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Using Push Notifications for Emergency and Safety Communication

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Emergency evacuation of festival sites is not that uncommon. Some recent examples, for very different reasons, include:

- Bestival 2017: Severe Weather (main area, high wind);
- Tommorowland 2017: Fire (main stage);
- Rock am Ring 2017: Terrorist threat; and
- Shambala 2017: Evacuation threatened due to local wildfires

Crowd Connected provides many festivals each year with real-time crowd monitoring, and also push notification targeting. Each year a couple of our customers use these systems during emergencies such as site-wide festival evacuations.

There's very little guidance available that addresses the use of push notifications for emergency and safety communication.

When the current UK Green and Purple guides were written, much of today's technology just wasn't available.

Passing reference is made in guidance to social media. The purple guide suggests that the key to communicating with the public is: *real-time provision of information using PA systems, video screens, variable message systems and stewards with loud hailers and even social media.*

Prior to the 2018 revision, the green guide made no mention of mobile devices or social media. And the purple guide makes just one reference to 'mobile text'.

With so little guidance available, this paper looks at the strengths of this communication medium as well as areas for caution and further research.

Typically festivals, stadiums, and other crowded places still rely on three key communication mediums:

- verbal communication over PA systems;
- messages on big screens or variable message displays; and
- face to face communication from stewards.

In this paper we'll compare these with push notifications.

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Coverage

Compared to other methods, push notifications are unlimited in coverage. PA systems seldom cover every last corner of a festival site. But push notifications can message customers in any location.

Limited coverage is a serious problem.

'A police officer asks the crowd management to make a loudspeaker announcement, but this cannot be done, because there is no working loudspeaker equipment despite requirements to have one. (Love Parade Report)

In addition to covering an entire festival site or stadium, push notifications reach off site too. As an example, one of our customers used push notifications to warn festival-goers who were en route but were still some way from site. They were instructed to park up and wait for further news rather than continuing to the festival. The opening of the campsite had been delayed due to an electrical storm, and customers were being advised to stay in their cars in the car park. Preventing more arrivals on the site was important to avoid further problems in the car parks.

1221 Dear guests, if you are not yet in xxx, we would like to ask you to use public parking outside of xxx and wait for further updates. Pay attention to our App & Twitter! We will contact you!

Targeting and Zoning

As well as the ability to cover very large areas, push notifications can target very precise zones, and groups of people.

Stadiums will have a zoned voice alarm system. But in comparison push notifications can be sent to very small zones, and the zones can be defined on the fly during an incident.

Poor weather caused an earlier than expected egress. This in turn caused major queues at the main egress route. The festival sent queue time information just to the people standing in that queue.

Messages can also be sent to groups of customers based on their entire location history. Imagine sending specific instructions when severe weather is imminent. This could be targeted at campers, or those who arrived by train, or those with a car in the car park. This can minimise the volume of notifications, while making them relevant to every recipient.

We've seen a festival send high wind advisory messages. They targeted just those people who were in the campsite the previous night (so we know they are campers). And they timed the message as they started returning to the campsite in the evening.

Reach

Coverage, targeting and zoning are key strengths of push notifications. But this comes at the expense of reach. Unlike broadcast messages (e.g. using voice alarms), push notifications will only ever reach a subset of the public.

The first hurdle is that people need to have downloaded an app on their smartphone. This is the biggest limiting factor. Very good rates are often achieved when an app is for a brand that has fans – a festival, or a football club. We have seen download rates reach over 90% of attendees. But download rates vary enormously, and are typically lower than this.

The next hurdle is that users need to give the right permissions (for location, and for notifications). And finally at the moment that messages need to be sent, the phone needs to have some kind of network connection. This can be WiFi, or 2G, 3G, or 4G cellular. But a phone that is completely cut off from the internet cannot receive a push notification.

A typical resulting reach at a festival might be 25%. That means that if a message were sent to the entire site, one in every four people will receive it. But it's important to understand that this rate is very variable. It depends on the demographic, on the territory, and on the app popularity.

Reliability

Finally for a communication system to be useful in emergency situations, it has to be reliable. For a message to get through, a number of individual systems need to be functioning:

- Crowd Connected's platform
- Apple and Google's cloud messaging infrastructure
- Cellular services or WiFi services

The systems in question are not 100% reliable. However they are all built with resilience in mind. They avoid, as far as possible, any single point of failure. It's likely that any issues would cause a reduction in the number of messages successfully delivered, rather than the failure of the entire system.

It's entirely reasonable to expect better uptime from this system than from an individual festival PA system or big screen.

It's also worth addressing the common misconception that 'phones don't work at festivals – the mobile networks can't cope'. It's true that it can be difficult to make voice calls from large events on green field sites. But we've never had a problem with sending or receiving the data we need. The small data packets can still get through even when voice calls are impossible, and other apps have stopped working. 4G continues to roll out. 5G is on the horizon. Wifi is increasingly being provided. So the available bandwidth will only increase.

Reliability (*cont.*)

It's also worth mentioning 'MTPAS'.

During major incidents UK Police Gold Commanders can notify mobile network operators to start prioritising calls and messaging from the emergency services and other responders. This is known as the 'Mobile Telecommunication Privileged Access Scheme'.

So it's possible that during a major incident data over cellular networks could be compromised. However many of the scenarios we're talking about (e.g. evacuating a festival due to severe weather) would not result in the police initiating MTPAS. The decision to request MTPAS is not taken lightly. The consequences of impairing the public's ability to communicate are taken into account. If the police are aware of the value of push notification communication at a major event or venue, they would need to take this into account when making a balanced decision to request MTPAS.

In any case with the UK emergency services transitioning onto EE managed 4G networks, we'll need to wait to see what impact this has on the MTPAS scheme.

How people respond to the message

Messages in emergencies may be used to instruct, warn, and inform the public.

When sending instructions, we need to consider behavioural response – how people respond to a message. When delivered via push notification, are individuals more or less likely to comply? Are they quicker or slower to follow instructions?

We've found very little research or guidance on this questions. We've heard anecdotally that digital communication in stadiums can be more trusted than face-to-face communication from a steward. It comes more directly from someone in control.

However there's also a theory that face-to-face communication may be more trusted.

While not directly related, DSTL has found mobile messaging to be a good medium for sending alerts:

The Defence Science Technology Laboratory has supported the use of mobile alerting with research studies demonstrating that it is the optimum medium for sending messages to members of the public.

Research into the impact of marketing push notifications that we've carried out does suggest that caution is needed.

How people respond to the message (*cont.*)

When festival-goers are sent blatant advertising messages (e.g. 'check out the sponsor stand!!'), they can actually become less likely to visit the suggested location.

A possible scenario during an evacuation would be as follows. A general message to leave by the nearest exit is broadcast over a PA system. A proportion of customers will naturally leave by gate A, and the rest by gate B.

Subsequently a push notification is sent to customers who arrived by public transport to leave by gate B.

We want to be certain that the message doesn't somehow push the recipients to gate A. Rather than ignoring the message, they deliberately do the opposite. It seems unlikely. But it's the kind of behaviour we do see with some marketing messages.

How crowds respond to the message

Maybe more importantly, we need to understand how the crowd as a whole responds. If only 25% of the public receive a push notification, what happens? At one extreme, could 25% of the public comply, leaving 75% unaware of what was happening?

Again there's no research or guidance we've found on this. We do know that when people in a crowd are faced with an emergency incident, they tend to help each other. It seems likely that if one in four receive a critical instruction, then the whole crowd will become aware of it. But there must a point below which an instruction is not effective, or the speed of response becomes far too slow.

Until it's clear what this limit is, push notifications can only be considered an additional communication medium. They shouldn't replace broadcast systems like voice and screens.

Pre-evacuation delay

There has been research into pre-evacuation delay. This is the time from notification until the majority of people start following instructions. For festivals 10 minute delays have been found when using traditional channels.

It's possible that by precisely targeting very detailed and personalised instructions and information, pre-delay could be reduced.

The more clear and explicit the information about the location and nature of the danger, the more efficient and effective the collective evacuation. (John Drury)

Communication with the crowd is crucial. This in turn means... providing alarm signals that are informative about the nature of the emergency. Crowds evacuate more effectively when trusted with information rather than treated as untrustworthy and prone to panic. (John Drury)

Monitoring evacuations

Despite the obvious benefits (like coverage, off site messaging and targeting), two critical questions remain:

Although it seems unlikely, could people react negatively to messaging? Not just ignoring the message, but deliberately taking a contrary action.

Will people quickly share messages, so an instruction sent to 25% of the public will reach the entire crowd? And without adding significant delay?

It's hard to research these issues. During real evacuations we can't use A/B tests and control groups. We need to give every person present the best possible information.

But we have been able to gather some relevant data during real evacuations that does start to improve our understanding.

During one 2018 festival that had a site-wide evacuation, a message was sent informing people that they needed to leave the site. Other communication (e.g. PA, video screens) was also used. Some festival-goers had push notifications enabled within the festival app, and some didn't. So that gives us two groups to look at. And using the constant location monitoring that our platform provides, we are able to look for differences in time to evacuate for these two groups.

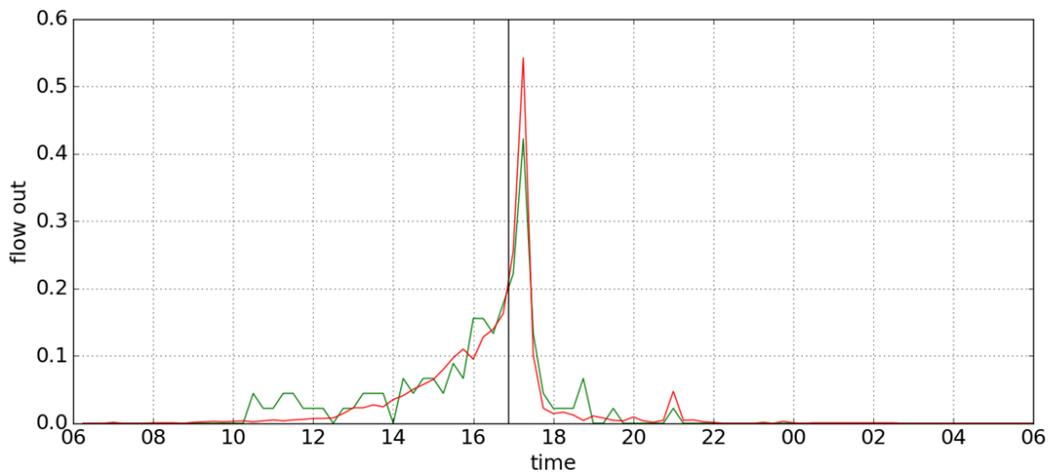
Monitoring evacuations (*cont.*)

If there was any negative reaction to an instruction to evacuate, we would expect an increase in the time to evacuate for those people that received the message.

If there was a lack of sharing significant enough to impact evacuation time, we would expect to see those that received the message evacuating the site quicker than the other group.

In the one dataset we have available, we don't see any evidence of either situation. We see both groups evacuating the site with almost identical profiles. (In the chart below the green and red lines are normalised, and show the non-messaged and messaged groups respectively.)

There's no evidence of negative reactions, or failure to share.



A complex future

The incidents that we may need to plan for, and our responses to them, are diverse. Planning for emergencies is no longer just about evacuations. We have to plan for a large number of possible responses:

- Partial evacuation
- Zonal evacuation
- Directional evacuation
- Invacuation
- Cordons
- Lock-down

These complex scenarios only increase the need to effectively notify and instruct the public across a whole site, off site, and also in a targeted way.

The movement in this direction is clear from the 6th edition of the green guide, just published. New and revised content includes:

- New guidance on the circulation and movement of spectators in those areas of the public domain that lie beyond the outer perimeter of the sports ground, but which are integral to the safe management of spectators and other personnel, both before and after an event, known as Zone EX.
- Recognition of the role played by mobile devices and social media in safety management and communications in general.
- The concept of 'invacuation'. Stadiums must consider the implications of an incident outside the ground. Safety management

options such as lockdown, partial evacuation and horizontal phased evacuation are explained.

The UK government has issued a document 'Crowded Places Guidance 2017'¹. It provides guidance on increasing the protection of crowded places from a terrorist attack. It applies to many public spaces included stadiums, arenas and major events such as music festivals.

All crowded places must have plans in place to respond to emergencies. This includes evacuating all or part of a site, or invacuating or locking down a site. A critical part of this is ensuring that the action to be taken can be communicated to all staff and visitors. The document says

"The plan must include a way to alert staff and visitors, including those with disabilities, to evacuate or take other response"

It also says that systems used for alerting must be able to guide people to specific exits / actions, so that for instance a single sound fire alarm is not sufficient.

Aside from festivals, stadiums and arenas, other events such as city marathons find customers in diverse location, situation, and vulnerability.

1. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/619411/170614_crowded-places-guidance_v1.pdf

A complex future (*cont.*)

With this diversity current systems for communicating with crowds can be particularly ineffective. Communication tools are needed that both extend the reach, and narrow the targeting.

Examples of sites with greater diversity:

- Greenfield sites: Festivals
- City wide events: New Year's Eve
- Large Campus: University, Theme Park
- Complex public space: Retail / Transport / multi-use city campus

Dynamic management

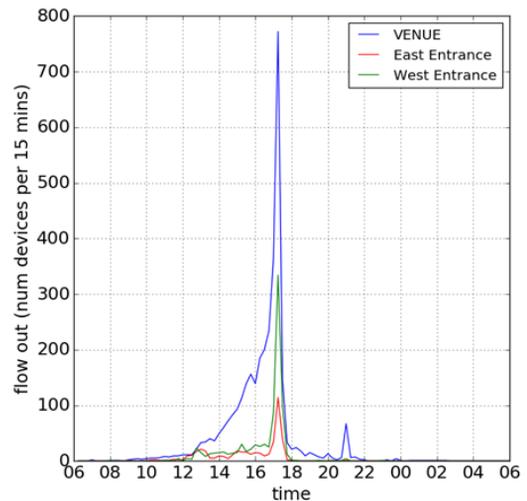
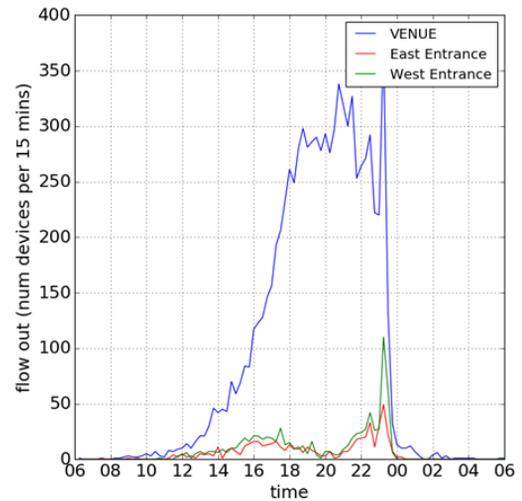
By combining real-time crowd monitoring with push notifications, dynamic management of evacuations becomes possible.

Sime's classic 1995 paper reports that directive announcements from a control that is monitoring crowd movement can reduce evacuation times by half or even two thirds, primarily through reduction of the pre-evacuation delay time.

For one 2018 festival we compared normal egress with an evacuation. Usage of the two main egress routes from the site varied significantly.

The upper chart shows a normal egress, the lower chart an evacuation. Around a third of festival-goers use the east entrance during normal egress. For the evacuation this drops to a quarter. It would be hard, perhaps impossible, to accurately predict this change in advance.

The ability to monitor this in real-time allows immediate response. Highly targeted messaging provides the right information and instruction to particular areas of the site.



A view on push notifications for emergency and safety messaging

- Until there is clearer research into message sharing, push notifications should be used in combination with other broadcast notification systems. It shouldn't be the sole method for communicating critical instructions.
- The benefits of coverage, off-site messaging and targeting are significant. Push notifications should therefore be an important part of emergency messaging at any festival, venue or event that has an official mobile app.
- Coordination is essential - central planning and control of the multiple communication mediums.
- Planning is essential. Messages and targeting need to be pre-defined, then adapted to suit a particular incident. Once an evacuation is initiated, it may be too late to start drawing target zones on a map and writing targeted messages. So the tools used need to be capable of pre-defining targeted message groups.

About the author

James Cobb is the founder and CEO of Crowd Connected, developers of the Colocator location insight platform for live events. The technology has been used across the globe by major music and sporting events and venues to improve operations, customer experience and safety.

He founded Crowd Connected in 2013, after a 20 year career in live events / live music which has seen him hold board positions of companies from a music festival to a text messaging platform provider, as well as a spell as chair of the Production Services Association. More recently his consultancy practice has provided large scale events in the UK and Europe with safety and compliance advice. Notable clients have included the Capital Summertime Ball at Wembley Stadium and the Jesus Christ Superstar Arena Tour.

He holds a Natural Science degree from the University of Cambridge, and a postgraduate diploma in Occupational and Environmental Health and Safety Management. He was previously a member of both IOSH and IEMA and is a current fellow of the RSA.

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A large, dense crowd of people is shown in a dark setting, likely at a concert or event. The crowd is the central focus, with many faces visible. In the background, a stage structure with a large screen is partially visible, though dimly lit. The overall atmosphere is that of a large-scale gathering.