Crowd Monitoring and Safety Applications

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Beyond staff communications, LoRa mesh infrastructure deployed at events can serve an active crowd safety function - providing real-time or near-real-time situational awareness about crowd density, movement, and emerging incidents. These capabilities are particularly relevant for large events where crowd crush is a genuine risk, or for venues where incident command needs rapid visibility into conditions across a large area.

Crowd Density Monitoring via Proxy Sensors

Direct counting of individual people is both technically complex and raises significant privacy concerns. A practical and privacy-preserving alternative is to use passive WiFi and Bluetooth probe request counting as a proxy for crowd density. Modern smartphones continuously broadcast probe requests as they search for known WiFi networks; these requests are detectable by any WiFi-capable device in passive monitoring mode.

A sensor node - typically a small single-board computer like a Raspberry Pi Zero 2W paired with a LoRa radio module - can count probe requests in a defined time window and transmit the count (not any identifying information) over the mesh to the operations centre. Correlating these counts with known venue capacity for each zone gives event safety staff a real-time density heatmap without collecting any individual-level data.

Important caveats: probe request counting provides relative density rather than absolute headcounts, and iOS and Android devices vary in probe request behaviour due to MAC randomisation policies. Calibrating the system during setup by counting known groups provides a correction factor.

Evacuation Coordination

In an emergency requiring full or partial venue evacuation, the mesh provides a communications channel that is explicitly independent of cellular and WiFi infrastructure - both of which will be saturated by thousands of people simultaneously trying to call, text, and post to social media.

Incident command can broadcast evacuation instructions to all staff simultaneously as a text message, confirm receipt from zone leaders, and monitor staff GPS positions to verify that all areas are being cleared.

Pre-event planning should include documented mesh-based evacuation protocols: which node operators are responsible for which zones, what messages signal different alert levels (shelter-in-place vs. full evacuation), and how to confirm all-clear. These protocols should be practised at least once before the event in a tabletop exercise.

Lost Child and Patron Location Assistance

GPS-enabled nodes worn or carried by children (or vulnerable patrons in need of escort services) can transmit their position over the mesh to a family reunification station. At a practical level, this is most useful as a check-in/check-out system at large family events: a wristband node given to a child at entry can be tracked to the family reunification tent if the child becomes separated. This is a straightforward application that requires minimal infrastructure beyond the existing mesh backbone.

Medical Team Dispatch

Medical teams at large events benefit from mesh communications in several ways beyond simple voice replacement. A text-based dispatch system over mesh allows the medical coordinator to send structured information (location grid reference, nature of complaint, resources needed) to the responding team - information that is easy to mishear over radio in a noisy festival environment. The GPS position of the medical team can be monitored by dispatch to confirm arrival and to direct the nearest available team to new incidents.

Privacy Considerations

Event organisers deploying crowd monitoring systems should address privacy proactively:

- **Aggregate data only:** Density counts by zone, not individual tracking, should be the operational norm. Log files should contain zone counts, not device identifiers.
- **Disclosure:** If probe request counting is used, this should be disclosed in event terms and conditions and on signage at venue entrances. Many events already disclose security camera use; WiFi monitoring disclosure belongs in the same category.
- **Data retention:** Density logs should be deleted after the event unless there is a specific safety or legal reason to retain them. Establish a data retention policy before deployment.
- **Staff GPS tracking:** Staff should be informed that their GPS position is visible to operations centre staff during the event. This is typically disclosed in staff onboarding materials.

Integration with Incident Command Structure

For permitted events with a formal incident command structure (required by many jurisdictions for events above a certain attendance threshold), the mesh communications system should be integrated into the ICS organisation chart. The communications unit leader should understand the mesh system capabilities and limitations, and the operations section should include mesh-based status reporting in its protocols. Pre-event coordination with local fire, EMS, and law enforcement should identify whether those agencies want read-only access to the mesh map or whether they prefer to operate on their own networks with liaison officer communications.

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