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A Radio Astronomer and an Architect Walk into a Bar…

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Outline

The Challenge

A little bit of background and context

The Architecture Integration Workshop

Retrospective

- What worked
- What didn't work
- Why we think it worked

Some evidence about the outcome

Conclusions and take-aways

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A **Radio Astronomer** and an **Architect** walk into a bar..

We're building a REALLY big radio telescope. There's a lot of software.
I'm worried. I can't sleep during the day.

Don't you mean "can't sleep at night"?

I'm an astronomer. I work all night and I *used to* sleep during the day.

What has you so worried?

Lots of subsystems. Each designed by a different team.
Teams are spread across the world. I don't have much authority.

What leverage do you have?

Well, I have to accept the architecture documentation at the Critical Design Review. I need visibility into how the pieces will work together.

We can help you with that.

Can you help us develop better documentation, so I can assess the risks?

Sure.

We don't have much time or money.

What else is new?

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A REALLY Big Radio Telescope

“One of the most visionary and ambitious science projects of the 21st century.

The Square Kilometre Array (SKA) radio telescope will ultimately be the largest scientific instrument on Earth, both in physical scale and in terms of the volume of data it will generate.”

(From the Square Kilometre Array Prospectus)

Two Antenna Arrays

- Mid Frequency – South Africa
- Low Frequency – Western Australia

Supercomputing centres

50-year system operational life

Managed from Global HQ, Jodrell Bank, UK

Image courtesy of SKA Organisation

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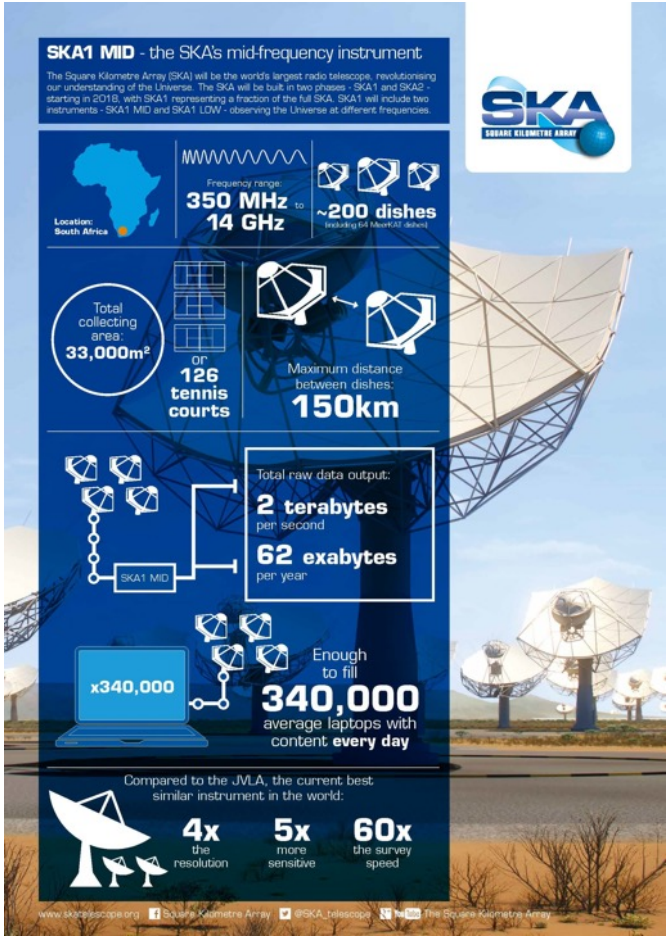
Mid-Frequency Array



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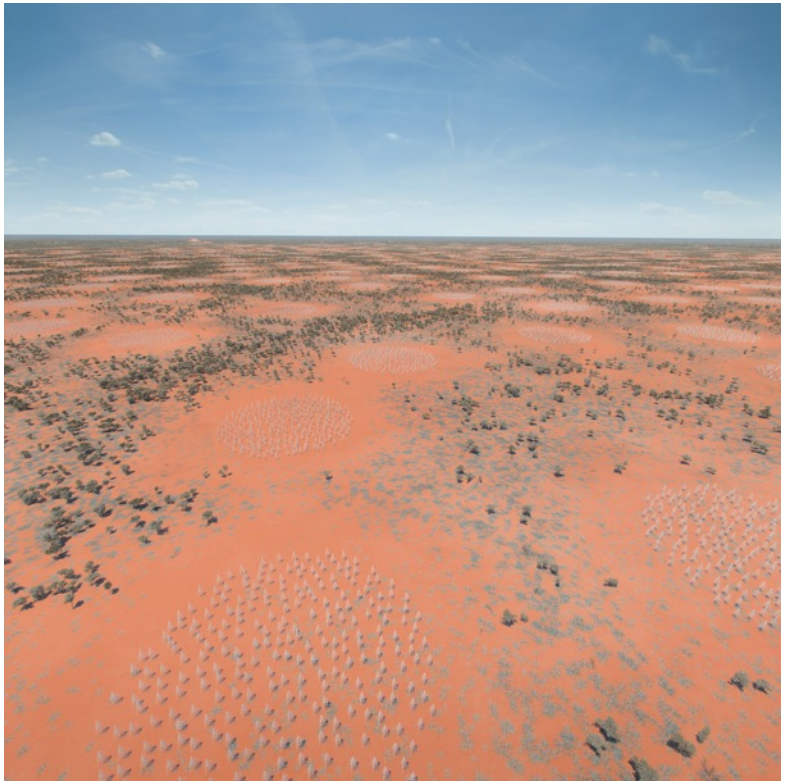
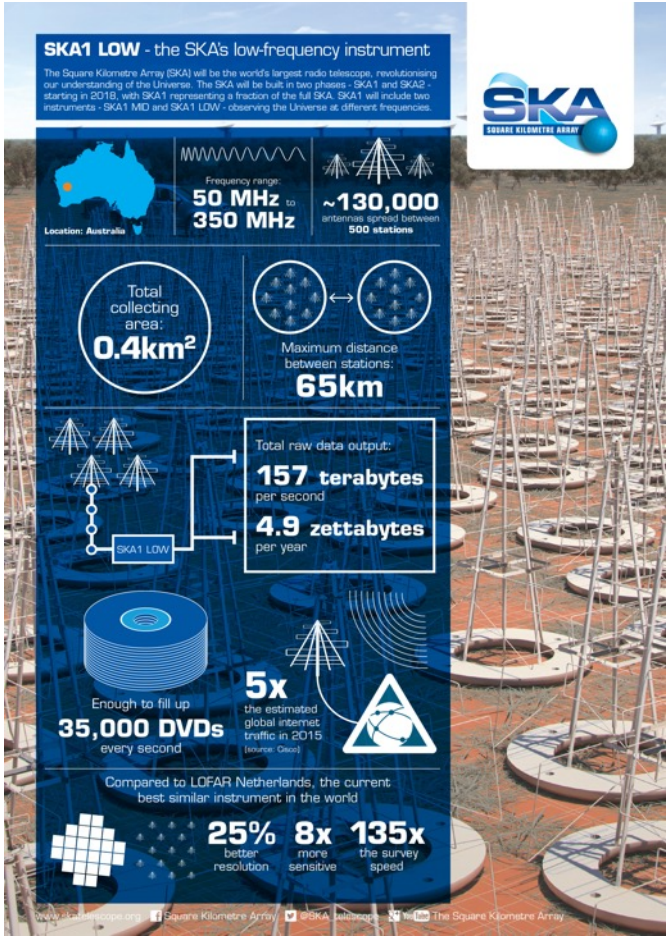
Low Frequency Array





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Engagement Context

Constraints:

Single face-to-face workshop

- Multi-day event
- At SKA HQ, Jodrell Bank, England

Very limited funding for preparation and follow-up

This project phase is a bit waterfall-ish

- Need to do enough design to demonstrate an acceptable level of “construction” risk
- “Construction” comes later, will include software design and development using SAFe

Participants:
30 attendees from 16 institutes across 8 countries, ~12 nationalities

Lots of domain knowledge, not just software developers

- Lots of hands-on coding experience
- Little formal software eng. training

Strong formal systems engineering/ requirements analysis capability

Strong project management capability

Consultants:
Funding limited us to 2 people: Neil Ernst and John Klein.

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Architecture Integration Workshop

Agile Mindset–YAGNI → Just Enough Learning

- Reuse/remix material from SEI course modules

Motivate the need for architecture design and documentation by doing analysis of the SKA system

- Find important questions that are hard to answer without sufficient documentation

Maximize hands-on practice to start producing artifacts for the SKA subsystems

- Leave the workshop with something useful

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Workshop Outline

Monday
- Introductions
- First mission thread analysis

Tuesday
- Discussion: Commonalities and themes across the findings of the first mission thread analysis.
- Learning Module: Quality Attributes

Wednesday
- Facilitated Working Session: Quality attribute scenarios
- Learning Module: Introduction to Views and Beyond documentation method

Thursday
- Second mission thread analysis
- Learning Module: Interface and behavior documentation

Friday
- Organize and prioritize quality attribute findings
- Assess mission thread coverage
- Wrap-up

Saturday
- Working session to tailor documentation template
- Start of practice and coaching session

Sunday
- Complete practice and coaching session.
- Final wrap-up

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What Worked

Just-in-time training

- Analysis – Identify a problem in our system/process
- Training – Learn a method to fix the problem
- Practice – Fix the problem, with SEI coaching

All exercises were based on the SKA system, and produced artifacts that attendees could actually use – demonstrated feasibility and value of the approach

- Mission thread with variations
- Quality attribute scenarios
- Produced design and documentation for 3 views, and parts of others

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What didn’t work so well

Defining a mission thread with such a large group – you need to go in with the steps already defined (at least 80%)

The group was not comfortable abstracting any part of the system – maybe a symptom of the diversity of the group and the scientific background?

- Couldn’t treat anything as a black box
- Every detail had to be complete and accurate
- Every analysis had to be end-to-end

Facilitation – balancing velocity against individual learning paces, cutting off questions and discussion to keep moving. We got early feedback from the client and were able to correct this.

7 straight days is a long time to go with no downtime.

I started having opinions about the architecture drivers and design – shifted from coaching to problem solving and directing

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Why it worked
(Missing any of these could have been fatal)

Attendees were extremely engaged and willing to learn – right through to the end of the last day

Context knowledge (Neil's experience with the scientific software community)

Domain knowledge (John's experience with phased array radar and signal processing, along with a little bit of amateur-level astronomy knowledge)

Flexibility – we brought a lot of material with us, and added and removed content as we learned more about attendees strengths and gaps

Physical fitness – 7 long days with the attendees, including after-work meetings and group dinners

Outstanding logistical support from the client's organization – we could focus 100% on delivery

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Fast-forward one year…

Time for the Critical Design Review for one major system element

- Review objective: Is the construction risk level acceptable?
- Decided to use an ATAM-style scenario-based evaluation as part of the review

Documentation artifacts were sufficient to support the evaluation

- Analyzed 9 scenarios over ~14 hours (including breaks)
- Documentation facilitated efficient and detailed discussion of architecture decisions – no analyses were stopped early because of insufficient documentation
- High quality evaluation – most of the identified risks were narrowly scoped

Element teams had used quality attribute scenarios to drive the architecture design

- We tailored the ATAM process to take advantage of all of the work that was already completed – we are saving the details about that for another talk ;)

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Conclusion and Take-aways

A little bit of just-in-time hands-on architecture training can have a big impact in the right context

The right context:

- Organizational commitment
- Architects open to new approaches
- The selected approach solves visible problems
- Architects have the experience to see the value in solving the problems

Executing the training is hard work (for everyone involved)

Ongoing post-training coaching might have improved the outcome even more

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http://www.skatelescope.org/
Exploring the Universe with the world's largest radio telescope...

https://www.sei.cmu.edu/architecture

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