The MeerKAT Graphical User Interface Technology Stack

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THHC3001
background
present = MeerKAT
present = MeerKAT
future = SKA
old katgui
old katgui – problems

- Adobe dependencies
  (based on Adobe Flex framework)
- sluggish
- mouse events not always registered
- not going to scale well (64 antennas)
approach
method

- user interface technology investigation
  - responsive web design
  - various typical use-case prototypes
- bi-monthly discussions with relevant stakeholders to clarify requirements
  - most importantly the telescope operators and commissioners (i.e. the end-users)
- iterative development approach
  - included monthly demonstrations of prototype displays
meerkat gui architecture
architecture overview

- client-server architecture
- real-time updates of monitor points
  - websockets & pubsub

### Websocket
- full-duplex socket connection
- eliminate need for polling
- event driven responses

### Pubsub
- publish & subscribe
- messaging design pattern
- publisher is a sender/provider
- subscriber is a receiver/consumer
- messages characterised into classes
- pubs & subs no knowledge of each other
backend
katportal

- katportal = backend component
  - runs various HTTP web servers
  - redis for the pubsub mechanism
  - client websocket connections subscribe to monitoring points
  - telescope system publish updates
http servers

- **auth webserver**
  - provides HTTP connection handling (RESTful API)
  - authentication = basic
  - authorisation = role based with session token (JWT)

- **monitor webserver**
  - provides websocket connection handling
  - no authorisation required
  - exposes subscribe-related commands (JSONRPC)

- **control webserver**
  - provides HTTP connection handling (RESTful API)
  - requires authentication & authorisation
example JWT token

```
Encoded  PASTE A TOKEN HERE

eyJbGciOiJIUzI1NiIsInR5cCI6IkpXVCJ9.eyJpZnRvY3VtZW50IjoiYWRtaW4iLCJ1c2VyX2lkIjoiYWxhYmxlIn0.

Decoded

HEADER: ALGORITHM & TOKEN TYPE

{
  "alg": "HS256",
  "typ": "JWT"
}

PAYLOAD: DATA

{
  "name": "CAK",
  "roles": ["user-admin",
             "control_authority",
             "read-only",
             "operator",
             "lead_operator"
           ],
  "iat": 1437475542,
  "req_role": "lead_operator",
  "email": "cak@skate.ac.za",
  "id": 1
}

VERIFY SIGNATURE

HMACSHA256(base64UrlEncode(header) + "." + base64UrlEncode(payload), secret)
```
backend technology stack
backend technology stack

Ubuntu 14.04 LTS
backend technology stack

Ubuntu 14.04 LTS

NGINX
backend technology stack

Ubuntu 14.04 LTS

redis

NGiNX
backend technology stack

Ubuntu 14.04 LTS

Python
Redis
NGINX
backend technology stack

- Tornado
- Python
- Redis
- NGINX
- Ubuntu 14.04 LTS
thick web-application

build for chrome
  but firefox & safari works too

separate connections for each browser tab

subscribe to namespaces (groups of similar monitoring points)
  e.g. alarms, sched, obs, ants

concurrent user interface state updates
frontend technology stack
frontend technology stack

- Directives
- Reusable Components
- Localization
- Embeddable
- Injectable
- Testable
frontend technology stack

Material design

- Reusable components
- Localization
- Embeddable
- Injectable
- Testable
frontend technology stack
- simple dashboard with customisable widgets
- grouped navigation represented as “navigation pies”
- sidebars with quick links
Seasonal Streaks Point to Recent Flowing Water on Mars (2015-09-30)

Explanations: These thin, changing streaks on Mars’ Called-Reducing Slope Lines (SRLs) these dark features start on the slopes of hills and craters but don’t usually extend to the bottom. What’s even more unusual is that these streaks appear to change with the seasons, appearing fresh and growing during warm weather and disappearing during the winter. After much study, including a recent chemical analyses, a leading hypothesis has emerged that these streaks are likely created by new occurrences of liquid salty water that evaporates as it flows. The source for the briny water is still unclear, with two possibilities being evaporation from the Martian atmosphere and underground movement. An exciting inference is that if those salty streaks are not too salty, they may be able to support biological life as Mars explores. The current name of this possible briny water was inspired by Mar’s researchers during the Cleopatra Mar’s mission, named after the star and Briny Water system since 2006. 

Interplay between the Martian atmosphere and liquid water is expected to support potential life as Mars explores.
landing page and navigation
landing page and navigation
many different health displays to maximise efficient fault finding

- interactive, customisable
- bold colours
- developed to be on large, heads-up displays
- important information always shown

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<th>All Comms OK</th>
<th>No Windstow Acti</th>
<th>Servers OK</th>
<th>CAM All OK</th>
<th>BMS</th>
<th>Config and Source</th>
<th>All Sensors OK</th>
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</table>

Interlock State: NONE

MKAT.CAMv10.TBD 2015-01-TBD

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22 October 2015
receptor health
receptor health
receptor health
receptor health (64)
Custom Health

Enter Sensor Regex Width: 200 Height: 400

ADD VIEW EXPORT TO URL
receptor pointing
sensorograph – historical data
alarms

- pushed via websockets
- alarms dedicated display
- alarm notifications
  - overlay on every page until operator acknowledges alarm
- alarm badges on main toolbar
alarms

Current Alarms

<table>
<thead>
<tr>
<th>Date/Time</th>
<th>Priority</th>
<th>Name</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>22-09-2015 12:45:59</td>
<td>new</td>
<td>Katstore_files_status</td>
<td>error/new_app_ann_katstore_file_status_is_false</td>
</tr>
<tr>
<td>28-09-2015 07:12:24</td>
<td>new</td>
<td>No_LeadOperator</td>
<td>normal/new_kipool_1s_type = &quot;<a href="mailto:cam@skala.ac.za">cam@skala.ac.za</a>&quot; status</td>
</tr>
<tr>
<td>22-09-2015 12:45:59</td>
<td>new</td>
<td>monctl_disk_use</td>
<td>normal/new_ganglia_monctl_kat_disk_part_max_used</td>
</tr>
</tbody>
</table>

Known Alarms

<table>
<thead>
<tr>
<th>Date/Change</th>
<th>Priority</th>
<th>Name</th>
<th>Message</th>
</tr>
</thead>
<tbody>
<tr>
<td>22-09-2015 12:42:57</td>
<td>known</td>
<td>CBF_Device_Status</td>
<td>unknown known/reading for updates: data._1.cbf.device_status</td>
</tr>
</tbody>
</table>
alarms
alarms
scheduling observations

- subarray = logical grouping of receptors
  - i.e. sub-telescope
  - MeerKAT supports 4

- schedule block = unit of observation work
  - executes an observation script

- subarray control is limited based on user role

- guide user through scheduling workflow
scheduling observations
scheduling observations

Subarrays.Observations

Resources

Schedule Block Details

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22 October 2015
scheduling observations
ipython shell
conclusion
conclusion

- involve the **actual users** of the interface early in the life cycle
- **pubsub** excellent to provide isolation between consumers and producers of data
- **web technologies** for control & monitoring applications is a viable option
- growth of computing power makes **thick clients** possible, reducing load at server
- users enjoy working with **attractive interfaces** … yes, even scientists
questions?