

# The Filtered Alert Hub: Technology and Opportunity

Presented 23 August, 2016  
by Eliot Christian  
at the 2016 CAP Implementation Workshop  
(Bangkok, Thailand)

Note: see also [WMO Alert Hub presentation, Sep 2015](#)

Today, we stand on the threshold of a profound revolution in how emergency alerting is accomplished in societies around the world.

With so many countries implementing CAP-enabled alerting, we can see that soon there will be thousands of CAP alert sources worldwide, together delivering hundreds of alerts per second. And so, the time is ripe for the next step: technology to select from this rich trove of emergency alerting just those alerts needed for particular cases. With the Filtered Alert Hub Technology, many lives will be saved and property protected as emergency alerting becomes more available, more precise, more reliable, completely secure, and as fast as it can be.

My name is Eliot Christian. I am retired from, but remain a volunteer to, the United States Geological Survey (USGS). I am also retired from, but I remain an advisor to WMO. For the past 15 years, I have been involved in defining and promoting the CAP standard, especially internationally.

My presentation describes a project for advancing the Filtered Alert Hub technology. Let me also note this technology may be used for the WMO Alert Hub, which I described in my CAP Workshop presentation last year.

## Presentation Outline

- **Background and Context**
- Scope
- Technology Overview
- From Prototype to Operations
- Estimated Loads and Metrics
- Current Status

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This is the outline of my presentation.

I will start with some background and context.

## Background and Context

### ➡ **The Filtered Alert Hub Technology**

- The Filtered Alert Hub Opportunity
- One Among Many Alerting Services
- Private and Public Alerting
- Official Sources of Public Alerts
- High-Priority Alerts

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Filtered Alert Hub

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With the increasing publication of CAP alerts as Internet news feeds, there are now services that aggregate those alerts to simplify access.

The Filtered Alert Hub technology is the next step--it uses custom filtering to make CAP alert feeds fit to specific purposes. For instance, a typical customized feed would select only official, high-priority emergency alerts for a specific city such as Bangkok.

## Background and Context

- The Filtered Alert Hub Technology
- ➡ **The Filtered Alert Hub Opportunity**
- One Among Many Alerting Services
- Private and Public Alerting
- Official Sources of Public Alerts
- High-Priority Alerts

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I am leading the "Filtered Alert Hub Opportunity": an effort to develop and deploy this technology as part of the "[NOAA Big Data Project](#)".

Background and Context  
- The Filtered Alert Hub Opportunity

- [NOAA Big Data Project](#) Collaborators: Amazon Web Services, Google Cloud Platform, IBM, Microsoft and Open Commons Consortium
- Each Collaborator has a signed CRADA ([Cooperative Research and Development Agreement](#)) with NOAA
- Each Collaborator is also an anchor for a Data Alliance that includes other companies and organizations by mutual agreement

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The Opportunity was announced in June to the five NOAA Collaborators: Amazon Web Services, Google Cloud Platform, IBM, Microsoft and the Open Commons Consortium.

Each Collaborator was invited to help develop this technology under its existing [CRADA \(Cooperative Research and Development Agreement\)](#) with NOAA.

Given that CAP alerts can be life-critical and alert timeliness can be crucial, the Filtered Alert Hub needs to minimize delivery time while being highly reliable and secure. The CRADA specifies that the efforts of the partners are on a "reasonable efforts" basis, however.

Under the Big Data Project, each of these five Collaborators is also an anchor for a Data Alliance, which means any other companies and organizations can be included, subject to mutual agreement with NOAA.

By advancing the Filtered Alert Hub technology, a Data Alliance can help save lives across societies and over time, but of course the partners may have other reasons to participate as well.

## Background and Context

- The Filtered Alert Hub Technology
- The Filtered Alert Hub Opportunity
- ➡ **One Among Many Alerting Services**
- Private and Public Alerting
- Official Sources of Public Alerts
- High-Priority Alerts

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It should be understood that emergency alerting is accomplished through the efforts of many actors, from family through community, to cities, states, and nations, and to various international institutions, spanning government, commercial, and other sectors.

The Filtered Alert Hub will be one among the many services in societies worldwide that support emergency alerting, including some with a similar scale and purpose.

## Background and Context

- The Filtered Alert Hub Technology
- The Filtered Alert Hub Opportunity
- One Among Many Alerting Services
- ➡ **Private and Public Alerting**
- Official Sources of Public Alerts
- High-Priority Alerts

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The Filtered Alert Hub will support private as well as public messaging about hazard threats. For instance:

- the initial report of an emergency situation is often a private message to the local emergency call center;
- private messaging is common as experts or security personnel communicate with emergency managers about a given hazard among themselves as a threat is being evaluated;
- alerting authorities in different jurisdictions may send alerts privately so that the appropriate local authority can send public alerts if they so decide.

Because each valid CAP alert message is identified as "Public", "Private", or "Restricted" in its mandatory "scope" element, the Filtered Alert Hub easily makes that distinction as needed.

## Background and Context

- The Filtered Alert Hub Technology
- The Filtered Alert Hub Opportunity
- One Among Many Alerting Services
- Private and Public Alerting
- **Official Sources of Public Alerts**
- High-Priority Alerts

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The Filtered Alert Hub distinguishes official sources of public alerts through reference to the international Register of Alerting Authorities, maintained by the World Meteorological Organization (WMO).

Because WMO is a treaty-level organization, each national assertion that a source is official has the force of law for the country making that assertion in this Register. About 500 official sources are currently listed.

It should be understood that the vast majority of emergency alerting occurs at the scale of a neighborhood or city. Such local alerting sources could be served by the Filtered Alert Hub but multiple levels of aggregation may be appropriate.

For example, the national alerting system of the United States currently aggregates only about 700 CAP sources, although thousands of CAP sources can be expected when CAP feeds are published by its 3,000 counties and 300 large cities (population greater than 100,000).



## Background and Context

- The Filtered Alert Hub Technology
- The Filtered Alert Hub Opportunity
- One Among Many Alerting Services
- Private and Public Alerting
- Official Sources of Public Alerts

### ➤ **High-Priority Alerts**

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The Filtered Alert Hub will distinguish "high priority" alerts. These are alerts issued when people need to be alerted in a "broadcast intrusive" manner, such as sounding a siren, inserting a television "crawl text", sending a cell broadcast message, etc.

These alerts are usually reserved for situations in which people need to act:

immediately or within the next hour,  
in response to an extraordinary or significant threat,  
that is already observed or is likely to occur.

(In a CAP message, this is indicated by the "urgency", "severity", and "certainty" elements each having one of the top two values.)

Although high priority alerts are less than one percent of the alert messages accessible to the public, such messages are especially crucial to enabling people to preserve life and protect property.

## Presentation Outline

- Background and Context
- **Scope**
- Technology Overview
- From Prototype to Operations
- Estimated Loads and Metrics
- Current Status

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Let me turn now to describe the Scope of the Filtered Alert Hub.

## Scope of the Filtered Alert Hub

- ➔ **Cloud Networking Only**
  - Types of Alert Inputs
  - Types of Alert Outputs
  - Auxiliary Service Interfaces

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From the Filtered Alert Hub perspective, alert communication starts when an alert message to be disseminated arrives from a supported sender, and it ends when the alert message is delivered to a supported receiver.

The Filtered Alert Hub scope therefore includes *only* communication supported by this particular service on the Internet-based cloud infrastructure, and the interfaces to this service.

Although many auxiliary communication channels can be facilitated by the Filtered Alert Hub (radio and television broadcast, cellular telephone services, landline telephones, satellite communications, etc.), only their interfaces with the Filtered Alert Hub are in scope.

## Scope of the Filtered Alert Hub

- Cloud Networking Only
- ➡ **Types of Alert Inputs**
- Types of Alert Outputs
- Auxiliary Service Interfaces

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Because lives can be threatened by all manner of hazards, emergency alerting in general must be "all-hazards" by design.

Here we should note that many different methods can be employed to help characterize a potential or actual hazard threat, including traditional and new sensors, and even "crowd sourcing".

Even when methods like these emit messages in CAP format, such a source of un-evaluated information is not encompassed in the Filtered Alert Hub Opportunity.

*Except*, that the interface for such an input source may be designated by the Data Alliance as an auxiliary interface.

## Scope of the Filtered Alert Hub

- Cloud Networking Only
- Types of Alert Inputs
- ➡ **Types of Alert Outputs**
- Auxiliary Service Interfaces

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Because all communications media are potentially useful in alerting, emergency alerting in general must be "all-media" by design, as well as being "all-hazards".

Among the types of alert outputs we can anticipate:

- direct action by sirens, trains or driverless cars;
- personal notification via smart-phone apps or in-car navigation devices;
- distinctive ring and message display on cell phones via cell broadcast;
- dissemination by online advertisers through overlay of ad messages;
- displaying alerts through various digital signage;
- in-home 'smoke alarms' upgraded to 'all-hazard alarms' through an ability to process CAP alerts.

The Filtered Alert Hub does not encompass any of the disparate methods that can pick up an alert message and act on it.

*Except*, that the interface for such an output type may be designated by the Data Alliance as an auxiliary interface.

## Scope of the Filtered Alert Hub

- Cloud Networking Only
- Types of Alert Inputs
- Types of Alert Outputs
- ➔ **Auxiliary Service Interfaces**

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As noted above and as described in the architecture section below, the Filtered Alert Hub Opportunity focuses on a constrained set of input, processing and output functions.

However, a Data Alliance may arrange for many other auxiliary services, such as:

- supporting various means of characterizing hazard threats,
- processing the rich set of alerting information for analytic and other purposes, or
- supporting various services that act on alert messages.

The only part of any such auxiliary services in scope for the Filtered Alert Hub are where the services use specific Filtered Alert Hub interfaces that the Data Alliance chooses to designate as auxiliary.

## Presentation Outline

- Background and Context
- Scope
- ➔ **Technology Overview**
- From Prototype to Operations
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Next, I want to do a brief Technology Overview of the Filtered Alert Hub.

## Technology Overview

### ➡ CAP Alerts

- CAP Alert Feeds
- Receive and Send Alerts Immediately
- Prototype Architecture
- CAP Alert Creation and Publishing

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The Filtered Alert Hub focuses on alerts that comply with the CAP standard.

This is because the CAP standard is now regarded worldwide as essential to building "all-hazards" and "all-media" alerting systems that are interoperable and leverage existing emergency alert systems while anticipating newer technologies.

In its essence, a CAP alert can be seen as a kind of standard business form. Like any other business form, a CAP alert defines various value selections, fill-in boxes, and check boxes. Together, these elements provide key details of a specific emergency, such as the type of event, the alerting area, the headline, the sender, and so on.

The set of CAP-compliant content, in the form of an Extensible Markup Language (XML) file, is a CAP alert message.



## Technology Overview

- CAP Alerts
- ➡ **CAP Alert Feeds**
- Receive and Send Alerts Immediately
- Prototype Architecture
- CAP Alert Creation and Publishing

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Each CAP alert message is typically communicated in publish-subscribe mode.

That is, a sender puts the CAP alert file on a publicly accessible Internet host and updates a news feed that links to that CAP alert file.

News feed subscribers then retrieve the CAP alert file as they would retrieve any other news item.

The Filtered Alert Hub will support both of the Internet-standard publish-subscribe formats: RSS and Atom.

## Technology Overview

- CAP Alerts
- CAP Alert Feeds
- ➡ **Receive and Send Alerts Immediately**
- Prototype Architecture
- CAP Alert Creation and Publishing

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The Filtered Alert Hub should be responsive for sudden onset emergencies such as an active shooter or Earthquake Early Warning. Here it is essential that the Filtered Alert Hub is able to send an alert within a second or so of when a new alert is posted.

Therefore, in addition to publish/subscribe, the Filtered Alert Hub will offer CAP alert sources the ability to "push" an alert immediately and will offer CAP alert subscribers the ability to receive a pushed alert immediately.

## Technology Overview

- CAP Alerts
- CAP Alert Feeds
- Receive and Send Alerts Immediately
- ➡ **Prototype Architecture**
- CAP Alert Creation and Publishing

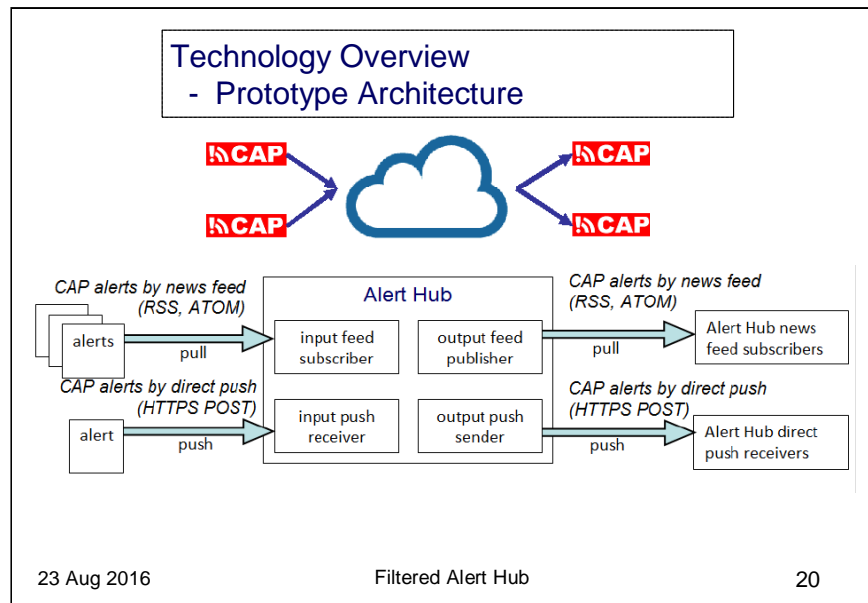
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And so, the architecture of the existing Filtered Alert Hub prototype focuses on the real-time challenge to get a copy of every newly published CAP alert and disseminate it quickly to each subscription that has specified filters matching that alert.

The Filtered Alert Hub prototype supports subscription filters on a broad set of criteria, including: official-only; high-priority only; area of interest; language; and, using XPath 2.0 filter expressions, any part of the XML content of the CAP alert.



A Filtered Alert Hub prototype is running now on the Amazon Cloud. The heart of the system is a Near Real-Time Event Processing pattern. This event-driven architecture is implemented with Amazon Web Services (AWS) Lambda.

The prototype uses four additional AWS Services primarily: Simple Storage Service (S3), Simple Notification Service (SNS), ElasticSearch, and DynamoDB.

## Technology Overview

- CAP Alerts
- CAP Alert Feeds
- Receive and Send Alerts Immediately
- Prototype Architecture
- ➡ **CAP Alert Creation and Publishing**

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As part of the ability for the Filtered Alert Hub prototype to accept a "pushed" alert immediately, the prototype supports direct entry of a CAP alert via the AWS Simple Storage Service "hosted Web site option".

## Technology Overview - CAP Alert Creation and Publishing

[Text templates for headline, description, instruction.](#)

**headline**

**description**

**instruction**

**areaDesc**

SW SE NE NW SW (lat, lon points)

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This HTML and Javascript web form ([example shown here](#)) uses simple HTML and client-side Javascript. The form can accept immediate upload of an already prepared CAP alert as well as direct editing from an empty form, and that also links to templates for common values of some CAP elements.

This facility could be developed, at the choice of the Data Alliance, into an offering for any alerting authority that wants to create and publish CAP alerts but has yet to fully implement a CAP editing and publishing tool (for example, alerting authorities throughout India).

## Presentation Outline

- Background and Context
- Scope
- Technology Overview
- ➔ **From Prototype to Operations**
- Estimated Loads and Metrics
- Current Status

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Now I want to explain the general plan for how we might proceed from prototype to an operational system.

## From Prototype to Operations

- ➡ **Functions Already Prototyped**
  - Security and Authentication Needs
  - Exception Reporting Needs
  - Organizational Resources

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The Filtered Alert Hub prototype offers proof-of-concept, open source, running code developed from experts in Amazon Web Services, among others.

In keeping with the architecture I described, the code includes several functions that are particular to handling CAP alerts and these are linked with well-defined interfaces as described in the [Filtered Alert Hub](#) design document.

These functions were developed separately; they are coded in different programming languages, and they have been run in different regions worldwide.

Each of the functions is fairly simple. The total amount of application code across all functions is about 2,500 lines.



## From Prototype to Operations

- Functions Already Prototyped
- ➡ **Security and Authentication Needs**
- Exception Reporting Needs
- Organizational Resources

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Filtered Alert Hub

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An operational Filtered Alert Hub needs a robust set of facilities to assure that the system is secure and that alerts are authentic as received and as delivered.

These functions would not be highly customized to this application. Rather, these functions should leverage industry best-practice facilities, especially those already available in cloud-based services that support other life-critical systems.

## From Prototype to Operations

- Functions Already Prototyped
- Security and Authentication Needs
- ➡ **Exception Reporting Needs**
- Organizational Resources

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An operational Filtered Alert Hub needs a fuller suite of functions for operational exception reporting to address input, processing, and output conditions such as data errors and performance issues.

These functions also should leverage industry best-practice facilities, especially those already available in cloud-based systems for similar Near Real-Time Event Processing.

## From Prototype to Operations

- Functions Already Prototyped
- Security and Authentication Needs
- Exception Reporting Needs
- ➡ **Organizational Resources**

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Staff time will be needed to support the Filtered Alert Hub as an operational system.

The people involved would typically receive automatic notifications by e-mail, such as the notices generated by the exception reporting and security functions discussed above.

In the vast majority of cases, the follow-up would require minimal expertise. For instance, a common notice would be that a particular CAP alert feed is experiencing problems or has begun emitting a high percentage of invalid CAP alerts.

On rare occasions, a notice may be generated that indicates a possible problem with the Filtered Alert Hub software. Those notices would have to be directed to more technical staff.

As the operational Filtered Alert Hub gains broad acceptance and recognition, a stream of enhancement suggestions can be expected. Such suggestions would have to be addressed through management as well as technical channels.

## Presentation Outline

- Background and Context
- Scope
- Technology Overview
- From Prototype to Operations
- **Estimated Loads and Metrics**
- Current Status

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The following Estimated Loads and Metrics are abbreviated from material in the Filtered Alert Hub design document.

## Estimated Loads and Metrics

- Rate and Volume of Input Alerts
- Number of Output Subscription Feeds
- Metrics

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The Filtered Alert Hub prototype is ingesting CAP alerts from about eighteen sources now. The aggregate average arrival rate is a few per minute and the peak minute rate is perhaps one per second. Each CAP alert on average is less than two KB.

However, the operational Filtered Alert Hub should anticipate much higher rates of alert arrival as more sources come online. A doubling per year for the next few years may be a good guess.

The Filtered Alert Hub prototype is distributing CAP alerts to about 2,100 subscription feeds: one per country and each of 1,870 cities.

Given there are about two national languages per country on average, the number of feeds will double if subscription feeds are distinguished by language. The number would double again if separate feeds are distinguished as "high-priority only", and again if separate feeds are distinguished as "official-only". Accordingly, the number of subscription feeds is likely to be on the order of 10,000.

The operational Filtered Alert Hub should be measured by customer-oriented metrics for the broad class of Near Real-Time Event Processing systems, and the sub-class of life-critical systems. Such metrics may include end-to-end latency, system availability, and responsiveness to sudden spikes as might be expected in a large-scale disaster such as the 2004 tsunami.

## Presentation Outline

- Background and Context
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- **Current Status**

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My last topic is "Current Status".



- [Open Commons Consortium](#) and [Amazon Web Services](#) already joined; others are welcome
- Core will be Free Open Source Software
- *Key Players:* Timo Proescholdt (WMO), Ian Ibbotson (Knowledge Integration Ltd), Walt Wells (OCC), Zac Flamig (OCC), Jed Sundwall (AWS), Gavin Adams (AWS), Bob Bunge (NOAA), Mark Paese (NOAA)
- [Contact me](#) about getting involved in this

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Amazon Web Services (AWS) and the Open Commons Consortium (OCC) responded to the NOAA Big Data Project announcement to help progress the Filtered Alert Hub technology under their existing CRADAs with NOAA.

This initiative remains open to other collaborators. I note that we have received interest from Hong Kong Observatory in that regard.

The project anticipates at least one instance of the core functions will be maintained as Free Open Source Software in the public domain.

Two developers are doing almost all of the work: Timo Proescholdt of WMO in Geneva, and Ian Ibbotson of Knowledge Integration Limited in England.

Our OCC contacts are Walt Wells and Zac Flamig.

Our primary contacts at AWS are Jed Sundwall and Gavin Adams.

Our primary contacts at NOAA are Bob Bunge and Mark Paese.

I am leading the initiative so please contact me if you know of cloud service providers and developers of cloud-based systems who wish to get involved.

## References

- [Filtered Alert Hub Opportunity Document](#)
- [Filtered Alert Hub Design Document](#)
- Project Lead:  
Eliot Christian <eliot.j.christian@gmail.com>

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This concludes my presentation. Here are links to the two documents on which my presentation is based.



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