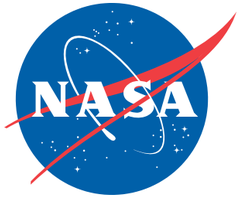
National Aeronautics and
Space Administration



General Coordinates Network

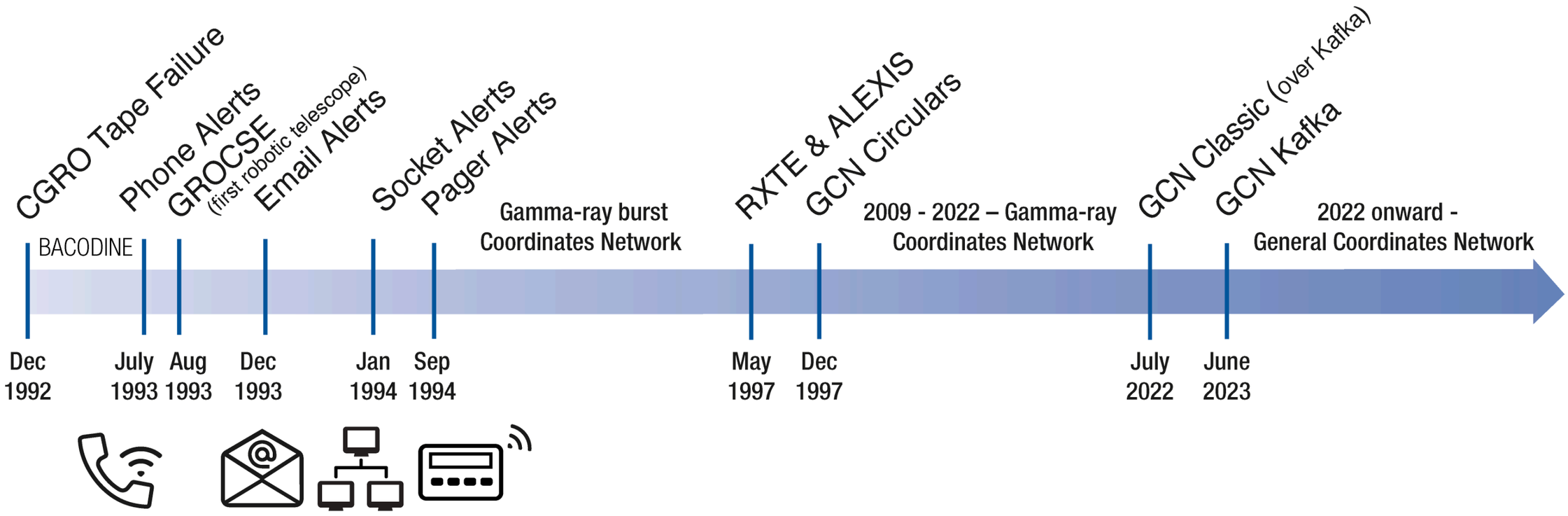
NASA's Next Generation Time-Domain and Multimessenger Alert System

A service of the Astrophysics Science Division at NASA's Goddard Space Flight Center

https://gcn.nasa.gov

Judy Racusin (GCN PI, NASA GSFC)

Early History of GCN



- BACODINE provided new alert formats (phone, email, socket, and pager)
- New instruments and transient types led to the Gamma-ray Coordinates Network

There are two kinds of GCN data products:

GCN NOTICES

```
TITLE:            GCN/FERMI NOTICE
NOTICE_DATE:      Wed 26 Aug 20 22:10:07 UT
NOTICE_TYPE:      Fermi-GBM Flight Position
RECORD_NUM:       45
TRIGGER_NUM:      620172587
GRB_RA:           296.300d {+19h 45m 12s} (J2000),
                  296.250d {+19h 45m 00s} (current),
                  296.416d {+19h 45m 40s} (1950)
GRB_DEC:          +71.817d {+71d 49' 00"} (J2000),
                  +71.868d {+71d 52' 03"} (current),
                  +71.693d {+71d 41' 35"} (1950)
GRB_ERROR:        5.50 [deg radius, statistical plus systematic]
GRB_INTEN:        1078 [cnts/sec]
DATA_SIGNIF:      22.80 [sigma]
INTEG_TIME:       1.024 [sec]
GRB_DATE:         19087 TJD;   239 DOY;   20/08/26
GRB_TIME:         79782.72 SOD {22:09:42.72} UT
GRB_PHI:           20.00 [deg]
GRB_THETA:        150.00 [deg]
DATA_TIME_SCALE: 1.0240 [sec]
HARD_RATIO:       0.54
LOC_ALGORITHM:    3 (version number of)
MOST_LIKELY:       93%  GRB
2nd_MOST_LIKELY:    4%  Generic Transient
DETECTORS:        0,0,0, 0,1,1, 0,0,0, 0,0,0, 0,0,
SUN_POSTN:        156.00d {+10h 24m 01s}  +10.00d {+09d 59' 51"}
SUN_DIST:          94.05 [deg]   Sun_angle= -9.3 [hr] (East of Sun)
MOON_POSTN:       258.31d {+17h 13m 14s}  -22.27d {-22d 15' 56"}
MOON_DIST:         97.64 [deg]
MOON_ILLUM:       63 [%]
GAL_COORDS:       103.87, 21.63 [deg] galactic lon,lat of the burst (or transient)
ECL_COORDS:        41.25, 79.40 [deg] ecliptic lon,lat of the burst (or transient)
LC_URL:           http://heasarc.gsfc.nasa.gov/FTP/fermi/data/gbm/triggers/2020/bn200826923/
COMMENTS:         Fermi-GBM Flight-calculated Coordinates.
COMMENTS:         This trigger occurred at longitude,latitude = 209.65,1.28 [deg].
COMMENTS:         The LC_URL file will not be created until ~15 min after the trigger.
```

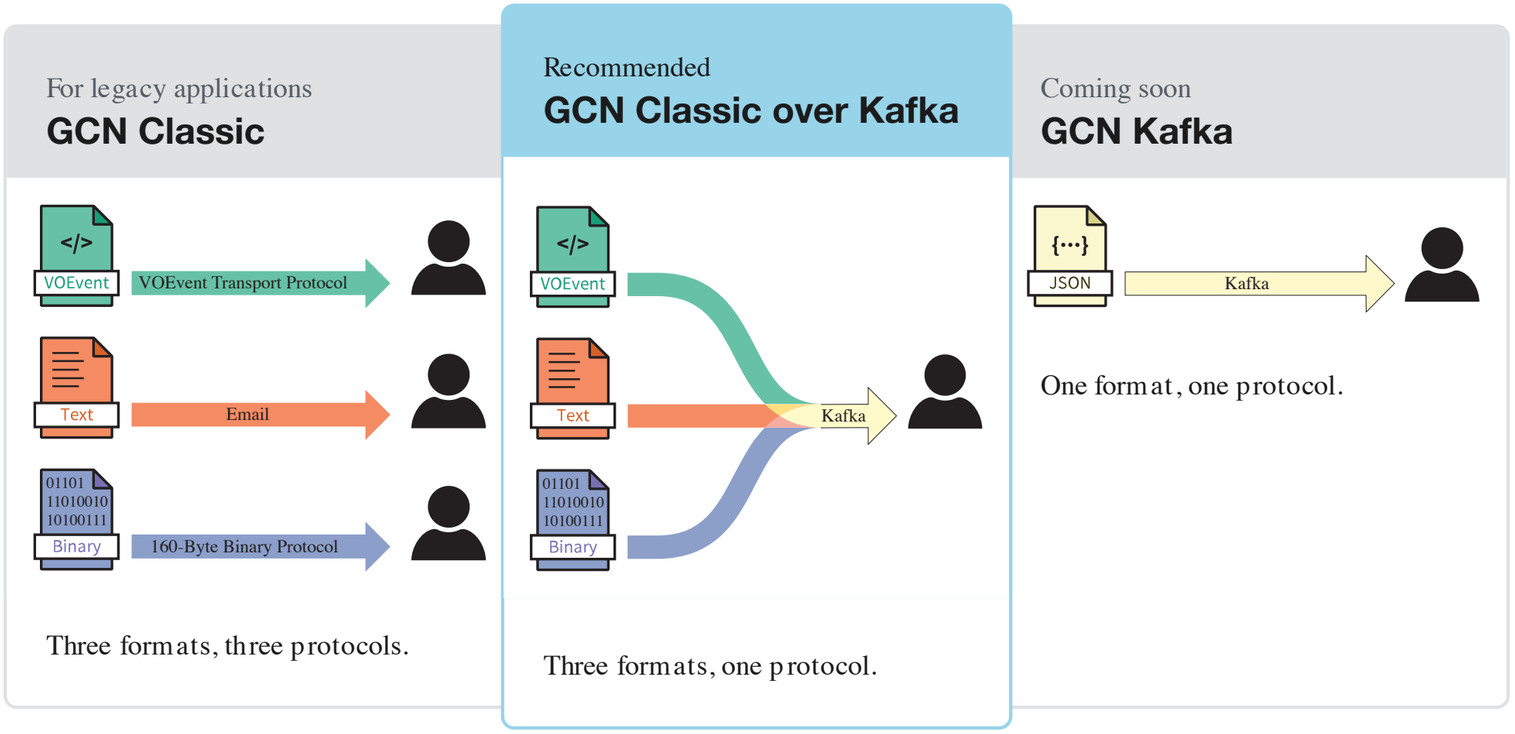
- By and for machines
- Fixed, predefined format
- Schema specific to each notice type

GCN CIRCULARS

```
TITLE:   GCN CIRCULAR
NUMBER:  28298
SUBJECT: GRB 200826B: Fermi GBM detection
DATE:    20/08/27 21:10:30 GMT
FROM:    Christian Malacaria at NASA-MSFC/USRA  <cmalacaria@usra.edu>

C. Malacaria (NASA-MSFC/USRA) and C.Meegan (UAH)
report on behalf of the Fermi GBM Team:

"At 22:09:42.72 UT on 26 August 2020, the Fermi Gamma-Ray Burst Monitor (GBM)
triggered and located GRB 200826B (trigger 620172587 / 200826923).

The on-ground calculated location, using the GBM trigger
data, was reported in GCN 28292.

The GBM light curve shows an exceptionally bright long GRB
with a duration (T90) of about 7.4 s (50-300 keV).
The time-averaged spectrum from T0-0.003 s to T0+ 12.544 s is
best fit by a Band function with Epeak = 410.3 +/- 5.6  keV,
alpha = -0.64 +/- 0.01, and beta = -2.52 +/- 0.04
The event fluence (10-1000 keV) in this time interval is
(1.414 +/- 0.006)E-04 erg/cm^2.
The 1.024-sec peak photon flux measured starting from T0+5.1 s in
the 10-1000 keV band is 110.1 +/- 0.7 ph/s/cm^2.

The spectral analysis results presented above are preliminary;
final results will be published in the GBM GRB Catalog:
https://heasarc.gsfc.nasa.gov/W3Browse/fermi/fermigbrst.html

For Fermi GBM data and info, please visit the official Fermi GBM Support Page:
https://fermi.gsfc.nasa.gov/ssc/data/access/gbm/"
```

- By and for humans (some automated)
- Freeform text (with established style)
- Citable (but not peer-reviewed)

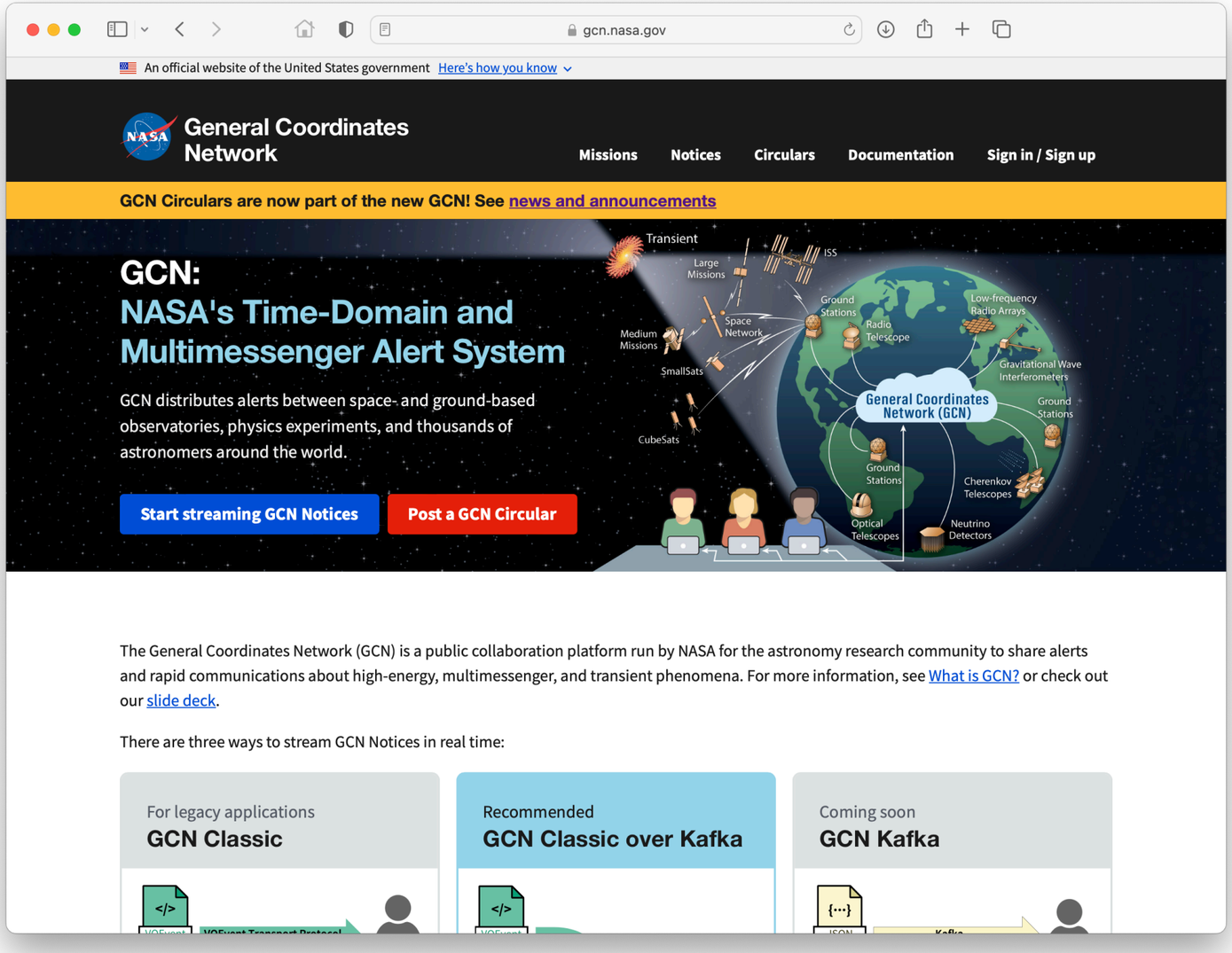
The New GCN is built on Kafka



- **GCN Classic** provides three formats over *three custom protocols*
- **GCN Classic over Kafka** provides all three formats over *one standard protocol*: Apache Kafka
- **GCN Kafka** will transition over the next few years to streaming all data in JSON format over Kafka (Notices and Circulars)

Why switch to the new GCN?

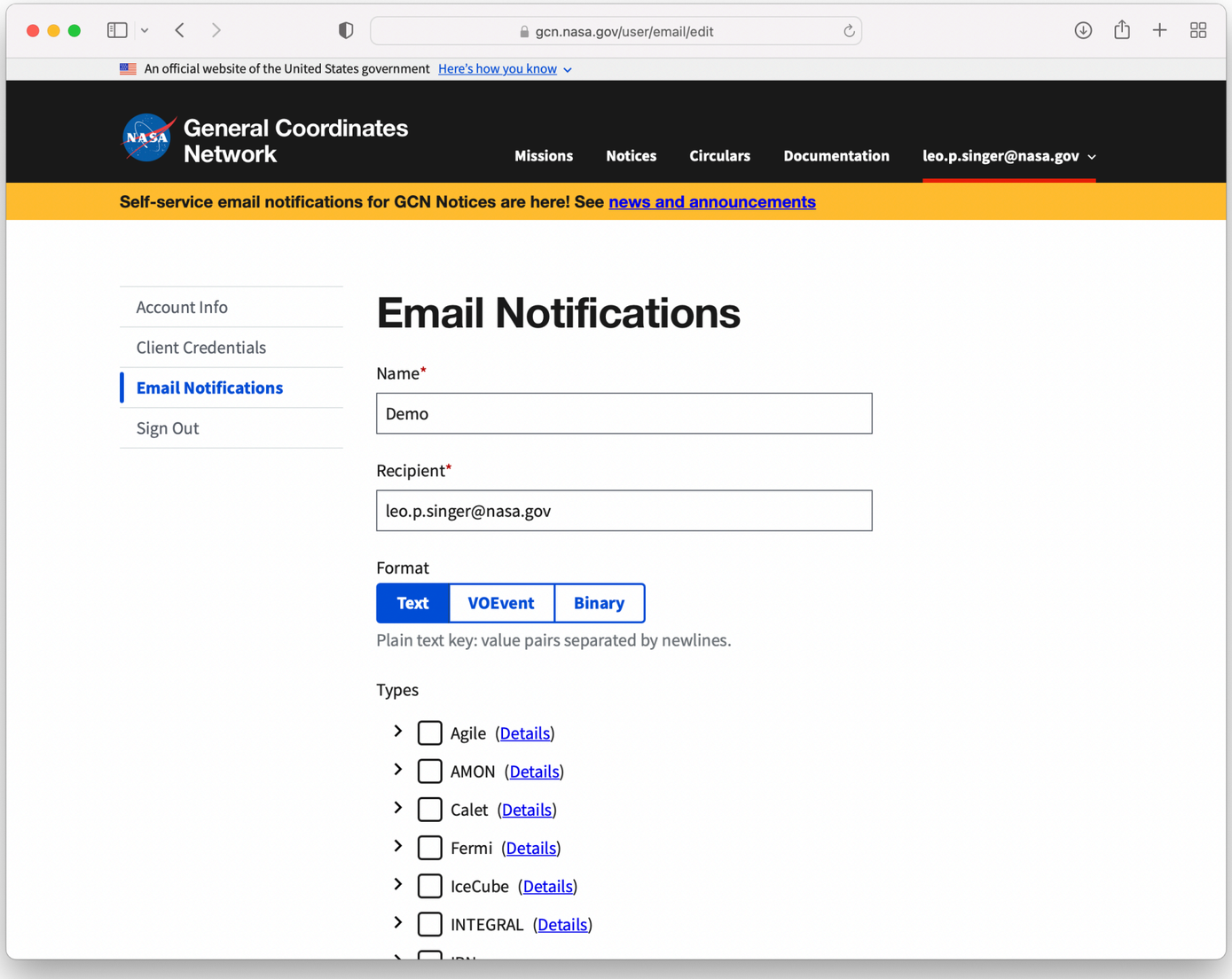
	GCN Classic	GCN Classic over Kafka
Self-service	**NO.** Users need to contact administrator in order to make account and subscription changes	**YES.** Manage your own account and subscription settings through the web site
Open standards	**NO.** Notices are sent using three custom protocols	**YES.** Notices are sent using one standard protocol, Apache Kafka
Open source	**NO.** Custom software needed to receive notices	**YES.** Receive notices using open-source software
Highly available	**NO.** Notices are broadcast by a single server	**YES.** Notices are broadcast by a cluster of highly-available Kafka brokers in the cloud
Secure	**NO.** Notices are sent as plaintext	**YES.** Notices are protected with SSL/TLS



New GCN web site

at https://gcn.nasa.gov

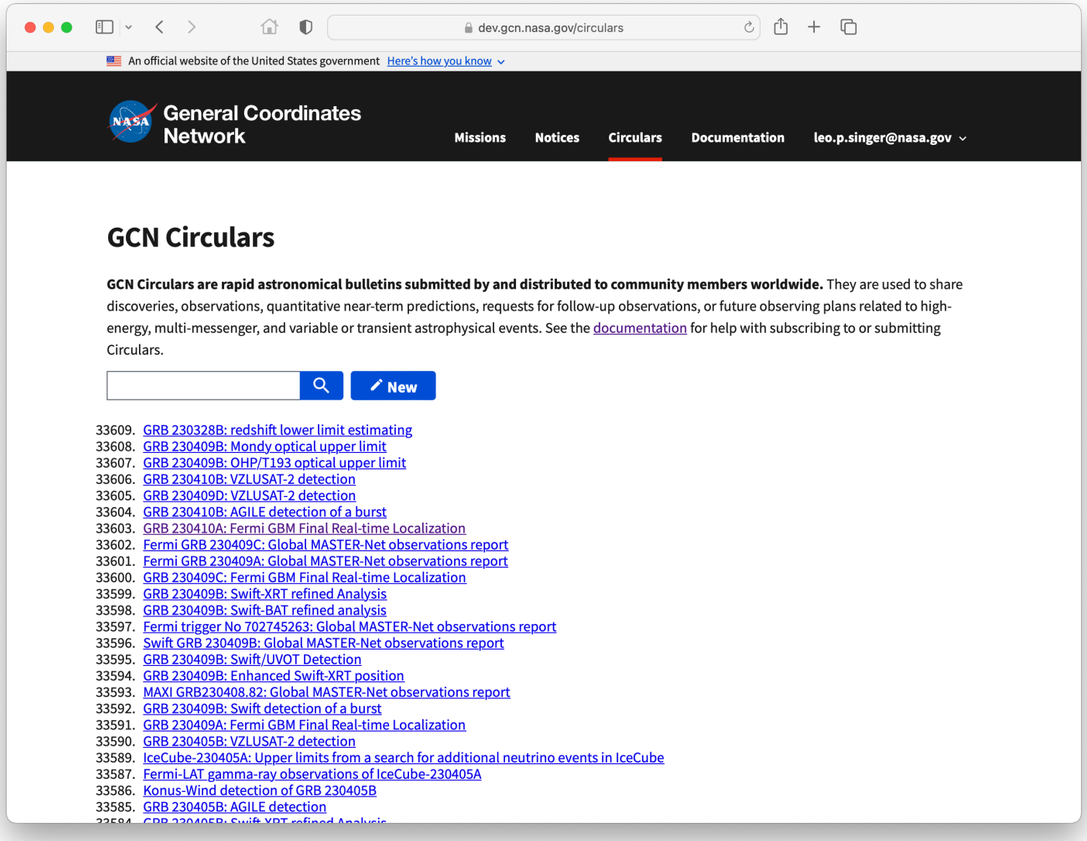
- Updated look and feel
- More accessible, based on US Web Design System
- Single sign on with:
  - email and password
  - Google
  - Facebook
  - LaunchPad (for NASA employees and affiliates)



Self-service email alerts

Email is still the most popular way to receive GCN Notices.

- Previously, users had to contact the GCN Team to create or modify their subscriptions manually.
- Now, you can manage your email subscriptions yourself through our new web site.
- **Note**: to cancel legacy email subscriptions on the old web site, contact us.



New and improved:

GCN Circulars

at https://gcn.nasa.gov/circulars

- Browse and search our new archive.
- Manage your own email subscriptions.
- Enroll yourself and your colleagues to submit Circulars with arXiv-style peer endorsements.
- Submit Circulars with our new Web form, or continue to submit by email.

(skip ahead for more on GCN Circulars)

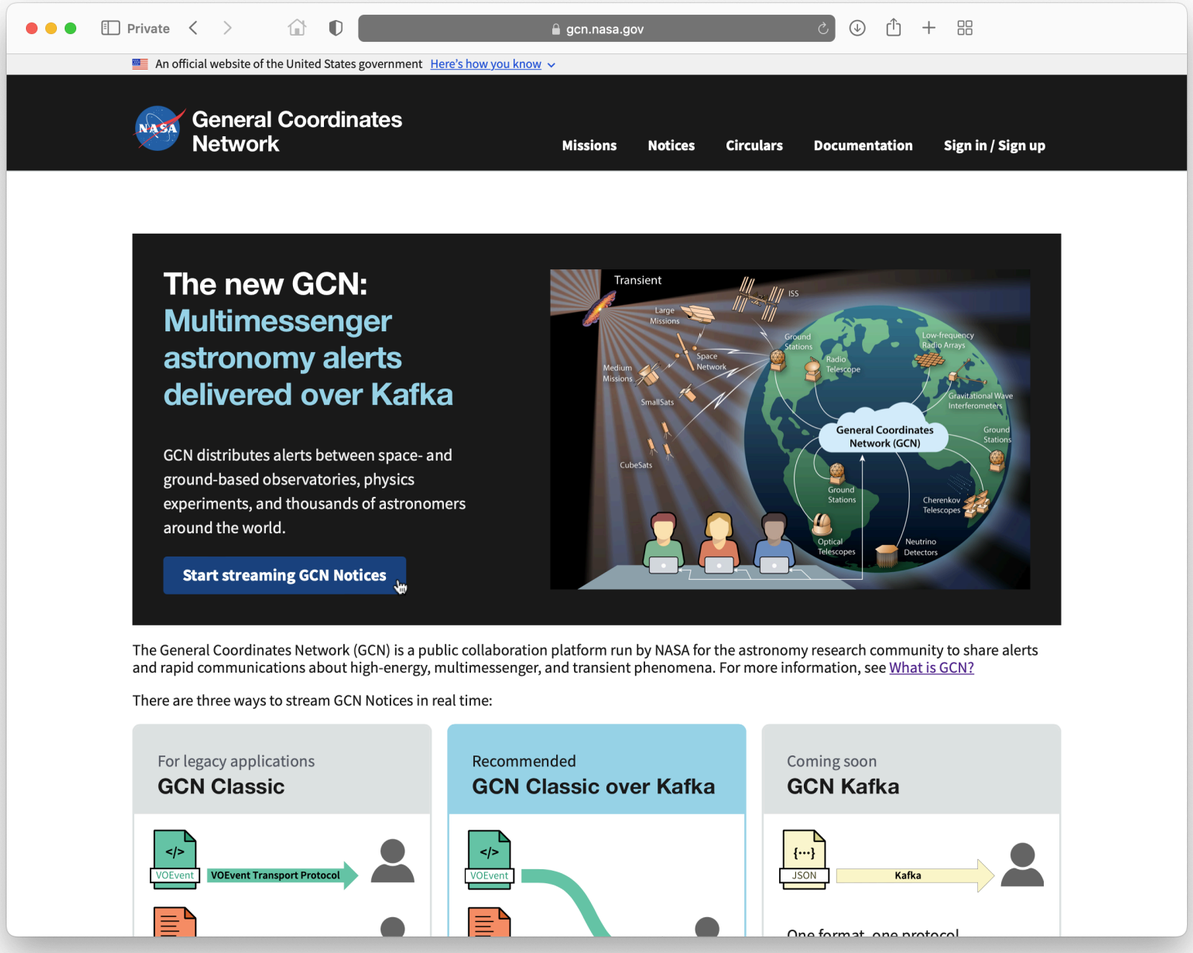
What’s staying the same?

GCN Classic is not going away any time soon. The following are still fully supported:

- GCN Notices legacy delivery mechanisms (email, socket, VOEvent Transport Protocol) of all current notice types
- GCN Circulars submission and delivery via email
- The old GCN Classic web site, https://gcn.gsfc.nasa.gov
- The live archives of GCN Notices on the old web site

However, new features and notice types are only available on the new web site and GCN Kafka.

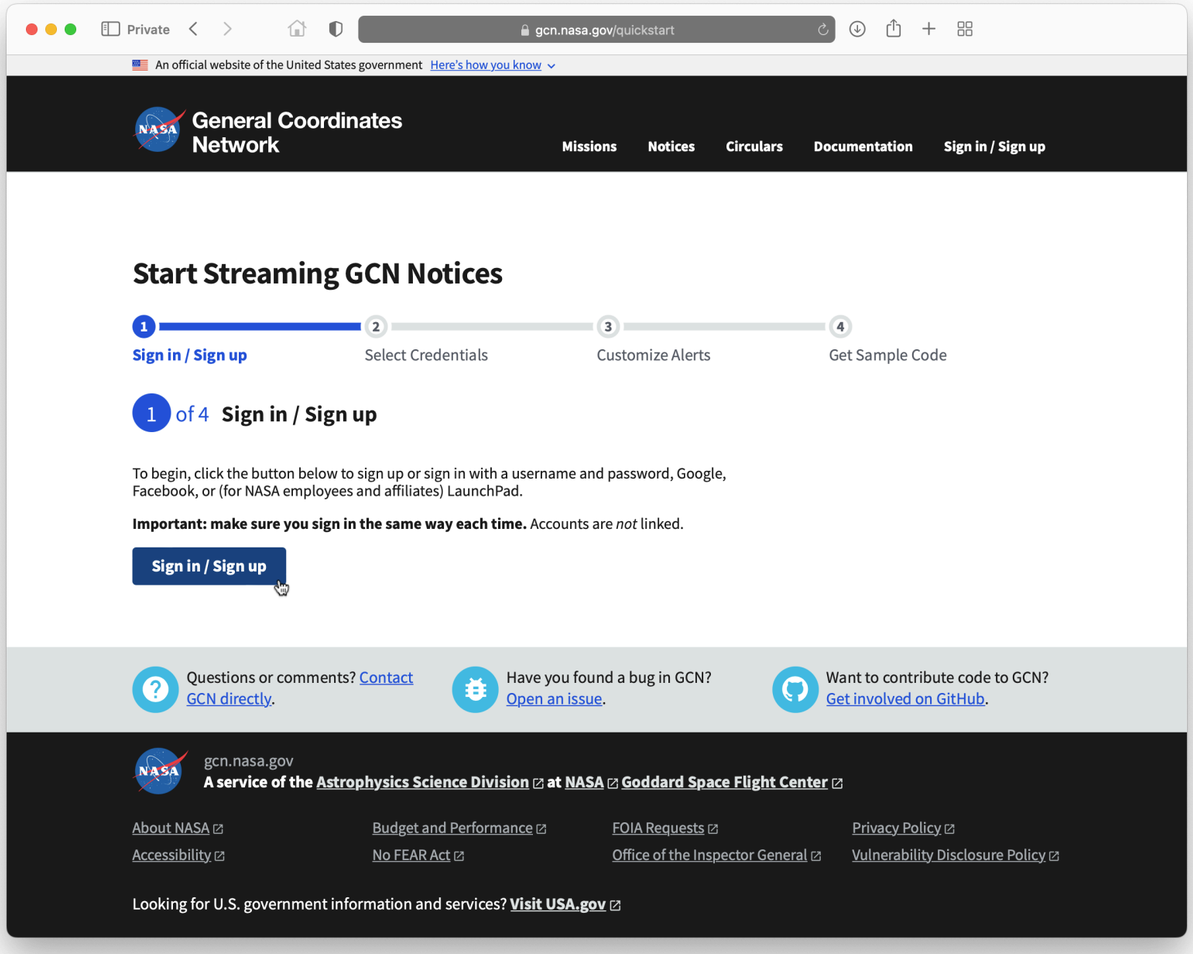
Streaming GCN Notices in Python



Launch quick start

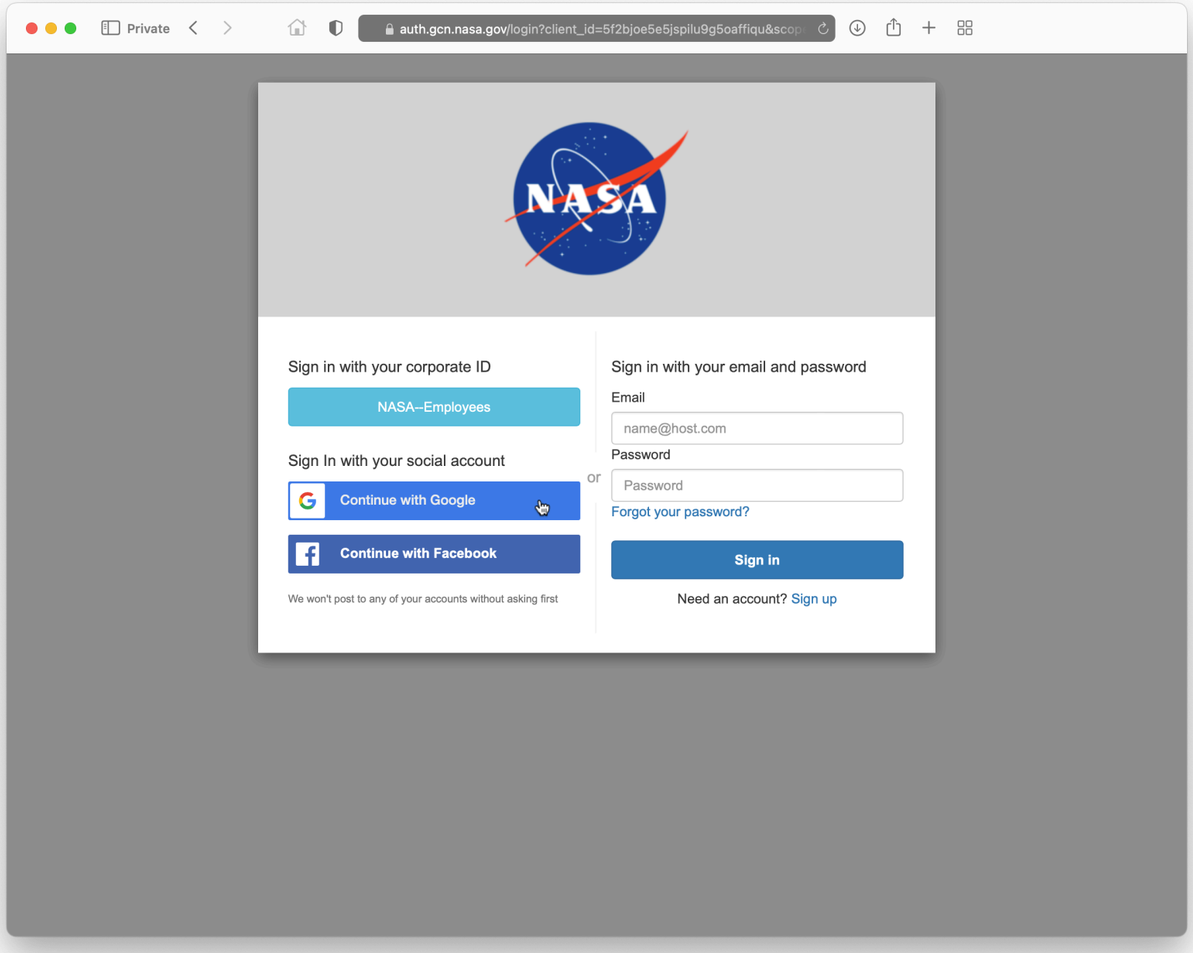
Go to https://gcn.nasa.gov and click Start streaming GCN Notices

(skip past demo)



Step 1: Sign in / Sign up

Click "Sign in / Sign up" to create a GCN account.

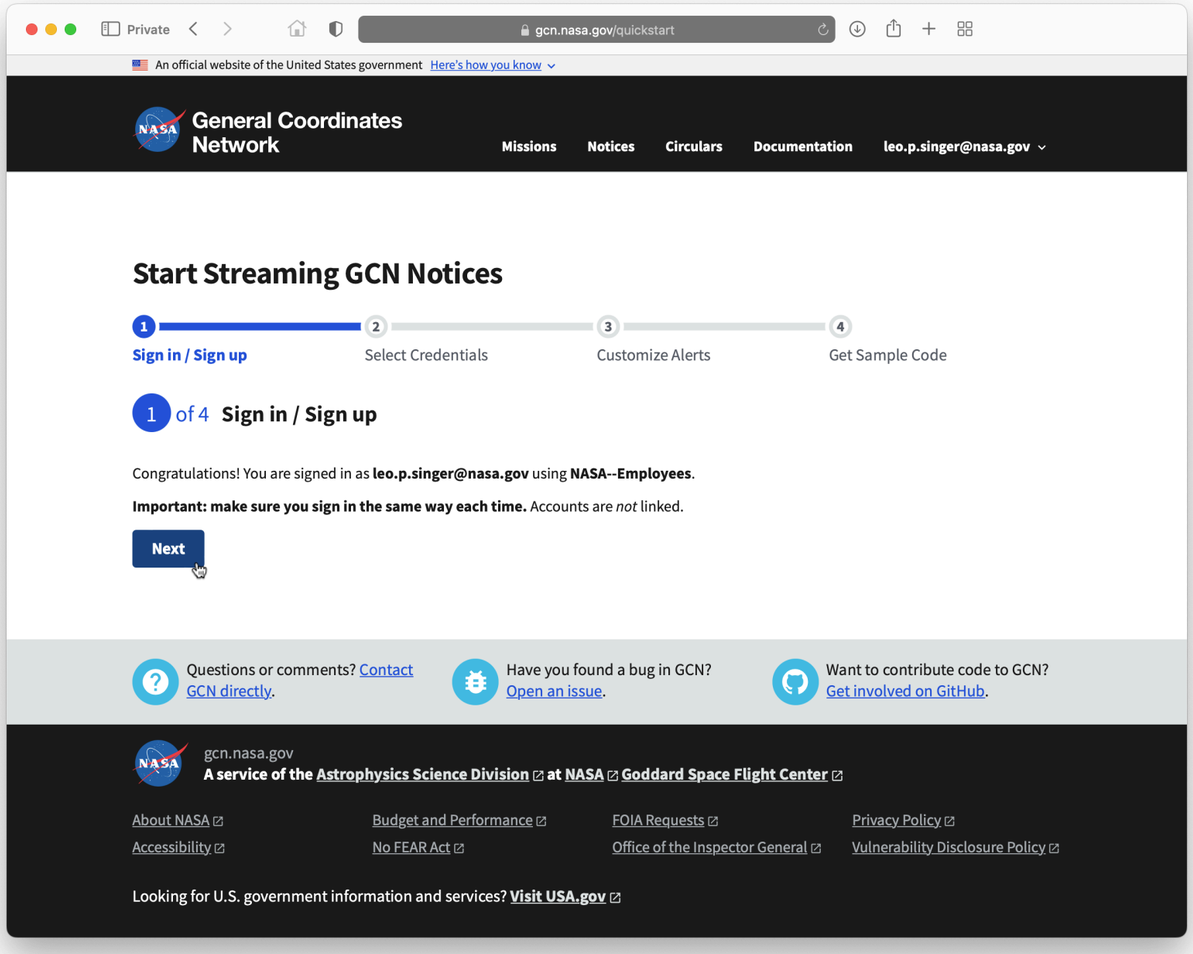


Choose how to sign up

Choose any one of the following methods to sign up:

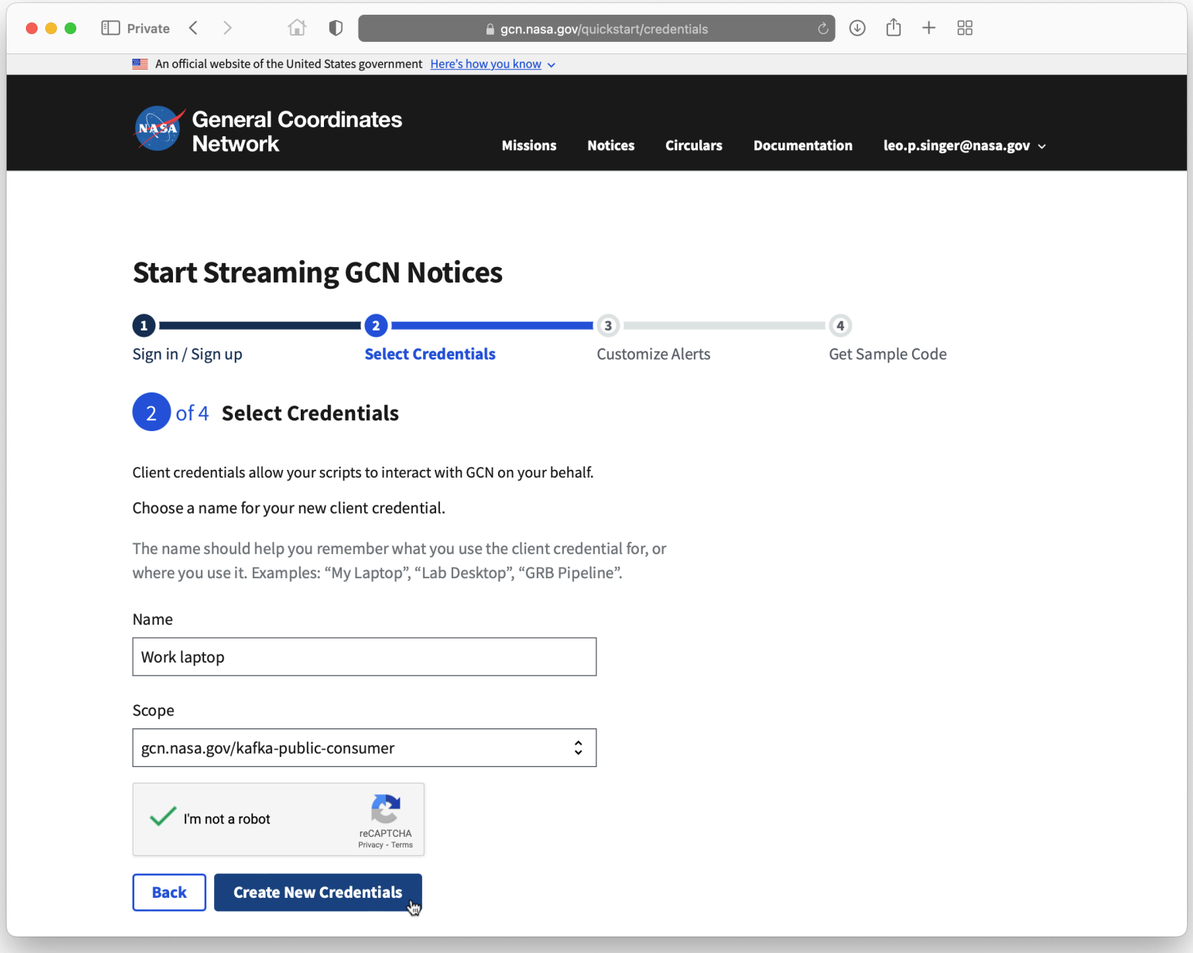
- Email and password
- Google
- Facebook
- (for NASA employees and affiliates) LaunchPad

Important: make sure you sign in the same way each time. Accounts are *not* linked.



Step 1 is done

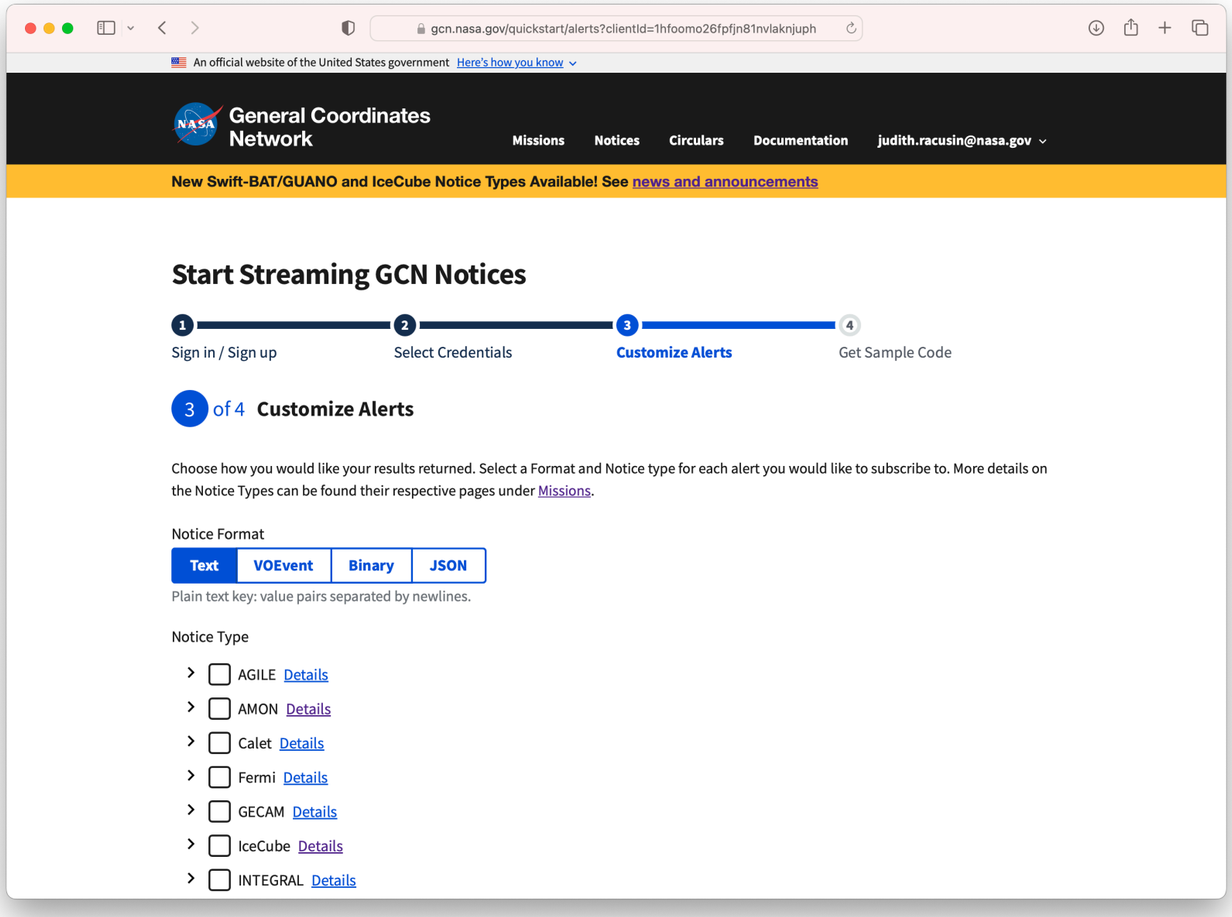
Click "Next" to continue



Step 2: Select Credentials

Client credentials allow your scripts to interact with GCN on your behalf.

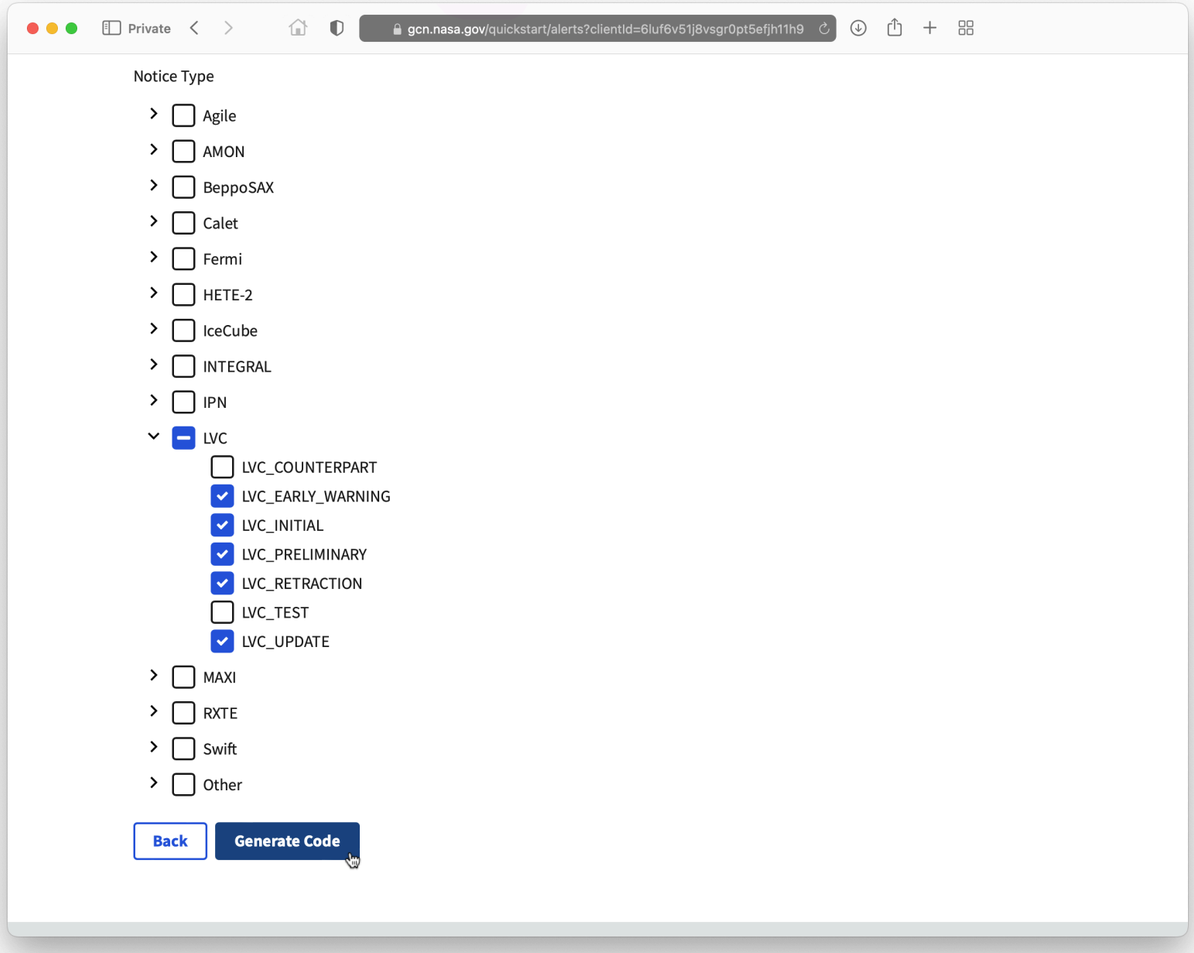
1. Choose a name for your credential.
2. Complete the CAPTCHA.
3. Click "Create New Credentials" to go to the next step.



Step 3: Customize Alerts

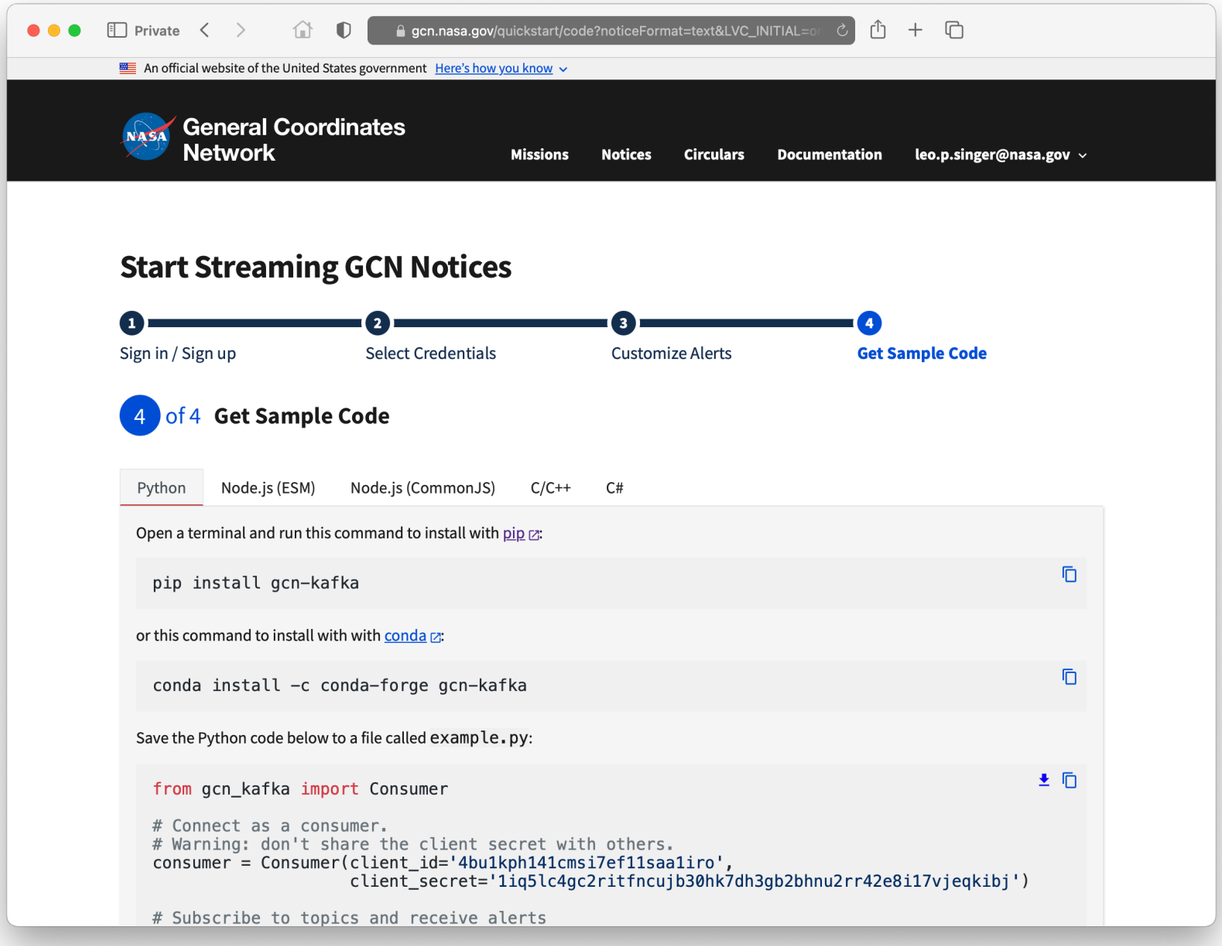
Select one of these alert formats.

- Text: plain text key-value pairs separated by newlines.
- VOEvent: VOEvent XML.
- Binary: 160-byte binary format. Field packing is specific to each notice type.
- JSON: key-value pairs and arrays, allows embedding attachments.



Step 3 Continued: Choose Notice Types

Select the missions that you want to subscribe to. Expand a mission to fine-tune notice types.

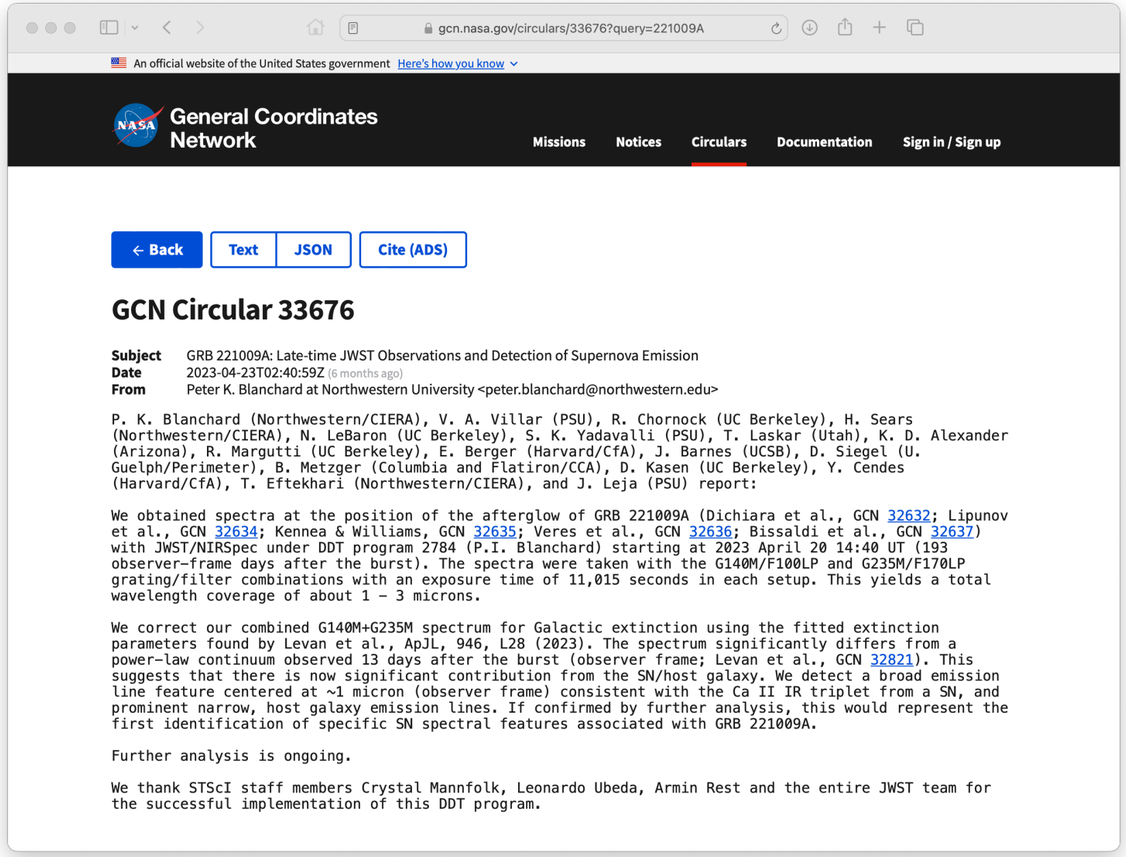


Step 4:
Get Sample Code

Copy and paste Python client code or download it to your computer to run.

Client sample code is also available in Node.js (ESM or CommonJS), C/C++, C#.

The New GCN Circulars



Improvements to Circulars

The new GCN Circulars are:

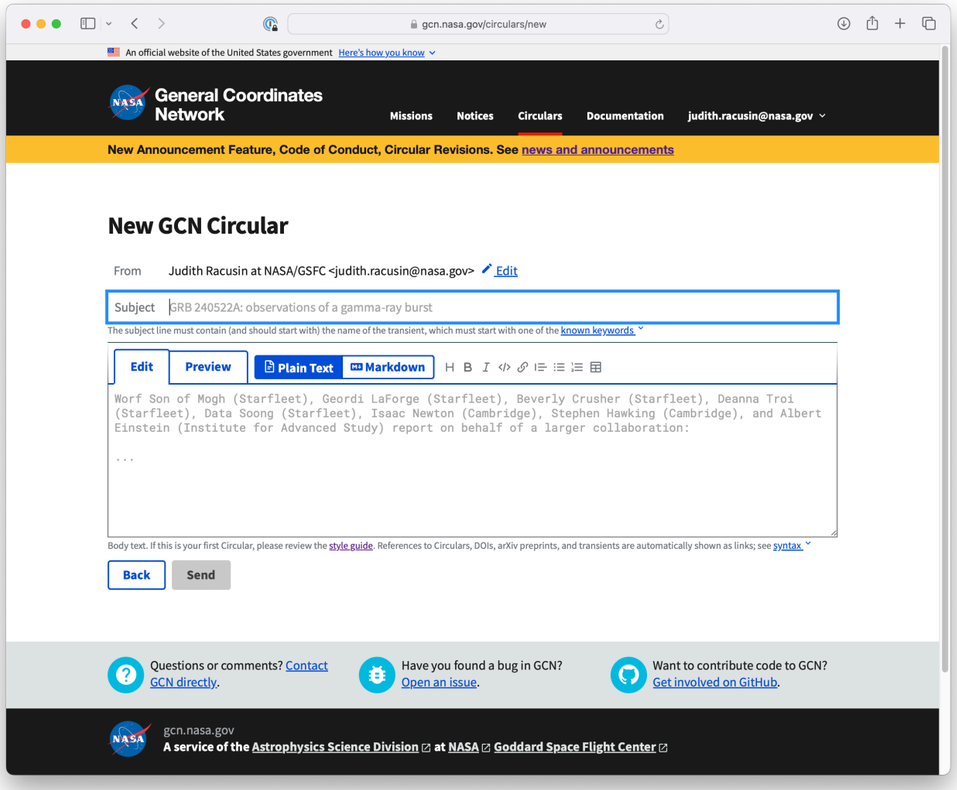
- **Self service**: Manage your own subscriptions and settings.
- **More inclusive**: It's easy to join the community and submit a GCN Circular.
- **Fast**: Email notifications are distributed in parallel to all users within seconds.
- **Robust**: Circulars run on highly available, distributed cloud services.
- **Sustainable**: GCN Circulars are robustly funded by NASA and are part of the open source GCN project.

Migrating GCN Circulars from GCN Classic

On April 17, 2023, GCN Circulars moved from the old site to the new one. If you had an account on the old system, then you already have an account on the new one!

GCN CIRCULARS MIGRATION CHEAT SHEET

	Old	New
Web archive	https://gcn.gsfc.nasa.gov/gcn3_archive.html	https://gcn.nasa.gov/circulars
Emails come from	gcncirc@capella2.gsfc.nasa.gov	no-reply@gcn.nasa.gov
Submit Circulars by email to	gcncirc@capella2.gsfc.nasa.gov	gcncirc@capella2.gsfc.nasa.gov circulars@gcn.nasa.gov (recommended)
Submit Circulars by web form	(not supported)	https://gcn.nasa.gov/circulars/new



New Features of Circulars

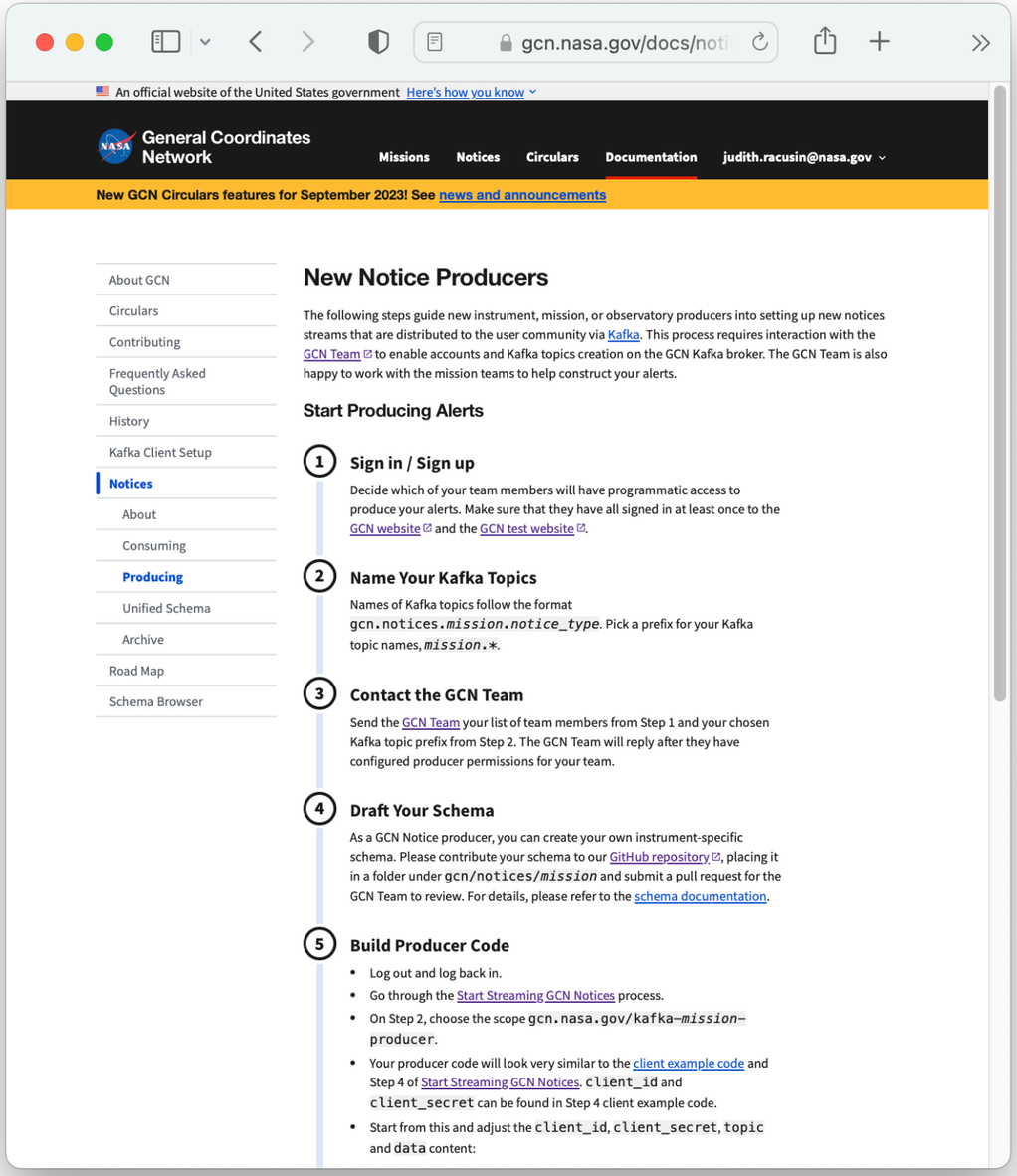
- Embed tables, coordinates, images, and styled text in Circulars with “Astro Flavored Markdown”
- Minor revisions to Circulars in archive
- Interoperability with other transient Kafka brokers (e.g. SCiMMA)
- Real-time integration with SAO/NASA Astrophysics Data Service (ADS)

Coming Soon to Circulars

- Receive Circulars over Kafka
- Link multiple emails with your account
- Browse Circulars by event and source class
- Data extraction via Natural Language Models

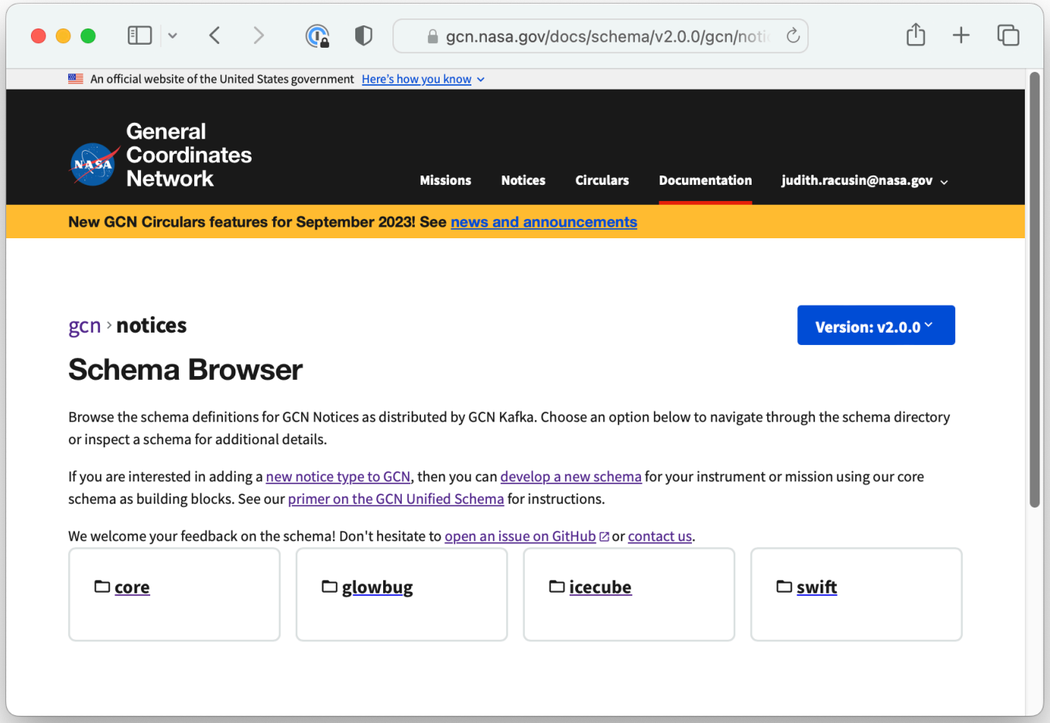
More enhancements are coming to GCN:

- New alert types and alerts from new missions and facilities
  - New Kafka-only notices for Swift-BAT/GUANO and IceCube
  - Many others in development including Einstein Probe, Glowbug, BurstCube, Super-K, Fermi-GBM, AMON
- Integrated, searchable database of Notices and Circulars (GCN Viewer)



Create new Notice types

- All new notice topics will only be distributed by GCN Kafka
- See step-by-step instructions
- Preferred notice format is JSON
- Unified JSON schema provides common core



Unified schema and alert format for GCN Kafka

- JSON schema with common core fields
- Instrument/mission/observatory specific fields where needed
- Schema development documentation
- Schema Browser
- GitHub project: nasa-gcn/gcn-schema

GCN Notices Sample Schema

```
{
  "$id": "https://gcn.nasa.gov/schema/main/gcn/notices/mission/sample.schema.json",
  "$schema": "https://json-schema.org/draft/2020-12/schema",
  "type": "object",
  "unevaluatedProperties": false,
  "title": "Your Schema Name",
  "description": "A description for your schema",
  "allOf": [
    {"$ref": "../core/Alert.schema.json"},
    {"$ref": "../core/Localization.schema.json"}
  ],
  "properties": {
    "example_field_1": {

"type": "string",
```

GCN Notices Sample Example

```
  "$schema": "https://gcn.nasa.gov/schema/main/gcn/notices/mission/sample.schema.json",
  "alert_datetime": "2023-09-28T01:40:30Z",
  "ra": 197.44871198,
  "dec": -23.38397612,
  "example_field_1": "The ultimate answer to life, the universe, and everything",
  "example_field_2": 42
}
```

https://gcn.nasa.gov/docs/notices/schema

Thanks for listening!

Web site: https://gcn.nasa.gov

This presentation: https://nasa-gcn.github.io/gcn-presentation/

Questions or comments? Contact GCN directly

Have you found a bug in GCN? Open an issue

Want to contribute code to GCN? Get involved on GitHub