SKA DISH Consortium

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SKA Engineering Meeting
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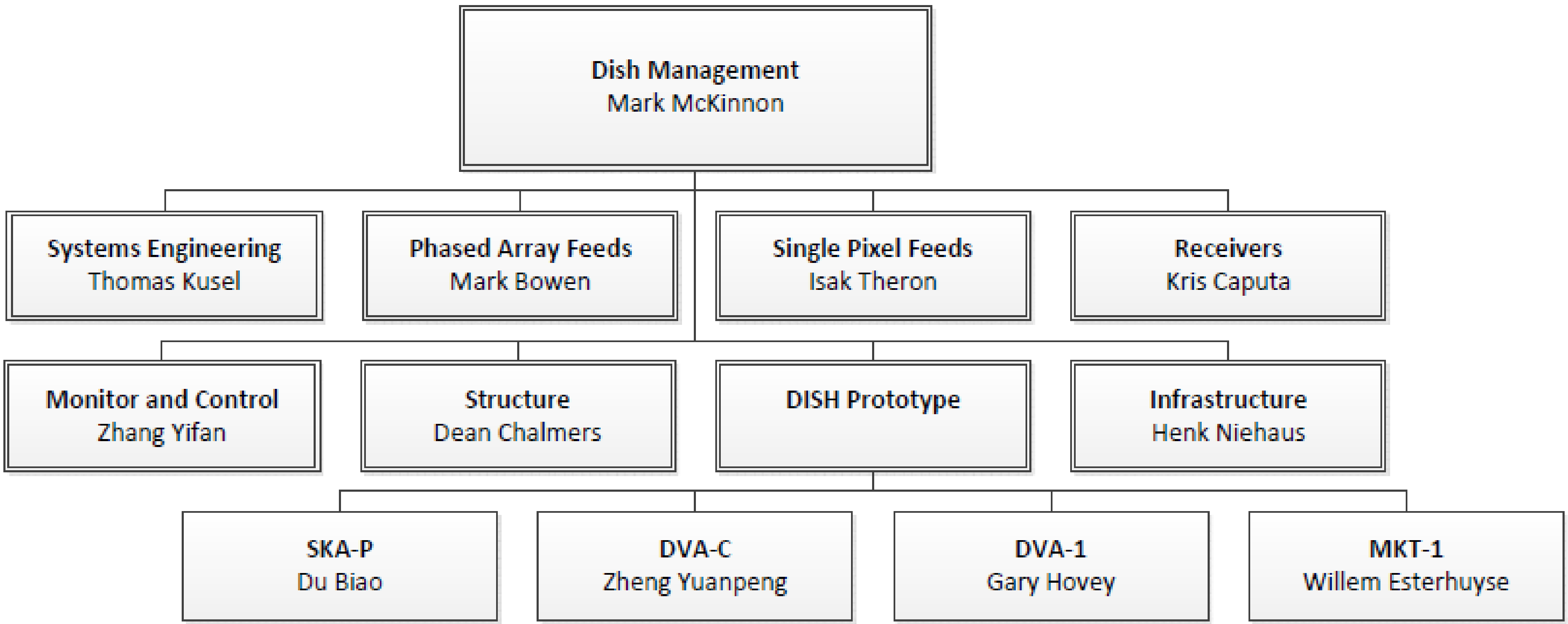
Outline

- DISH Consortium Partners
- WBS and Organization
- General Scope of Work
- Element Work Plans
  - Activities and Approaches
  - Prototypes
  - Challenges and Risks
- Schedule

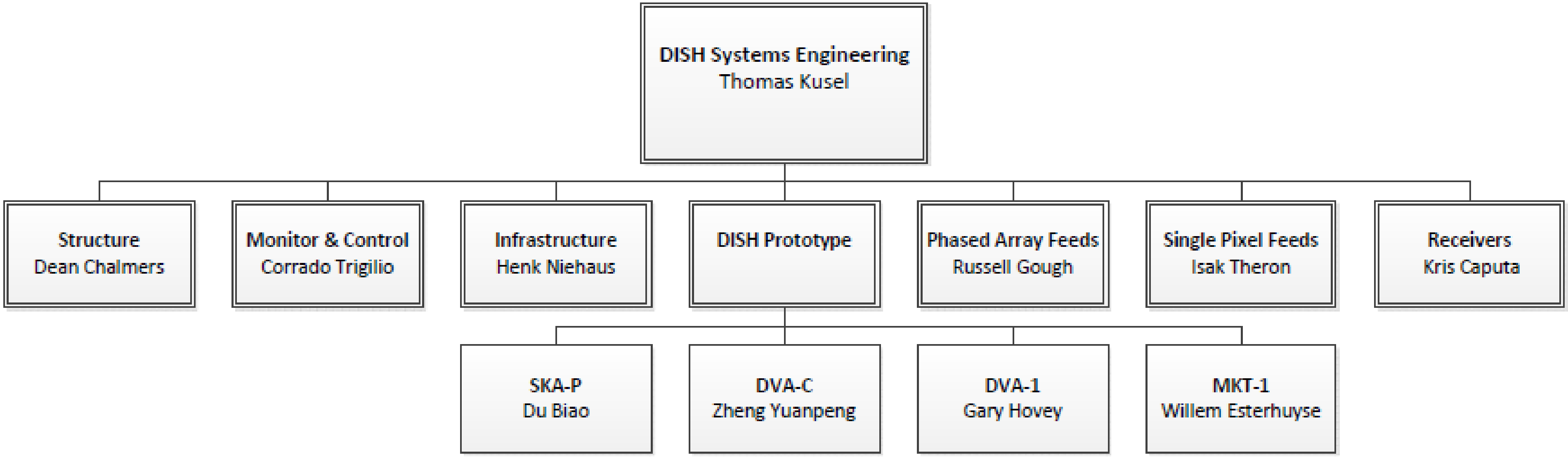
DISH Consortium Partners

- CSIRO – Australia (Full)
- RPC Technologies – Australia (Industry)
- SKA – South Africa (F)
- EMSS – South Africa (I)
- JLRAT – China (F)
- NRC – Canada (F)
- INAF – Italy (F)
- EIE/SAM – Italy (I)
- Chalmers – Sweden (F)
- MPIfR – Germany (F)
- IAF Fraunhofer – Germany (F)
- Vertex Antennentechnik – Germany (I)
- Spain University Group (Associate)

SKADC Work Package Management Team



SKADC Systems Engineering Expertise Group



SKADC General Scope of Work

- SKADC is responsible for the design and verification of the dish structure, optics, feed suites, receivers, and all supporting systems and infrastructure for SKA1-mid and SKA1-survey

SKADC Element Work Plans

Dish Structure

- Objective: Deliver the construction-ready design for the structure element of the SKA1-mid and SKA1-survey dishes
- Activities and Approaches
  - Analyse options of dish structure alternatives from prototypes
  - Estimate construction costs of alternatives for cost/performance comparison
  - Preliminary and detailed design of the chosen Dish Structure design
  - Preparation of detailed drawings and manufacturing and verification test plans for the design of the pre-production SKA Dish Structure prototype
  - Conduct reviews: concept, systems requirements, preliminary design, pre-production readiness, and critical design
- Challenges and Risks
  - Results from DVA verification tests not timely for design down-select
  - Design requirements drive cost to unacceptable levels

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Dish Prototypes

- Activities and Approaches
  - Evaluate designs and perform verification tests of three prototype dishes to inform the design of a pre-production unit (SKA-P)
    - DVA-1 (NRC Canada)
    - DVA-C (JLRAT China)
    - MKT-1 (South Africa)
  - Detailed design, manufacture, verification, and costing of SKA-P by JLRAT to inform production cost

- Challenges and Risks
  - Short timescale to build and test DVA-C and SKA-P
  - Uniformity in evaluating and costing prototype units

Dish Prototypes: MKT-1

Dish Prototypes: MKT-1

Dish Prototypes: DVA-1

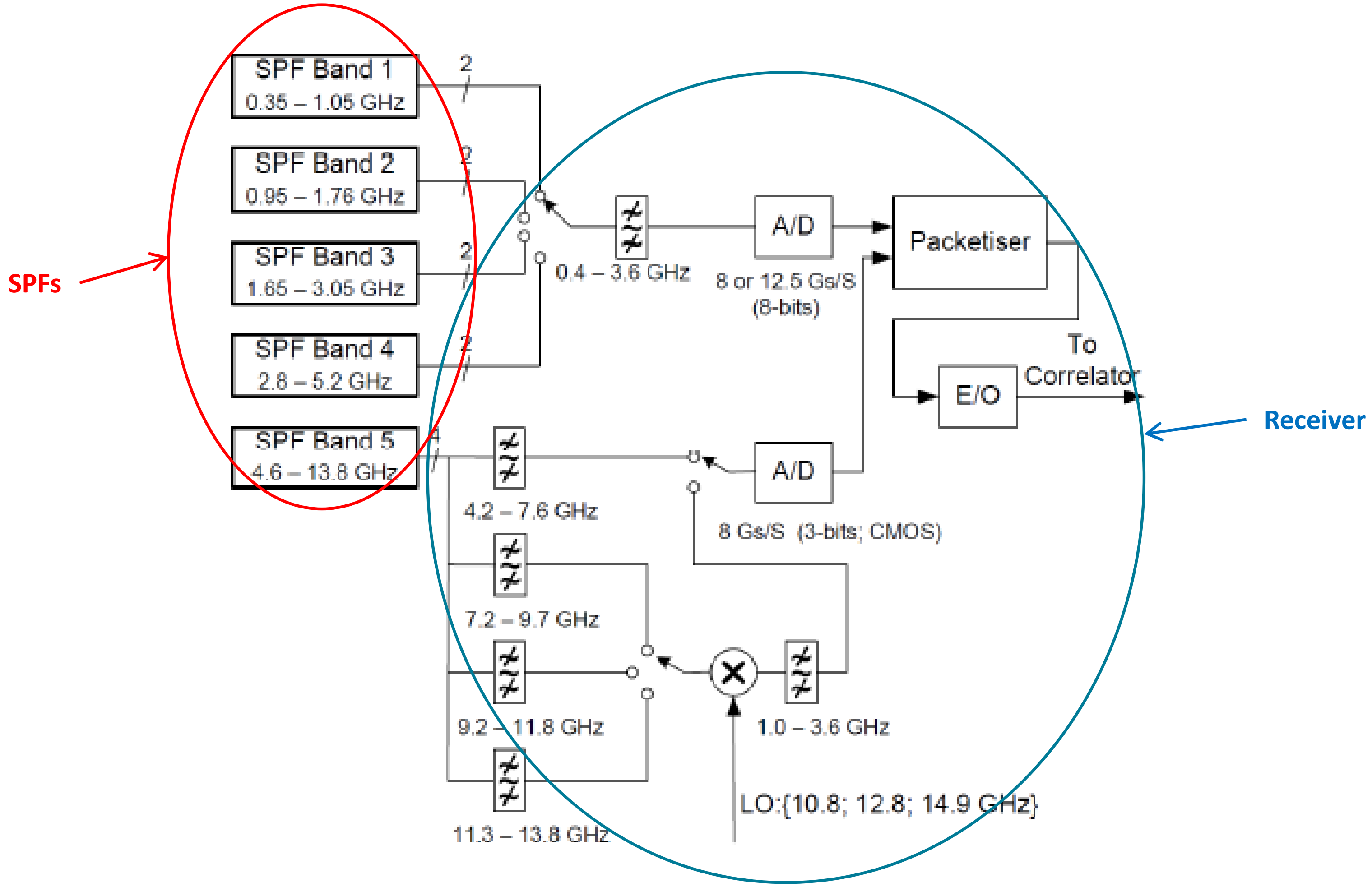
Oct 1, 2013

Single Pixel Feeds (SPFs) - I

- Activities and Approaches
  - Design and prototype feed elements (e.g. horns) for all 5 bands
  - Optimize feed types with optical configurations; down-select to final design
  - Design and prototype low noise amplifiers (LNAs). One LNA may cover all of Bands 3-5 in a single WBSPF
  - Design and prototype three cryostats: one each for Bands 1 and 2, and one for all of Bands 3-5
  - Design and prototype of high pressure helium and vacuum services
  - Integration of SPF packages; develop test and calibration equipment

- Challenges and Risks
  - Feed optimization may draw out design effort
  - Multiple, large feeds may not fit in a single cryostat
  - Effort required to coordinate work among large number of partners

Single Pixel Feeds (SPFs) - II



Block Diagram of SKA-mid receiver package

Receivers

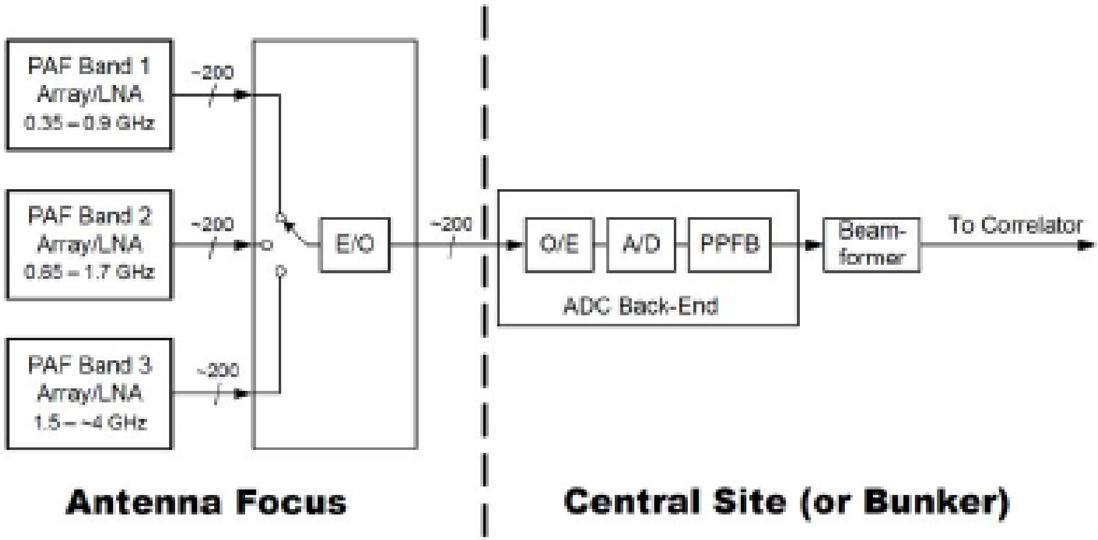
- Activities and Approaches
  - Develop preliminary receiver design for SKA1 Bands 1-5
  - Conduct COTS studies and make major component selection
  - Detailed receiver design for the high-priority Bands 1 and 2, to include designs for system enclosure, cooling, RFI, and EMI
  - Develop and deliver prototypes of Band 1 and 2 receivers and common receiver sub-systems (e.g. enclosure, calibration test, local monitor & control)
  - Verification of the Band 1 and 2 receiver systems, and integrate them with the feed package and Dish

- Challenges and Risks
  - Receiver not complaint with EMI and RFI requirements, or with site operational requirements (e.g. thermal, gain, and phase stability)
  - Interface control with other consortia (e.g. SaDT)

Phased Array Feeds (PAFs) - I

- Activities and Approaches
  - Design and prototype PAF Band 2 (includes sufficient electronics to form at least one beam, full chassis, cabling, cooling, and support infrastructure)
  - Develop preliminary designs of PAF Bands 1 and 3
  - Select optimum feed from tests of NRC Vivaldi & CSIRO chequerboard arrays
  - Design and prototype a PAF polyphase filter bank (PPFB) and beamformer for PAF Band 2, but also to accommodate PAF Bands 1 and 3
  - Develop integrated LNA, CMOS ADC, and high-speed link for on-antenna digitization (reduces cost, weight, and power consumption) as possible alternative to RF-over-fibre
- Challenges and Risks
  - Cost/performance depends upon RF-over-fibre receiver; could limit the number of channels per ADC
  - Full band sampling could lead to excessive costs

Phased Array Feeds (PAFs) - II



Block diagram of SKA-survey receiver package

Local Monitor and Control (LMC)

- Activities and Approaches
  - Define the architecture of the LMC system, to include interfaces with other DISH elements and Telescope Manager (TM), with emphasis on long term maintainability (e.g. use open source software)
  - Develop the detailed design of the LMC software, to include the TM interface, operational databases, scheduler, pointing program, operator displays, and alarm, logging, and monitoring services
  - Develop prototype software and hardware (e.g. computers, boards, interfaces, racks, and weather/environmental sensors) for the LMC system
  - Conduct interface and verification testing of the prototype

- Challenges and Risks
  - LMC architecture highly dependent on designs in other consortia, particularly TM and SaDT.

Systems Engineering

- Activities
  - Derive requirements for the DISH work element and its sub-elements
  - Manage interfaces between DISH and other work elements
  - Define alternative implementation concepts for the dish optics and structural configurations. Evaluate trade-offs to converge on a single concept.
  - Define the architectural design of the chosen concept and manage interfaces between sub-elements.
  - Manage the assembly, integration, and qualification of the work element
  - Work element logistics engineering
- Challenges and Risks
  - Difficult to converge on definition of dish optics concept and antenna preliminary design, and thus completion of pre-production prototype, due to distributed organizations and aggressive schedule
  - Maintaining a consistent level of product quality over different, internationally-distributed organizations

Management

- Activities
  - Overall consortium administration (e.g. SKAO interface, maintenance of and adherence to Consortium Agreement)
  - Schedule planning and tracking
  - Organization and coordination of reviews
  - Operation of the SKADC Board
  - Change control, risk management, and review of element costing
  - Support industrial partners and subcontractors

- Challenges and Risks
  - Potential delays due to negotiation of SKAO Memorandum of Understanding, Consortium Agreement, and IP policy
  - Significant effort required to communicate processes and requirements across a large and geographically diverse consortium

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SKADC High-Level Schedule

- May 15, 2014: DISH optics review and selection (CoDR)
- Aug 15, 2014: DVA-C prototype testing complete
- Aug 15, 2014: MKT-1 prototype testing complete
- Nov 7, 2014: DISH PDR
- May 27, 2015: DISH Detail Design Review (DDR)
- Jul 23, 2015: Receiver prototype subassemblies complete
- Sep 18, 2015: PAF DDR complete
- Apr 27, 2016: SKA1 pre-production dish build complete
- Oct 12, 2016: SKA1 pre-production dish verification testing complete
- Nov 16, 2016: DISH CDR

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