

The XL Groups Challenge

Scaling "near-instant" push-to-talk for very large groups in the move from narrowband to broadband mission-critical communications

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This paper is a general, vendor-neutral discussion of an industry-wide challenge. It draws on the author's 25+ years in public-safety communications and on published 3GPP and ETSI specifications. It does not describe or endorse any specific product.

1. The challenge in a sentence

Nations moving from narrowband public-safety systems — TETRA, and its national deployments such as the UK's Airwave, or P25 — to broadband mission-critical (MCX) solutions face a common, stubborn problem: delivering *near-instant* push-to-talk group calls at the scale real operations demand. In the opening minutes of an unplanned major incident, or across a large public-order operation, a single talk group can swell to hundreds — sometimes thousands — of affiliated users. Setting up a group call that large, that fast, is the challenge of "XL Groups".

2. Why very large groups matter: all-informed situational awareness

Support for very large groups is not a vanity requirement; it is routinely mandated in nationwide public-safety procurements because established operational practice depends on it. Large "all-informed" talk groups let every responder build a mental picture of what is happening on the ground simply by listening — vital in fast-moving situations where looking down at a screen is a dangerous distraction.

These groups are used to manage large planned events — a major summit, an international sporting fixture, a city-centre festival — and, critically, in the first chaotic minutes of an unplanned major incident, when responders in the vicinity self-deploy and the group can grow to thousands almost instantly. Nor is this the preserve of large nations: many smaller countries rely on national talk groups of thousands of users for day-to-day situational awareness.

In public safety, a group call that is only "nearly" set up is a message half-heard — and in a safety-of-life situation, that is operationally unacceptable.

3. "Near-instant": a benchmark forged in the narrowband era

Since the earliest UHF/VHF radio, responders have expected to press-and-talk. Experience through the TETRA era hardened that expectation into a measurable benchmark. Users trained to press, wait for a grant tone, then speak, would under stress simply "press and talk" — and if call set-up took longer than around half a second, the first words were clipped and lost, forcing the control room to ask for them again and burning precious seconds. A target of **sub-300 milliseconds** for group-call set-up became, over two decades, the de-facto industry definition of "near-instant" critical voice.

A lesson worth remembering

Narrowband systems learned this lesson the hard way. Early ambitions to individually poll and confirm every member of a group before a call could proceed proved too slow to be usable at scale. The pragmatic consensus that emerged — reliably achieving near-instant push-to-talk to whichever members were available at the instant PTT was pressed, and bringing latecomers in automatically via "late entry" — is precisely the trade-off that the broadband generation is now re-learning.



Large public-order operations routinely rely on all-informed talk groups of hundreds or thousands of users.

4. How a broadband group call is actually assembled

In 3GPP MCX (MCPTT, per TS 23.379), the performance of group-call set-up is governed largely by *how* the users are assembled into the call. Two architectural choices dominate, and the difference between them is where XL-Group scalability is won or lost.

Invited at the moment of PTT (the "pre-arranged" model)

Here, individually addressed SIP signalling is sent to every affiliated member the moment push-to-talk is pressed. The back-and-forth grows in *direct proportion* to the size of the group. For a handful of users this is imperceptible; for hundreds or thousands it is not.

Joined on affiliation (the "chat-group" model)

Alternatively, users are joined to an active call session earlier — typically when they affiliate to the group at the start of a shift or an operation — so the heavy signalling is spread over time and largely completed well before the group is needed. At the moment PTT is pressed, comparatively little work remains.

The pre-established session — and its residual penalty

Solution designers can attempt to mitigate the pre-arranged model by pre-establishing the call session in advance. This helps, but it does not eliminate the problem: an additional, individually addressed "connect" message must still be sent to every member at the instant PTT is pressed to bring them into the pre-established session — signalling that, once again, grows with the size of the group and is not required by the affiliation-joined approach.

5. Why it does not scale linearly

The common thread is unicast signalling that grows one-to-one with group membership. As a group climbs from tens of users into the hundreds and thousands, the cumulative set-up signalling — not radio coverage, and not raw bandwidth — becomes the limiting factor, and the sub-300 ms target slips out of reach. In practical field terms, models that invite or connect every member at PTT time tend to hold up only for group sizes measured in the tens, well short of the hundreds or thousands that all-informed operations demand.

Multicast bearer technologies (eMBMS today, 5G MBS in future) are sometimes offered as the answer. They can help distribute media and some floor-control signalling efficiently — but they do not remove the per-member, individually addressed connect signalling that the invite-at-PTT and pre-established models require. An architecture that needs little more than floor-control signalling at the moment of PTT is far better placed to exploit multicast in the future; one that must still connect every member individually is not.

As the group grows, it is per-member signalling — not coverage or bandwidth — that becomes the wall. The architecture chosen at design time decides where that wall sits.

6. The operational risk: "all-informed" quietly becomes "partially-informed"

The danger is subtle. Faced with slow set-up at scale, a pre-arranged group call can be configured to proceed once only a proportion of members have responded. Set-up appears acceptable — but the all-informed situational-awareness group that responders depend on for rapid, coordinated response has quietly become a *partially-informed* one. Some of the people who should be hearing the picture are not yet in the call. In a safety-of-life service, that gap is exactly the kind of latent failure that never shows up in a demonstration and only surfaces on the worst night of the year.



7. What buyers and programmes should do

XL-Group scalability is a design-time decision with field-day consequences, and it is one of the areas where independent scrutiny pays for itself. Whether you are procuring, delivering or assuring a national MCX capability, the questions below separate a proposition written to win from one engineered to work:

Seven questions to ask about XL Groups

- **Quantify the need.** State the maximum group sizes required for all-informed working — including the worst-case surge in a major incident — as a hard requirement, not an aspiration.
- **Interrogate the architecture.** Ask precisely how the solution assembles a large group call: are members joined on affiliation, or invited/connected at the moment PTT is pressed?
- **Demand evidence at scale.** Insist on near-instant (sub-300 ms) set-up demonstrated at your largest required group size — in the field, not at proof-of-concept or plug-test scale.
- **Probe the signalling.** Understand how per-member signalling grows with group size, and what happens to set-up time as it does.
- **Test late entry and concentrated load.** Verify behaviour for members out of coverage at call start, and for a large group congregated within a single cell.
- **Beware the "partial" compromise.** Confirm whether the solution proceeds before all members are connected — and whether that turns all-informed into partially-informed.
- **Write it into acceptance.** Make XL-Group performance a contractual acceptance criterion, independently verified — not a marketing claim taken on trust.

8. Conclusion

As governments worldwide migrate from proven narrowband systems to broadband MCX, near-instant push-to-talk for very large groups remains a core, non-negotiable capability — and one of the hardest to deliver at national scale. It is one thing to demonstrate acceptable performance in a proof-of-concept or a small field trial; it is quite another to deliver it reliably, at scale, in the hands of front-line users on their worst day.

The organisations that navigate this well are not those with the biggest budgets, but those that ask the hard architectural questions early, demand evidence at true scale, and hold the answers to independent scrutiny — before the network is built, and before the limit is discovered in the field.

Independent assurance for your MCX programme

Critical Insights provides independent, technically-grounded support on XL-Group scalability, coverage and performance assurance, bid and procurement support, and programme recovery — for user organisations, governments and vendors. If large-group scalability is a question for your programme, let's talk.

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