COMMERCIAL - Indoors	300	0	500	0	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	0	300	0	0	0
INSTITUTIONAL - Indoors	600	0	50	0	50	0
INDUSTRIAL - Indoors	400	0	50	0	0	0
PARK / FIELD - Outdoors	250	0	500	0	0	0
ARENA - Indoors	100	0	300	0	0	0
CHURCH / CMTY CENTRE - Indoors	300	0	400	0	0	0
TOTAL	**5000**	**1120**	**5000**	**1670**	**5000**	**4820**
COMPONENT RAW COVERAGE		**22%**		**33%**		**96%**
COVERAGE PRODUCT BY TIME REGIME		291200		175350		1759300
AGGREGATE PRODUCT	2225850					
COMPONENT AVERAGE COVERAGE	**61%**					

COMPONENT **EBS(WS) - RADIO / TV / CABLE TV**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	0	20	0	4000	0
HOME - Cooking / Cleaning / Laundry	150	75	500	250	70	35
HOME - Working with PC/Laptop	350	0	50	0	100	0
HOME - Watching TV/Cable	150	0	250	0	200	0
HOME - Watching Video / DVD	20	10	50	25	100	50
HOME - Reading	50	25	100	50	100	50
HOME - Exercising	20	10	50	25	0	0
HOME - Using Cell Phone	150	0	200	0	50	0
HOME - Using Landline Phone	100	0	150	0	50	0
HOME - Hobby Activities	10	5	50	25	50	25
HOME - Conversation / Entertaining	100	0	250	0	100	0
HOME - Outdoors	50	0	150	0	10	0
STREET - Walking - Outdoors	150	0	300	0	50	0
VEHICLE - Driving	400	280	700	490	50	35
SCHOOL - Indoors	720	0	0	0	0	0
SCHOOL - Outdoors	80	0	30	0	0	0
OFFICE - Indoors	500	100	50	5	20	2
COMMERCIAL - Indoors	300	0	500	0	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	0	300	0	0	0
INSTITUTIONAL - Indoors	600	60	50	5	50	5
INDUSTRIAL - Indoors	400	40	50	5	0	0
PARK / FIELD - Outdoors	250	0	500	0	0	0
ARENA - Indoors	100	0	300	0	0	0
CHURCH / CMTY CENTRE - Indoors	300	0	400	0	0	0
TOTAL	**5000**	**605**	**5000**	**880**	**5000**	**202**

COMPONENT RAW COVERAGE		**12%**		**18%**		**4%**
COVERAGE PRODUCT BY TIME REGIME		157300		92400		73730
AGGREGATE PRODUCT	323430					
COMPONENT AVERAGE COVERAGE	**9%**					

COMPONENT **TELEPHONE**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	0	20	0	4000	0
HOME - Cooking / Cleaning / Laundry	150	150	500	500	70	70
HOME - Working with PC/Laptop	350	350	50	50	100	100
HOME - Watching TV/Cable	150	100	250	150	200	120
HOME - Watching Video / DVD	20	20	50	50	100	100
HOME - Reading	50	50	100	100	100	100
HOME - Exercising	20	10	50	25	0	0
HOME - Using Cell Phone	150	0	200	0	50	0
HOME - Using Landline Phone	100	100	150	150	50	50
HOME - Hobby Activities	10	10	50	50	50	50
HOME - Conversation / Entertaining	100	50	250	125	100	50
HOME - Outdoors	50	0	150	0	10	0
STREET - Walking - Outdoors	150	0	300	0	50	0
VEHICLE - Driving	400	0	700	0	50	0
SCHOOL - Indoors	720	720	0	0	0	0
SCHOOL - Outdoors	80	80	30	0	0	0
OFFICE - Indoors	500	500	50	50	20	20
COMMERCIAL - Indoors	300	30	500	50	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	0	300	0	0	0
INSTITUTIONAL - Indoors	600	600	50	50	50	50
INDUSTRIAL - Indoors	400	40	50	5	0	0
PARK / FIELD - Outdoors	250	0	500	0	0	0
ARENA - Indoors	100	0	300	0	0	0
CHURCH / CMTY CENTRE - Indoors	300	0	400	0	0	0
TOTAL	**5000**	**2810**	**5000**	**1355**	**5000**	**710**
COMPONENT RAW COVERAGE		**56%**		**27%**		**14%**
COVERAGE PRODUCT BY TIME REGIME		730600		142275		259150
AGGREGATE PRODUCT	1132025					
COMPONENT AVERAGE COVERAGE	**31%**					

COMPONENT **CELL**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	0	20	0	4000	0
HOME - Cooking / Cleaning / Laundry	150	90	500	300	70	42
HOME - Working with PC/Laptop	350	210	50	30	100	60
HOME - Watching TV/Cable	150	60	250	90	200	75
HOME - Watching Video / DVD	20	12	50	30	100	60
HOME - Reading	50	30	100	60	100	60
HOME - Exercising	20	6	50	30	0	0
HOME - Using Cell Phone	150	90	200	120	50	30
HOME - Using Landline Phone	100	30	150	45	50	18
HOME - Hobby Activities	10	6	50	30	50	30
HOME - Conversation / Entertaining	100	30	250	75	100	30
HOME - Outdoors	50	30	150	90	10	6
STREET - Walking - Outdoors	150	75	300	150	50	25
VEHICLE - Driving	400	100	700	150	50	12
SCHOOL - Indoors	720	420	0	0	0	0
SCHOOL - Outdoors	80	48	30	18	0	0
OFFICE - Indoors	500	300	50	30	20	12
COMMERCIAL - Indoors	300	180	500	300	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	18	300	180	0	0
INSTITUTIONAL - Indoors	600	120	50	10	50	10
INDUSTRIAL - Indoors	400	240	50	30	0	0
PARK / FIELD - Outdoors	250	150	500	300	0	0
ARENA - Indoors	100	60	300	120	0	0
CHURCH / CMTY CENTRE - Indoors	300	180	400	240	0	0
TOTAL	**5000**	**2485**	**5000**	**2428**	**5000**	**470**

COMPONENT RAW COVERAGE		**50%**		**49%**		**9%**
COVERAGE PRODUCT BY TIME REGIME		646100		254940		171550
AGGREGATE PRODUCT	1072590					
COMPONENT AVERAGE COVERAGE	**29%**					

COMPONENT **PAGER**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	0	20	0	4000	0
HOME - Cooking / Cleaning / Laundry	150	15	500	50	70	7
HOME - Working with PC/Laptop	350	35	50	5	100	10
HOME - Watching TV/Cable	150	15	250	25	200	20
HOME - Watching Video / DVD	20	2	50	5	100	10
HOME - Reading	50	5	100	10	100	10
HOME - Exercising	20	2	50	5	0	0
HOME - Using Cell Phone	150	15	200	20	50	50
HOME - Using Landline Phone	100	10	150	15	50	5
HOME - Hobby Activities	10	1	50	5	50	5
HOME - Conversation / Entertaining	100	10	250	25	100	10
HOME - Outdoors	50	5	150	15	10	1
STREET - Walking - Outdoors	150	15	300	30	50	5
VEHICLE - Driving	400	40	700	70	50	5
SCHOOL - Indoors	720	0	0	0	0	0
SCHOOL - Outdoors	80	0	30	0	0	0
OFFICE - Indoors	500	50	50	5	20	2
COMMERCIAL - Indoors	300	30	500	50	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	3	300	30	0	0
INSTITUTIONAL - Indoors	600	60	50	5	50	5
INDUSTRIAL - Indoors	400	40	50	5	0	0
PARK / FIELD - Outdoors	250	25	500	50	0	0
ARENA - Indoors	100	10	300	30	0	0
CHURCH / CMTY CENTRE - Indoors	300	30	400	40	0	0
TOTAL	**5000**	**418**	**5000**	**495**	**5000**	**145**

COMPONENT RAW COVERAGE		**8%**		**10%**		**3%**
COVERAGE PRODUCT BY TIME REGIME		108680		51975		52925
AGGREGATE PRODUCT	213580					
COMPONENT AVERAGE COVERAGE	**6%**					

COMPONENT **IP STREAM**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	0	20	0	4000	0
HOME - Cooking / Cleaning / Laundry	150	0	500	0	70	0
HOME - Working with PC/Laptop	350	350	50	50	100	100
HOME - Watching TV/Cable	150	0	250	0	200	0
HOME - Watching Video / DVD	20	0	50	0	100	0
HOME - Reading	50	0	100	0	100	0
HOME - Exercising	20	0	50	0	0	0
HOME - Using Cell Phone	150	0	200	0	50	0
HOME - Using Landline Phone	100	0	150	0	50	0
HOME - Hobby Activities	10	0	50	0	50	0
HOME - Conversation / Entertaining	100	0	250	0	100	0
HOME - Outdoors	50	0	150	0	10	0
STREET - Walking - Outdoors	150	0	300	0	50	0
VEHICLE - Driving	400	0	700	0	50	0
SCHOOL - Indoors	720	0	0	0	0	0
SCHOOL - Outdoors	80	0	30	0	0	0
OFFICE - Indoors	500	400	50	40	20	16
COMMERCIAL - Indoors	300	30	500	50	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	0	300		0	
INSTITUTIONAL - Indoors	600	150	50	12	50	12
INDUSTRIAL - Indoors	400	40	50	5	0	0
PARK / FIELD - Outdoors	250	0	500	0	0	0
ARENA - Indoors	100	0	300	0	0	0
CHURCH / CMTY CENTRE - Indoors	300	5	400	10	0	0
TOTAL	**5000**	**975**	**5000**	**167**	**5000**	**128**
COMPONENT RAW COVERAGE		**20%**		**3%**		**3%**
COVERAGE PRODUCT BY TIME REGIME		253500		17535		46720
AGGREGATE PRODUCT	317755					
COMPONENT AVERAGE COVERAGE	**9%**					

COMPONENT **FACILITY WARNING DEVICE (FWD)**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	0	20	0	4000	0
HOME - Cooking / Cleaning / Laundry	150	0	500	0	70	0
HOME - Working with PC/Laptop	350	0	50	0	100	0
HOME - Watching TV/Cable	150	0	250	0	200	0
HOME - Watching Video / DVD	20	0	50	0	100	0
HOME - Reading	50	0	100	0	100	0
HOME - Exercising	20	0	50	0	0	0
HOME - Using Cell Phone	150	0	200	0	50	0
HOME - Using Landline Phone	100	0	150	0	50	0
HOME - Hobby Activities	10	0	50	0	50	0
HOME - Conversation / Entertaining	100	0	250	0	100	0
HOME - Outdoors	50	0	150	0	10	0
STREET - Walking - Outdoors	150	0	300	0	50	0
VEHICLE - Driving	400	0	700	0	50	0
SCHOOL - Indoors	720	720	0	0	0	0
SCHOOL - Outdoors	80	80	30	30	0	0
OFFICE - Indoors	500	500	50	50	20	20
COMMERCIAL - Indoors	300	300	500	500	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	0	300	0	0	0
INSTITUTIONAL - Indoors	600	600	50	50	50	50
INDUSTRIAL - Indoors	400	400	50	50	0	0
PARK / FIELD - Outdoors	250	0	500	0	0	0
ARENA - Indoors	100	100	300	300	0	0
CHURCH / CMTY CENTRE - Indoors	300	300	400	400	0	0
TOTAL	**5000**	**3000**	**5000**	**1380**	**5000**	**70**
COMPONENT RAW COVERAGE		**60%**		**28%**		**1%**
COVERAGE PRODUCT BY TIME REGIME		780000		144900		25550
AGGREGATE PRODUCT	950450					
COMPONENT AVERAGE COVERAGE	**26%**					

COMPONENT **HOME SECURITY SYSTEM**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	4	20	4	4000	800
HOME - Cooking / Cleaning / Laundry	150	30	500	100	70	14
HOME - Working with PC/Laptop	350	70	50	10	100	20
HOME - Watching TV/Cable	150	30	250	50	200	40
HOME - Watching Video / DVD	20	4	50	10	100	20
HOME - Reading	50	10	100	20	100	20
HOME - Exercising	20	8	50	10	0	0
HOME - Using Cell Phone	150	30	200	40	50	10
HOME - Using Landline Phone	100	20	150	30	50	10
HOME - Hobby Activities	10	2	50	10	50	10
HOME - Conversation / Entertaining	100	20	250	50	100	20
HOME - Outdoors	50	0	150	0	10	0
STREET - Walking - Outdoors	150	0	300	0	50	0
VEHICLE - Driving	400	0	700	0	50	0
SCHOOL - Indoors	720	0	0	0	0	0
SCHOOL - Outdoors	80	0	30	0	0	0
OFFICE - Indoors	500	0	50	0	20	0
COMMERCIAL - Indoors	300	0	500	0	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	0	300	0	0	0
INSTITUTIONAL - Indoors	600	0	50	0	50	0
INDUSTRIAL - Indoors	400	0	50	0	0	0
PARK / FIELD - Outdoors	250	0	500	0	0	0
ARENA - Indoors	100	0	300	0	0	0
CHURCH / CMTY CENTRE - Indoors	300	0	400	0	0	0
TOTAL	**5000**	**228**	**5000**	**334**	**5000**	**964**
COMPONENT RAW COVERAGE		**5%**		**7%**		**19%**
COVERAGE PRODUCT BY TIME REGIME		59280		35070		351860
AGGREGATE PRODUCT	446210					
COMPONENT AVERAGE COVERAGE	**12%**					

COMPONENT **WARDEN / MLS**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	10	20	10	4000	4000
HOME - Cooking / Cleaning / Laundry	150	150	500	500	70	70
HOME - Working with PC/Laptop	350	350	50	50	100	100
HOME - Watching TV/Cable	150	150	250	250	200	200
HOME - Watching Video / DVD	20	20	50	20	100	100
HOME - Reading	50	50	100	100	100	100
HOME - Exercising	20	20	50	50	0	0
HOME - Using Cell Phone	150	120	200	160	50	40
HOME - Using Landline Phone	100	100	150	150	50	50
HOME - Hobby Activities	10	10	50	50	50	50
HOME - Conversation / Entertaining	100	100	250	250	100	100
HOME - Outdoors	50	50	150	150	10	10
STREET - Walking - Outdoors	150	150	300	300	50	50
VEHICLE - Driving	400	0	700	0	50	0
SCHOOL - Indoors	720	720	0	0	0	0
SCHOOL - Outdoors	80	80	30	30	0	0
OFFICE - Indoors	500	0	50	0	20	0
COMMERCIAL - Indoors	300	0	500	0	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	0	300	0	0	0
INSTITUTIONAL - Indoors	600	0	50	0	50	0
INDUSTRIAL - Indoors	400	0	50	0	0	0
PARK / FIELD - Outdoors	250	250	500	500	0	0
ARENA - Indoors	100	0	300	0	0	0
CHURCH / CMTY CENTRE - Indoors	300	300	400	400	0	0
TOTAL	**5000**	**2630**	**5000**	**2970**	**5000**	**4870**
COMPONENT RAW COVERAGE		**53%**		**59%**		**97%**
COVERAGE PRODUCT BY TIME REGIME		683800		311850		1777550
AGGREGATE PRODUCT	2773200					
COMPONENT AVERAGE COVERAGE	**76%**					

COMPONENT **WEB SITE**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	0	20	0	4000	0
HOME - Cooking / Cleaning / Laundry	150	0	500	0	70	0
HOME - Working with PC/Laptop	350	350	50	50	100	100
HOME - Watching TV/Cable	150	0	250	0	200	0
HOME - Watching Video / DVD	20	0	50	0	100	0
HOME - Reading	50	0	100	0	100	0
HOME - Exercising	20	0	50	0	0	0
HOME - Using Cell Phone	150	0	200	0	50	0
HOME - Using Landline Phone	100	0	150	0	50	0
HOME - Hobby Activities	10	0	50	0	50	0
HOME - Conversation / Entertaining	100	0	250	0	100	0
HOME - Outdoors	50	0	150	0	10	0
STREET - Walking - Outdoors	150	0	300	0	50	0
VEHICLE - Driving	400	0	700	0	50	0
SCHOOL - Indoors	720	0	0	0	0	0
SCHOOL - Outdoors	80	0	30	0	0	0
OFFICE - Indoors	500	400	50	40	20	16
COMMERCIAL - Indoors	300	30	500	50	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	0	300		0	
INSTITUTIONAL - Indoors	600	150	50	12	50	12
INDUSTRIAL - Indoors	400	40	50	5	0	0
PARK / FIELD - Outdoors	250	0	500	0	0	0
ARENA - Indoors	100	0	300	0	0	0
CHURCH / CMTY CENTRE - Indoors	300	5	400	10	0	0
TOTAL	**5000**	**975**	**5000**	**167**	**5000**	**128**
COMPONENT RAW COVERAGE		**20%**		**3%**		**3%**
COVERAGE PRODUCT BY TIME REGIME		253500		17535		46720
AGGREGATE PRODUCT	317755					
COMPONENT AVERAGE COVERAGE	**9%**					

COMPONENT **TWITTER**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	0	20	0	4000	0
HOME - Cooking / Cleaning / Laundry	150	90	500	300	70	42
HOME - Working with PC/Laptop	350	210	50	30	100	60
HOME - Watching TV/Cable	150	60	250	90	200	75
HOME - Watching Video / DVD	20	12	50	30	100	60
HOME - Reading	50	30	100	60	100	60
HOME - Exercising	20	6	50	30	0	0
HOME - Using Cell Phone	150	90	200	120	50	30
HOME - Using Landline Phone	100	30	150	45	50	18
HOME - Hobby Activities	10	6	50	30	50	30
HOME - Conversation / Entertaining	100	30	250	75	100	30
HOME - Outdoors	50	30	150	90	10	6
STREET - Walking - Outdoors	150	75	300	150	50	25
VEHICLE - Driving	400	100	700	150	50	12
SCHOOL - Indoors	720	420	0	0	0	0
SCHOOL - Outdoors	80	48	30	18	0	0
OFFICE - Indoors	500	300	50	30	20	12
COMMERCIAL - Indoors	300	180	500	300	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	18	300	180	0	0
INSTITUTIONAL - Indoors	600	120	50	10	50	10
INDUSTRIAL - Indoors	400	240	50	30	0	0
PARK / FIELD - Outdoors	250	150	500	300	0	0
ARENA - Indoors	100	60	300	120	0	0
CHURCH / CMTY CENTRE - Indoors	300	180	400	240	0	0
TOTAL	**5000**	**2485**	**5000**	**2428**	**5000**	**470**

COMPONENT RAW COVERAGE		**50%**		**49%**		**9%**
COVERAGE PRODUCT BY TIME REGIME		646100		254940		171550
AGGREGATE PRODUCT	1072590					
COMPONENT AVERAGE COVERAGE	**29%**					

COMPONENT **SIG-ALERT**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	0	20	0	4000	0
HOME - Cooking / Cleaning / Laundry	150	0	500	0	70	0
HOME - Working with PC/Laptop	350	0	50	0	100	0
HOME - Watching TV/Cable	150	0	250	0	200	0
HOME - Watching Video / DVD	20	0	50	0	100	0
HOME - Reading	50	0	100	0	100	0
HOME - Exercising	20	0	50	0	0	0
HOME - Using Cell Phone	150	0	200	0	50	0
HOME - Using Landline Phone	100	0	150	0	50	0
HOME - Hobby Activities	10	0	50	0	50	0
HOME - Conversation / Entertaining	100	0	250	0	100	0
HOME - Outdoors	50	0	150	0	10	0
STREET - Walking - Outdoors	150	15	300	30	50	5
VEHICLE - Driving	400	200	700	350	50	25
SCHOOL - Indoors	720	0	0	0	0	0
SCHOOL - Outdoors	80	0	30	0	0	0
OFFICE - Indoors	500	0	50	0	20	0
COMMERCIAL - Indoors	300	0	500	0	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	0	300	0	0	0
INSTITUTIONAL - Indoors	600	0	50	0	50	0
INDUSTRIAL - Indoors	400	0	50	0	0	0
PARK / FIELD - Outdoors	250	0	500	0	0	0
ARENA - Indoors	100	0	300	0	0	0
CHURCH / CMTY CENTRE - Indoors	300	0	400	0	0	0
TOTAL	**5000**	**215**	**5000**	**380**	**5000**	**30**
COMPONENT RAW COVERAGE		**4%**		**8%**		**1%**
COVERAGE PRODUCT BY TIME REGIME		55900		39900		10950
AGGREGATE PRODUCT	106750					
COMPONENT AVERAGE COVERAGE	**3%**					

COMPONENT **TONE ALERT RADIO**

PERSON ACTIVITY MODE	WEEKDAY POPULATION	WEEKDAY COVERAGE	WEEKEND POPULATION	WEEKEND COVERAGE	NIGHT POPULATION	NIGHT COVERAGE
HOME - Sleeping / Bathing	20	20	20	20	4000	4000
HOME - Cooking / Cleaning / Laundry	150	150	500	500	70	70
HOME - Working with PC/Laptop	350	350	50	50	100	100
HOME - Watching TV/Cable	150	150	250	250	200	200
HOME - Watching Video / DVD	20	20	50	50	100	100
HOME - Reading	50	50	100	100	100	100
HOME - Exercising	20	20	50	50	0	0
HOME - Using Cell Phone	150	150	200	200	50	50
HOME - Using Landline Phone	100	100	150	150	50	50
HOME - Hobby Activities	10	10	50	50	50	50
HOME - Conversation / Entertaining	100	100	250	250	100	100
HOME - Outdoors	50	0	150	0	10	0
STREET - Walking - Outdoors	150	0	300	0	50	0
VEHICLE - Driving	400	0	700	0	50	0
SCHOOL - Indoors	720	720	0	0	0	0
SCHOOL - Outdoors	80	0	30	0	0	0
OFFICE - Indoors	500	500	50	50	20	20
COMMERCIAL - Indoors	300	300	500	500	0	0
COMMERCIAL - Outdoors (Parking Lot)	30	0	300	0	0	0
INSTITUTIONAL - Indoors	600	600	50	50	50	50
INDUSTRIAL - Indoors	400	400	50	50	0	0
PARK / FIELD - Outdoors	250	0	500	0	0	0
ARENA - Indoors	100	100	300	300	0	0
CHURCH / CMTY CENTRE - Indoors	300	300	400	400	0	0
TOTAL	**5000**	**4040**	**5000**	**3020**	**5000**	**4890**
COMPONENT RAW COVERAGE		**81%**		**60%**		**98%**
COVERAGE PRODUCT BY TIME REGIME		1050400		317100		1784850
AGGREGATE PRODUCT	3152350					
COMPONENT AVERAGE COVERAGE	**86%**					