Ready to Host the SKA: MeerKAT Data Transport Network Design - Lessons Learnt

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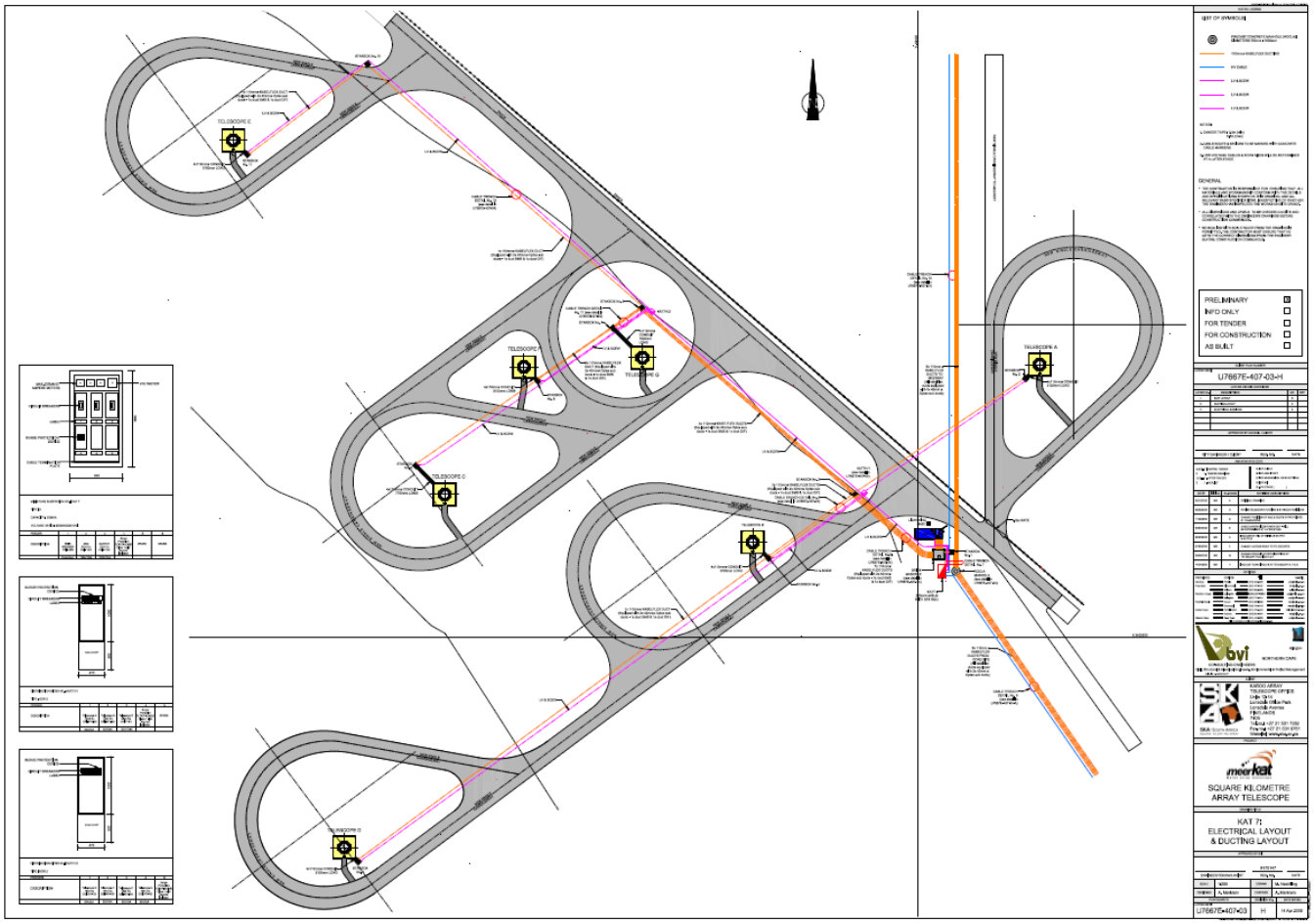
KAT-7 Pathfinder

KAT 7 Site April 2010

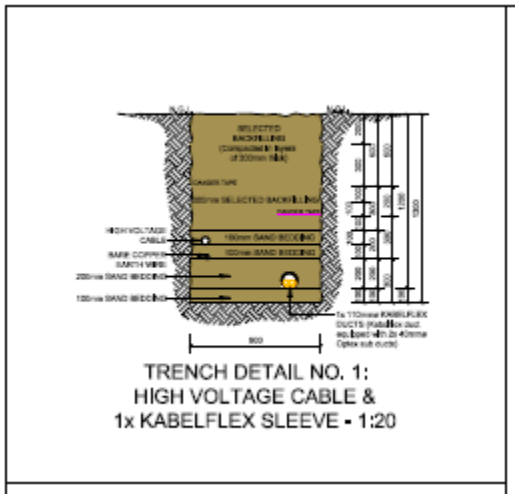
KAT-7: Fibre Network centred on the ASC shielded container located in proximity of the dishes

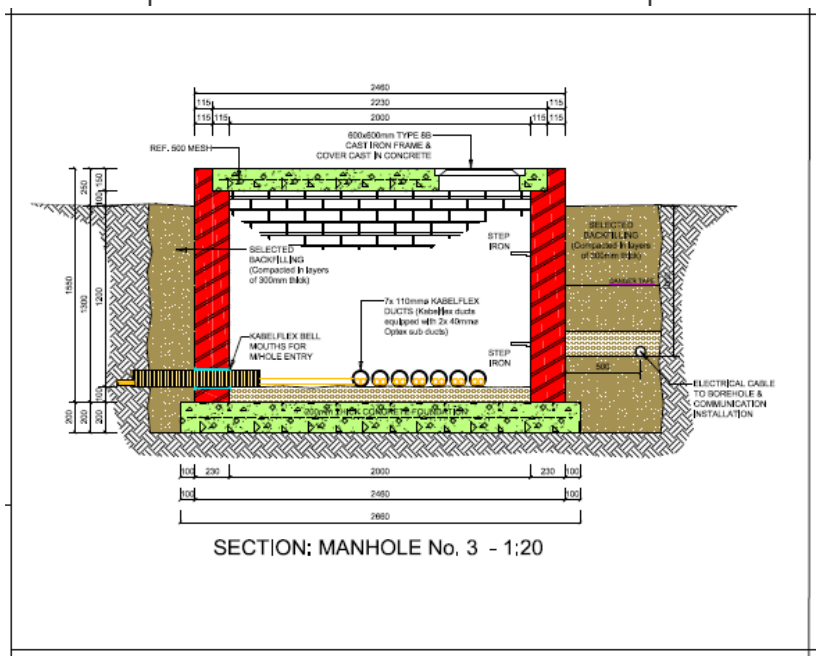
KAT-7 Reticulation Design

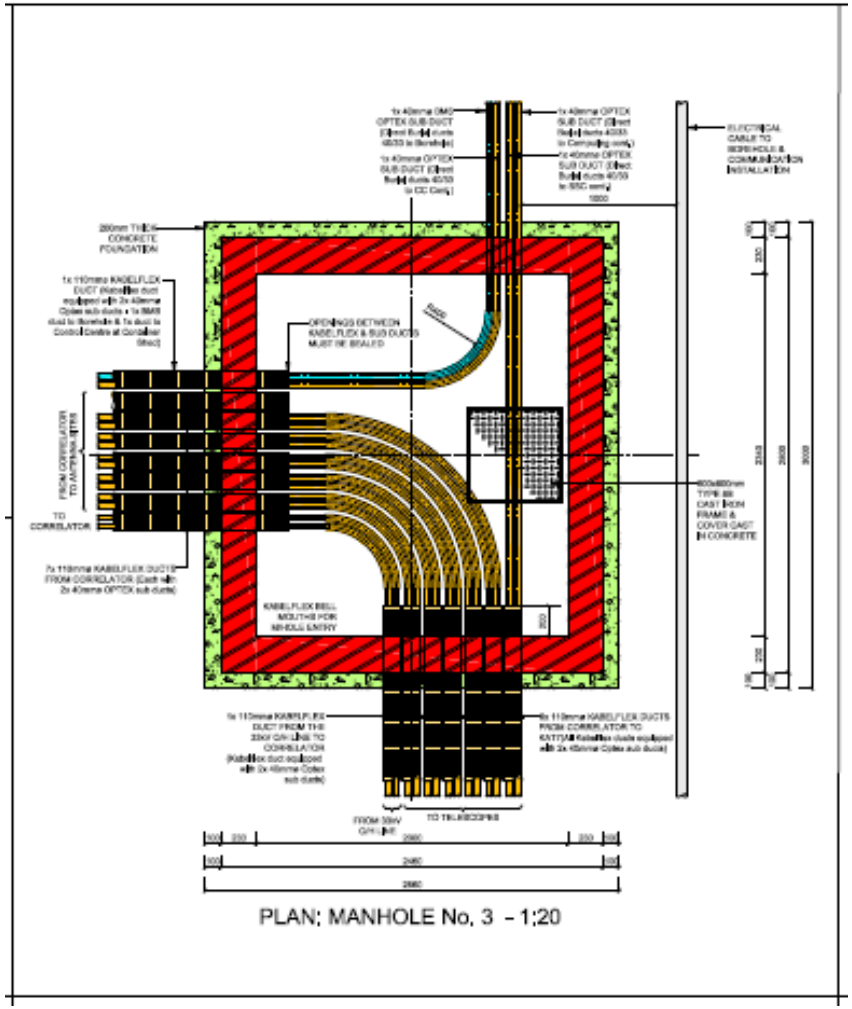


Fibre Optic cables and power cables run in the same trenches to reduce costs

KAT-7: Detailed Infrastructure Design

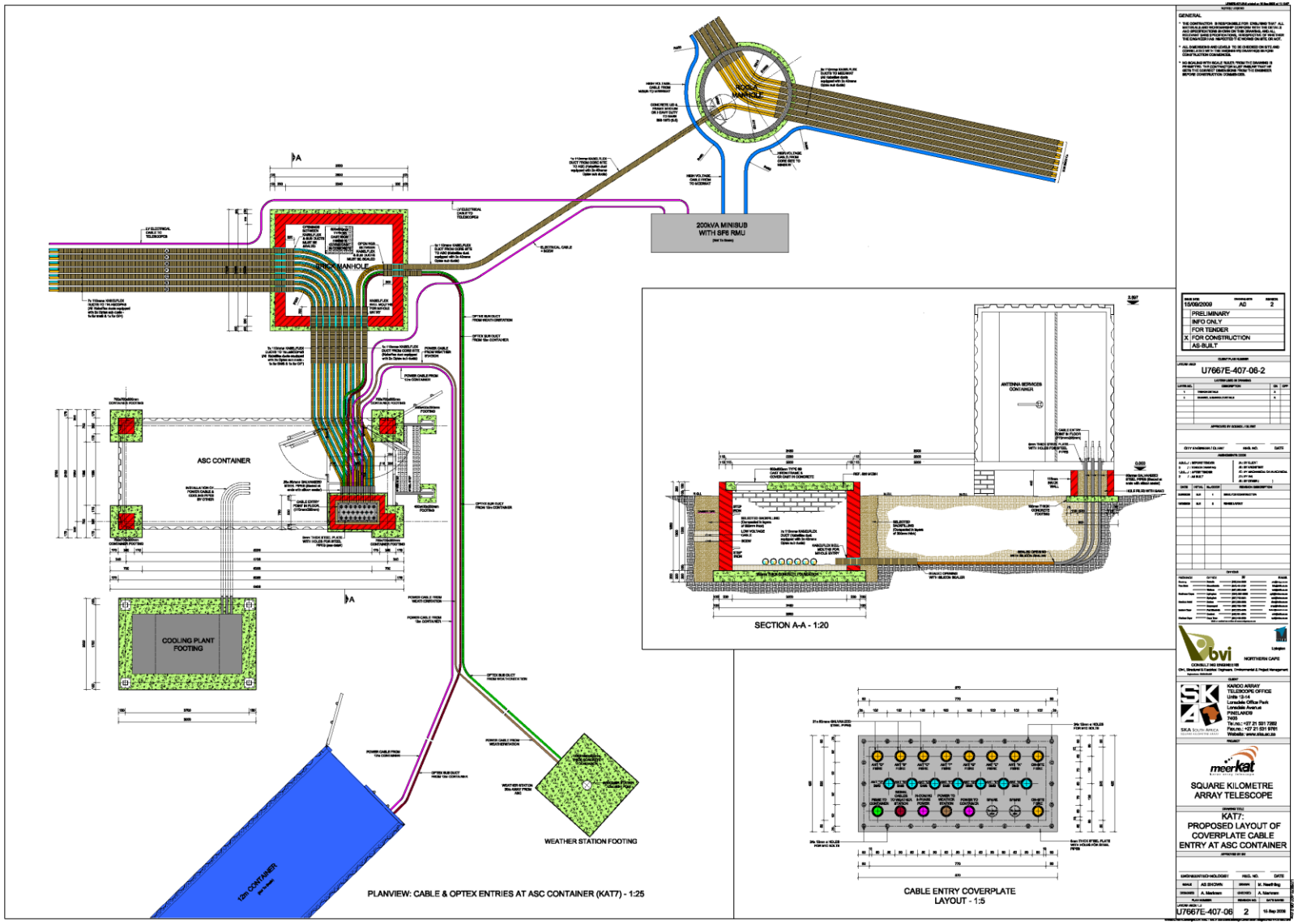




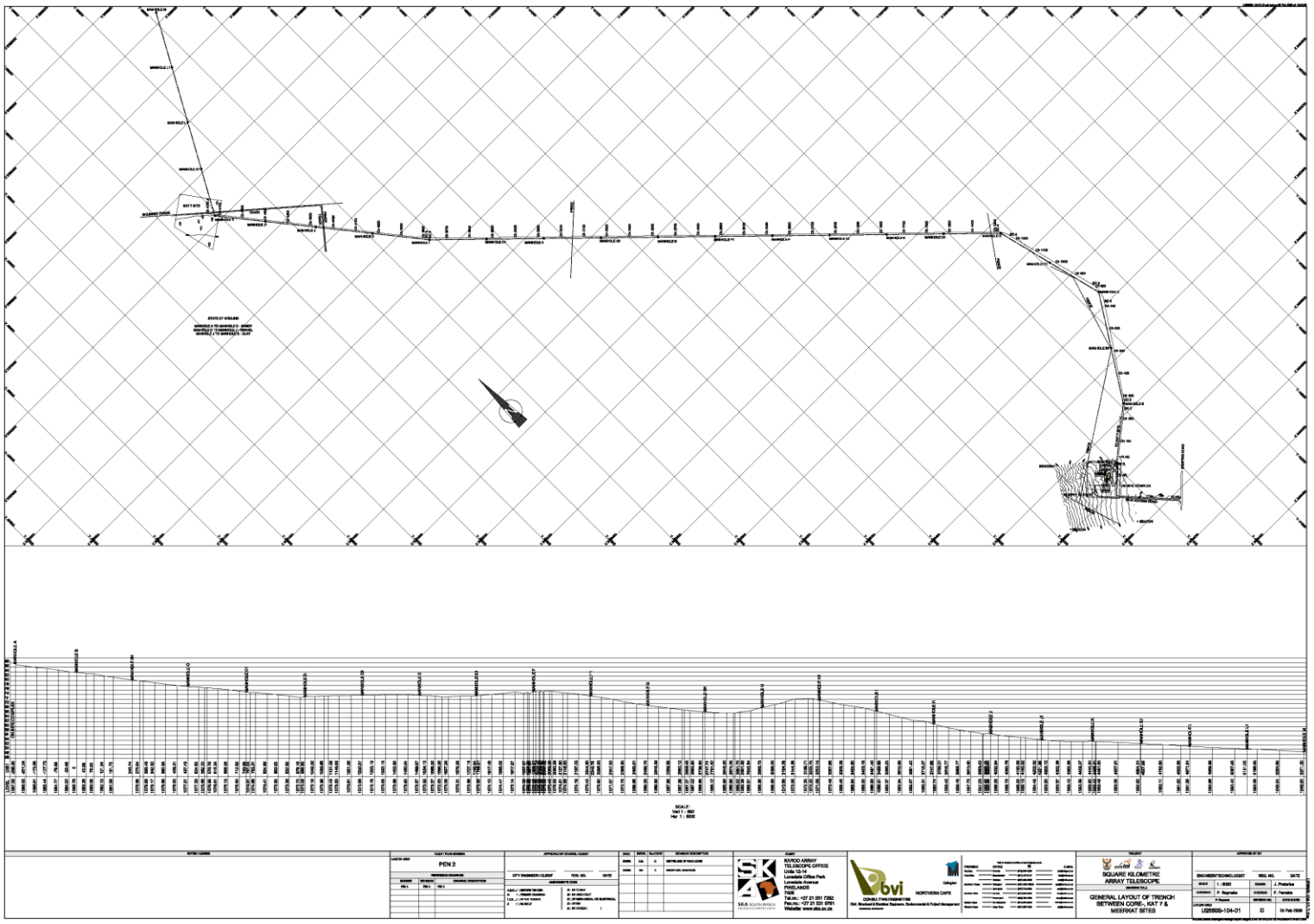


Manhole and trench designs detailed before implementation

KAT-7: Detailed infrastructure design (cont)



KAT-7 Fibre Route survey



Fibre route from KAT-7 to Losberg complex

KAT-7 Core Fibre Implementation

- 40 mm subducts installed in 110 mm sleeves
- Conventional cable and blown fibre considered - conventional cable implemented due to cost
- No cable length longer than 200 m - no joints in fibre cable
- Composite cable installed: 12 Core Multi-mode / 12 Core Single Mode G.652D for evaluation purposes. SM currently in operation
- E2000 connectors selected as a standard
- All fibre buried at 1 m below surface to minimise temperature effects
- Only Single Mode fibre installed from KAT-7 to Losberg (5.6 kms). No joints

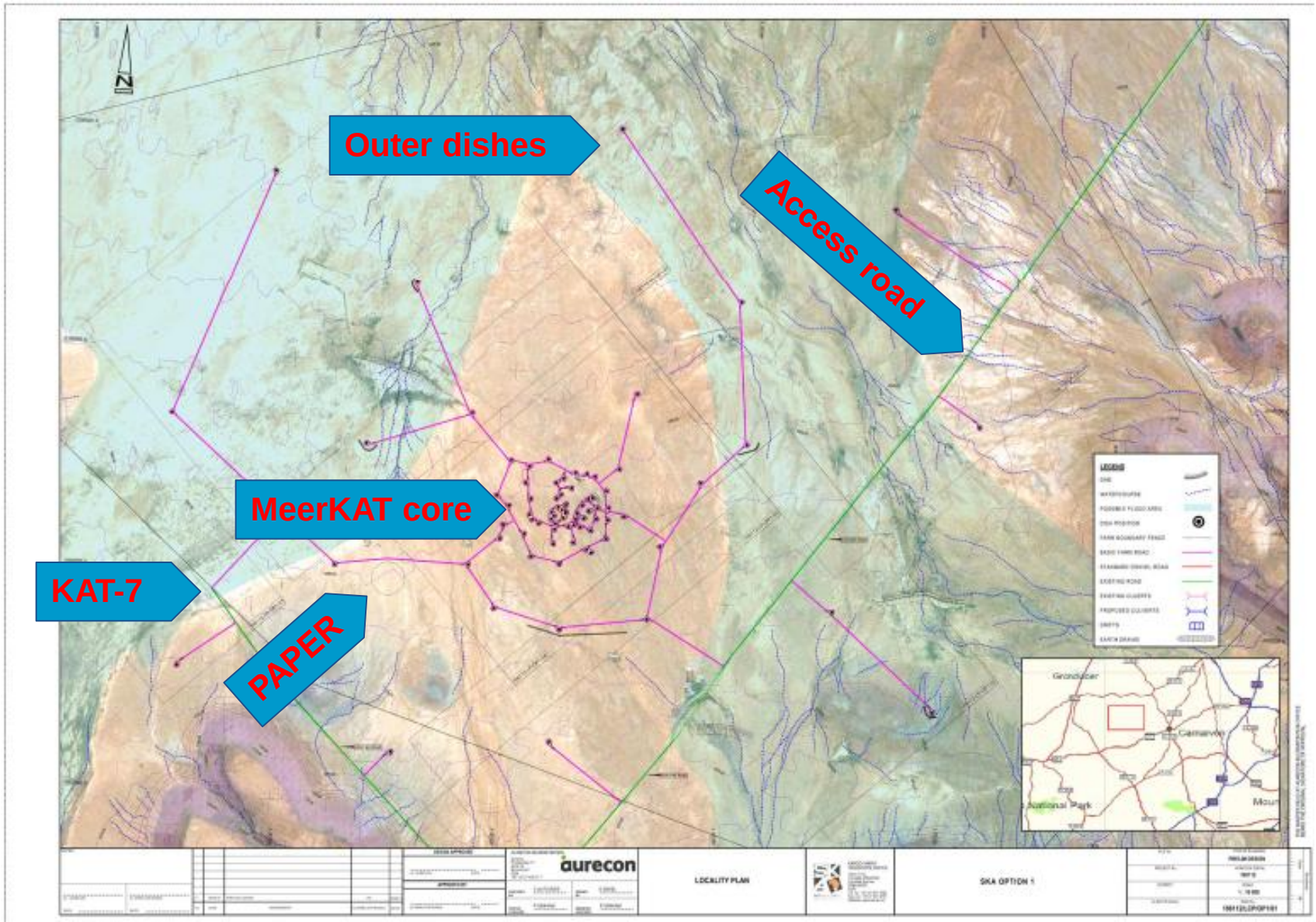
KAT-7 Infrastructure

Klerefontein Support Base

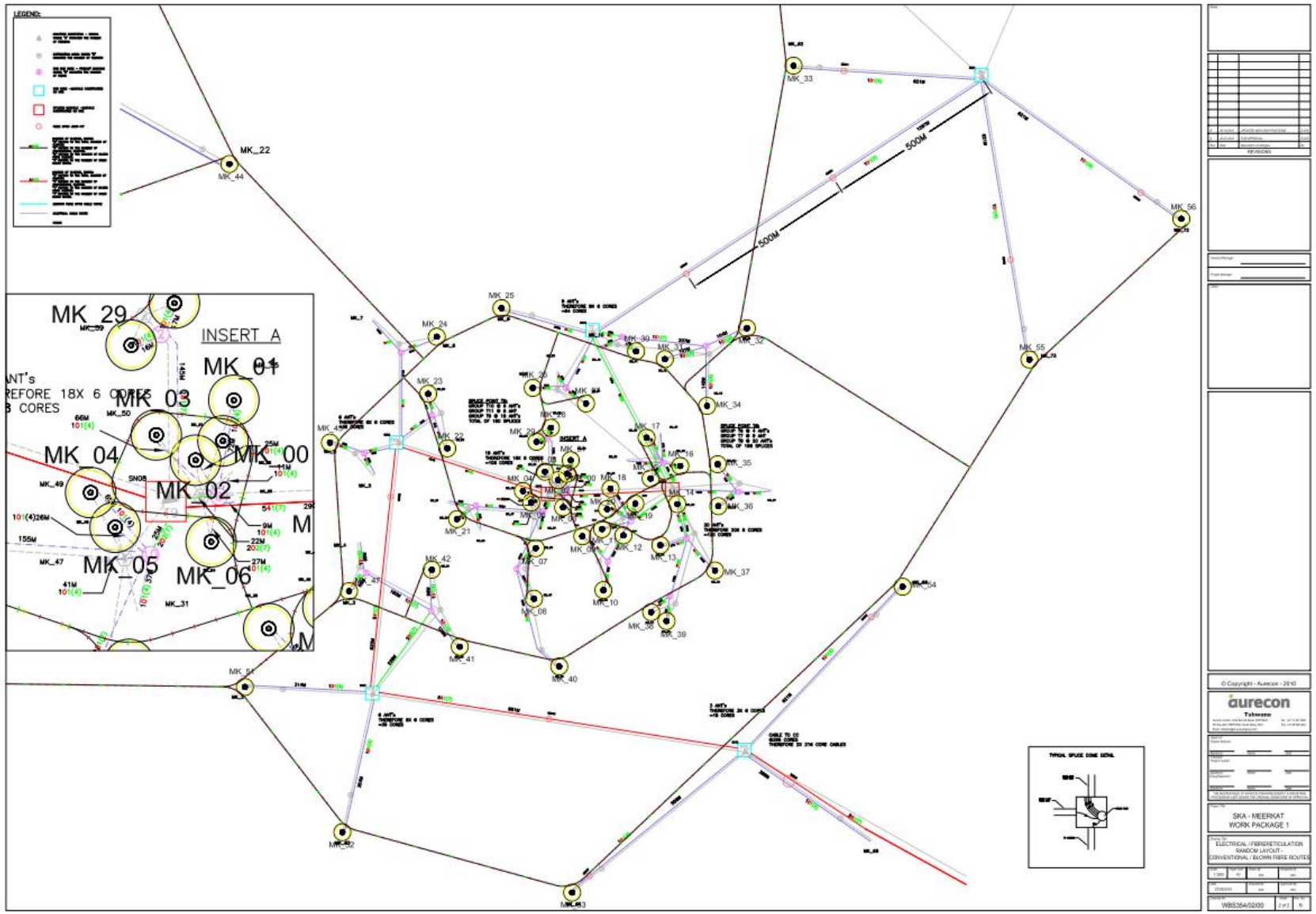
Core Site Complex

78 Km access road to site

MeerKAT Road / Reticulation Network



MeerKAT Reticulation Design



MeerKAT Core Fibre Design

- Still a work-in-progress
- Will generally follow KAT-7 design standards due to success and flexibility
- Redundant fibre rings will be implemented where appropriate
- Only single mode fibre will be installed due to extended cable distances
- NSN / IT Portugal developing digital fibre drivers for use from antennas to Array Processor building
- When new buildings are complete, all equipment and fibre terminations will be moved into the new Array Processor building
- ITC study underway to encompass all Karoo site locations, Cape Town & Rosebank

Colour-coded subducts during installation

PAPER with KAT-7 in background

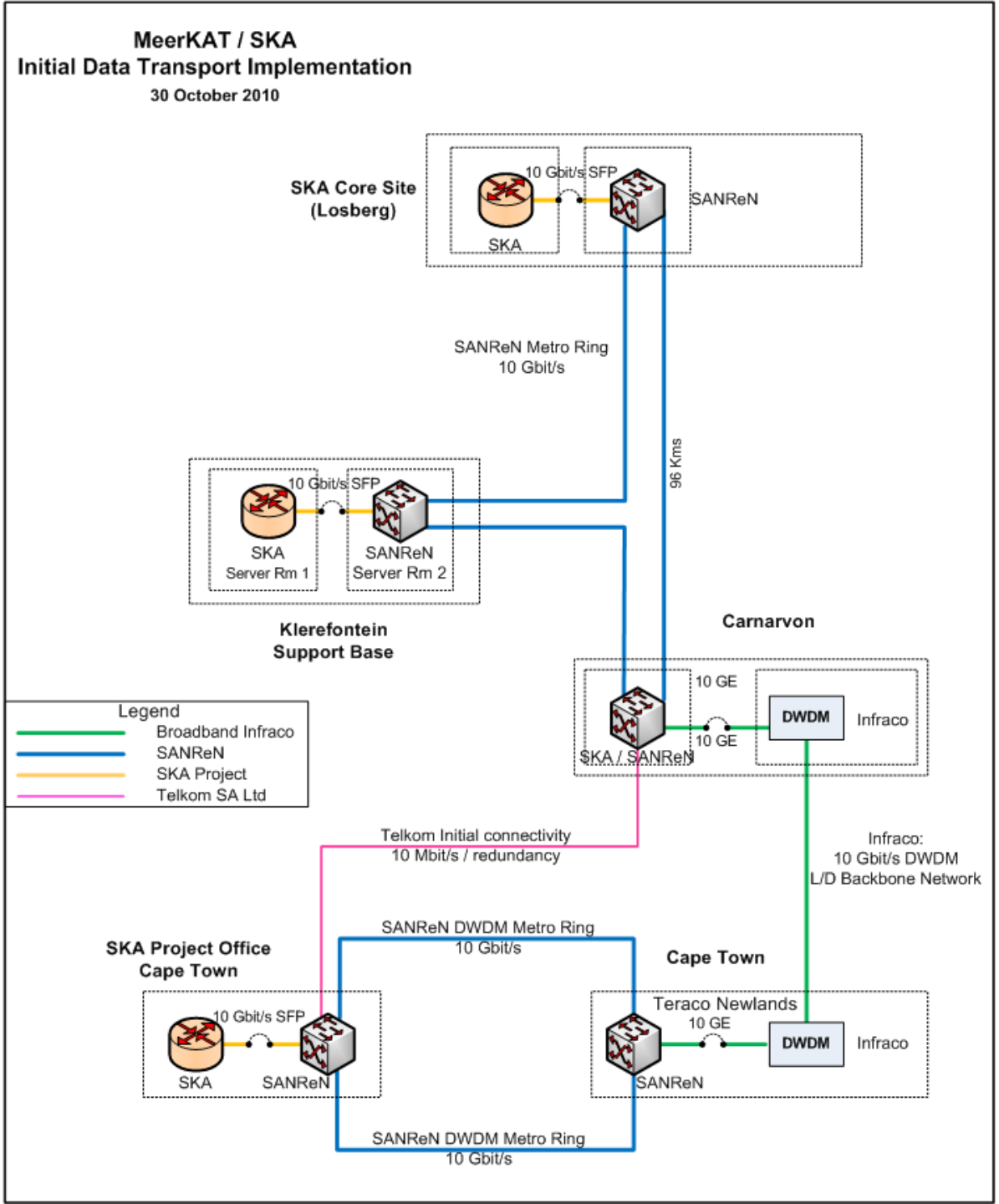
MeerKAT Long Haul Data Transport

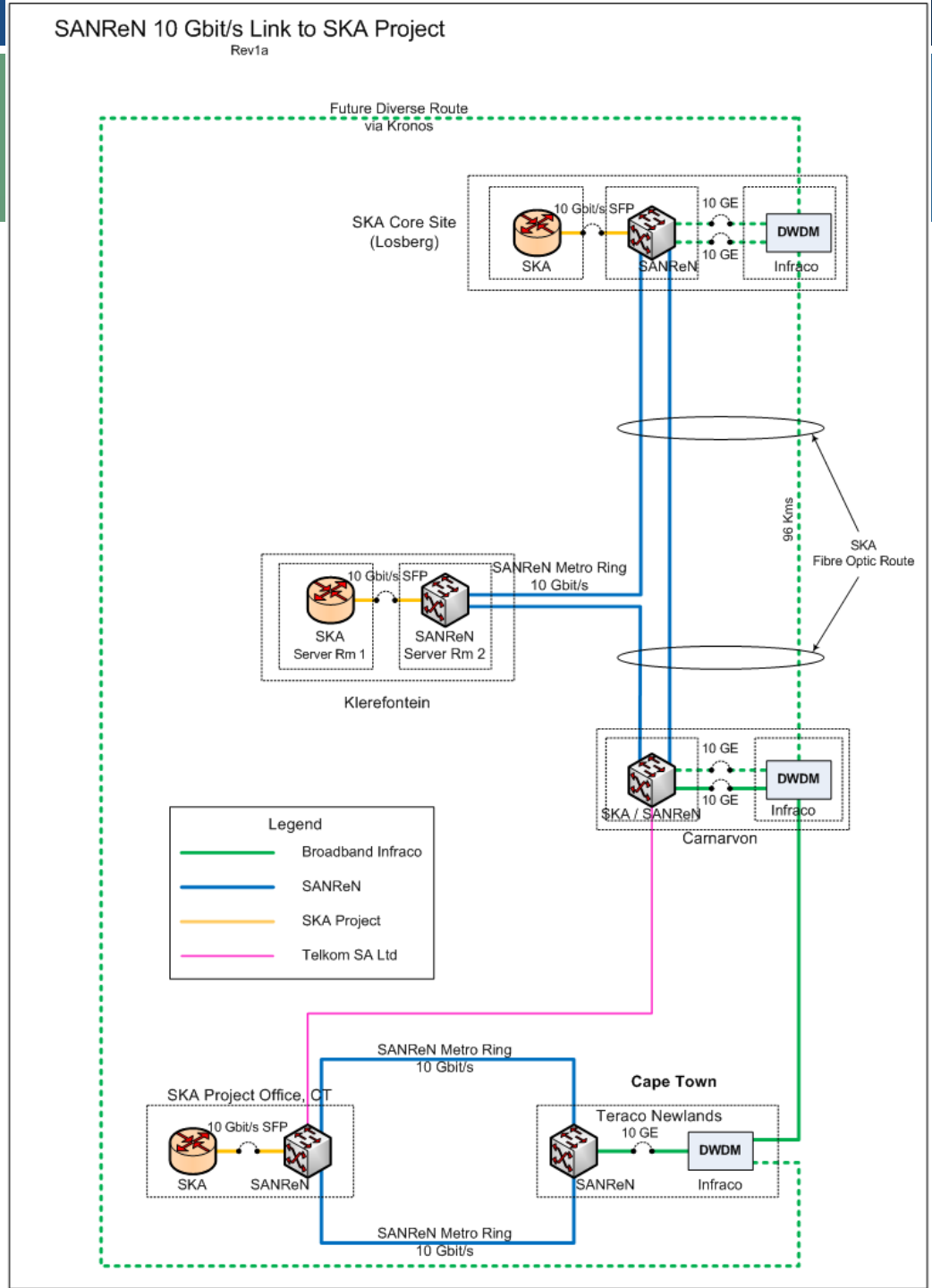
1. A new 33 kV Powerline has been constructed from Carnarvon to the SKA Core site encompassing a MASS (Metal-Armoured Self Supporting) fibre optic cable implemented as the earth-wire.
2. SKA SA has established the SKA SA POP Station in Carnarvon.
3. SANReN has implemented a 10 Gbit/s fibre “metro ring” from the SKA POP site in Carnarvon, connecting the Losberg Core Site and the Klerefontein Support Base. This will provide full flexibility between these three sites. The sites terminate in Cisco switches with DWDM functionality.

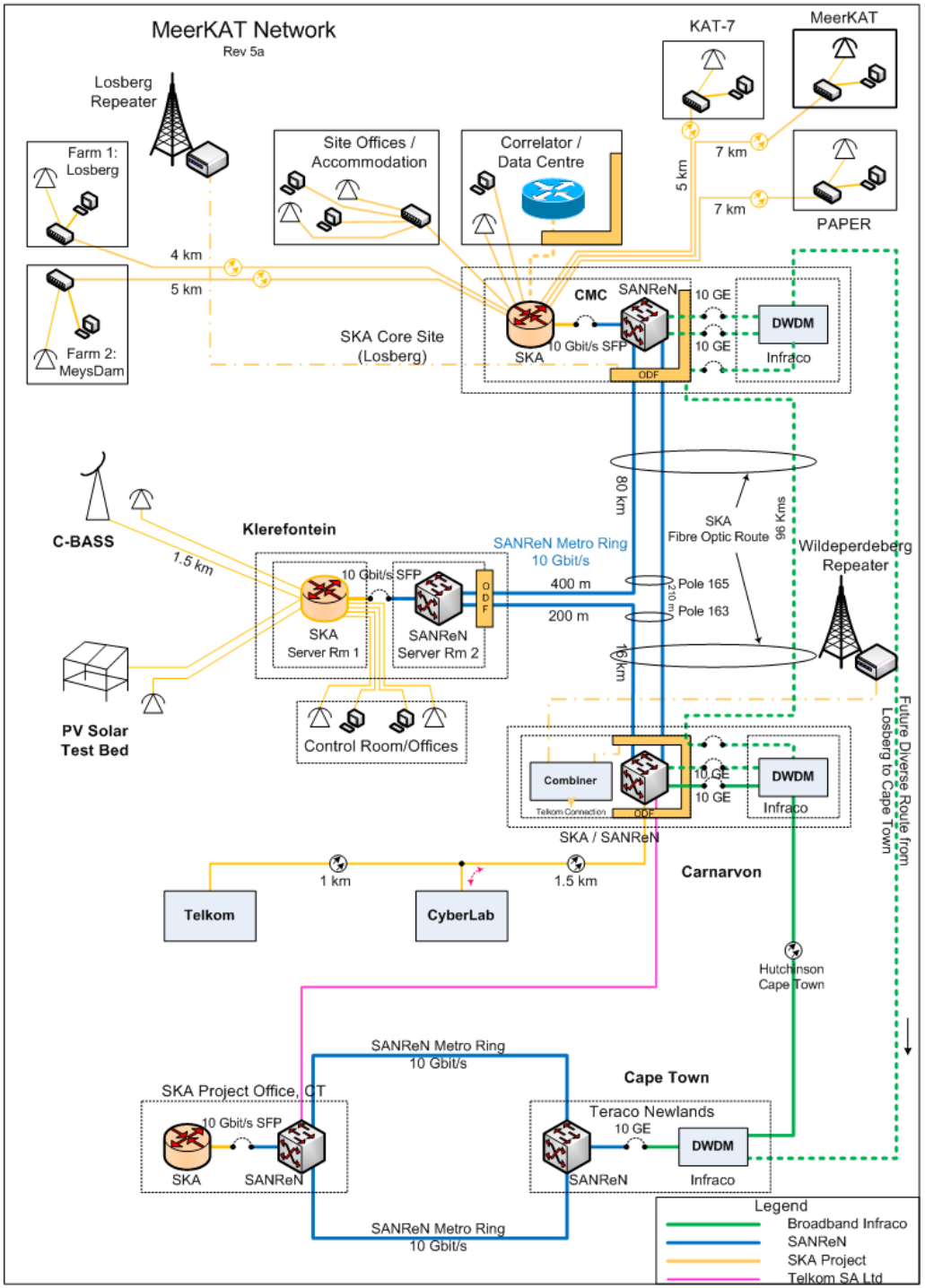
Carnarvon POP Site

MeerKAT Long HaulData Transport (cont.)

4. A contract has been placed by SANReN (South African National Research Network) on SA national operators Neotel / Broadband Infraco for the initial 10 Gbit/s connectivity from Cape Town to Carnarvon. The full fibre optic connectivity will be in place by end June 2011.
5. SANReN placed a contract on the SA national operator Telkom for a temporary capacity of 10 Mbit/s from Carnarvon to the SKA Cape Town Project Office to facilitate KAT-7 antenna commissioning activities. This fibre link will be upgraded in future to provide a redundant fibre optic link. The link from Losberg to Cape Town office was commissioned in November 2010 enabling KAT-7 remote operations.
6. The SKA Cape Town Project Office will be connected into the new SANReN fibre optic DWDM Cape Town “metro ring” mid 2011. This will provide full DWDM fibre connectivity via the Infraco L/D network from SKA Core Site to Cape Town.


MeerKAT / SKA
Initial Data Transport Implementation
30 October 2010
SKA Core Site
(Losberg)
10 Gbit/s SFP
SKA
SANReN
SANReN Metro Ring
10 Gbit/s
96 Kms
10 Gbit/s SFP
SKA
Server Rm 1
SANReN
Server Rm 2
Klerefontein
Support Base
Carnarvon
10 GE
DWDM
Infraco
10 GE
SKA / SANReN
Legend
Broadband Infraco
SANReN
SKA Project
Telkom SA Ltd
Telkom Initial connectivity
10 Mbit/s / redundancy
Infraco:
10 Gbit/s DWDM
L/D Backbone Network
SANReN DWDM Metro Ring
10 Gbit/s
SKA Project Office
Cape Town
Cape Town
10 Gbit/s SFP
SKA
SANReN
Teraco Newlands
10 GE
DWDM
Infraco
SANReN
SANReN DWDM Metro Ring
10 Gbit/s


SANReN 10 Gbit/s Link to SKA Project
Rev1a
Future Diverse Route
via Kronos
SKA Core Site
(Losberg)
10 Gbit/s SFP
10 GE
10 GE
SKA
SANReN
DWDM
Infraco
96 Kms
SKA
Fibre Optic Route
SANReN Metro Ring
10 Gbit/s
10 Gbit/s SFP
SKA
Server Rm 1
SANReN
Server Rm 2
Klerefontein
10 GE
10 GE
DWDM
SKA / SANReN
Infraco
Carnarvon
Legend
Broadband Infraco
SANReN
SKA Project
Telkom SA Ltd
SANReN Metro Ring
10 Gbit/s
SKA Project Office, CT
10 Gbit/s SFP
SKA
SANReN
Cape Town
Teraco Newlands
10 GE
DWDM
SANReN
Infraco
SANReN Metro Ring
10 Gbit/s


MeerKAT Network
Rev 5a
KAT-7
MeerKAT
Losberg Repeater
Site Offices / Accommodation
Correlator / Data Centre
5 km
7 km
7 km
PAPER
Farm 1: Losberg
4 km
5 km
Farm 2: MeysDam
SKA Core Site (Losberg)
CMC
SANReN
10 GE
10 GE
DWDM
Infraco
SKA
10 Gbit/s SFP
ODF
80 km
SKA Fibre Optic Route
96 Kms
Wildeperdeberg Repeater
C-BASS
1.5 km
Klerefontein
SANReN Metro Ring 10 Gbit/s
10 Gbit/s SFP
400 m
200 m
Pole 165
Pole 163
210 m
16 km
SKA Server Rm 1
SANReN Server Rm 2
ODF
PV Solar Test Bed
Control Room/Offices
Combiner
Telkom Connection
10 GE
10 GE
DWDM
Infraco
ODF
SKA / SANReN
Future Diverse Route from Losberg to Cape Town
1 km
1.5 km
Carnarvon
Telkom
CyberLab
Hutchinson Cape Town
SANReN Metro Ring 10 Gbit/s
Cape Town
SKA Project Office, CT
10 Gbit/s SFP
SKA
SANReN
Teraco Newlands
10 GE
DWDM
SANReN
Infraco
SANReN Metro Ring 10 Gbit/s
Legend
Broadband Infraco
SANReN
SKA Project
Telkom SA Ltd

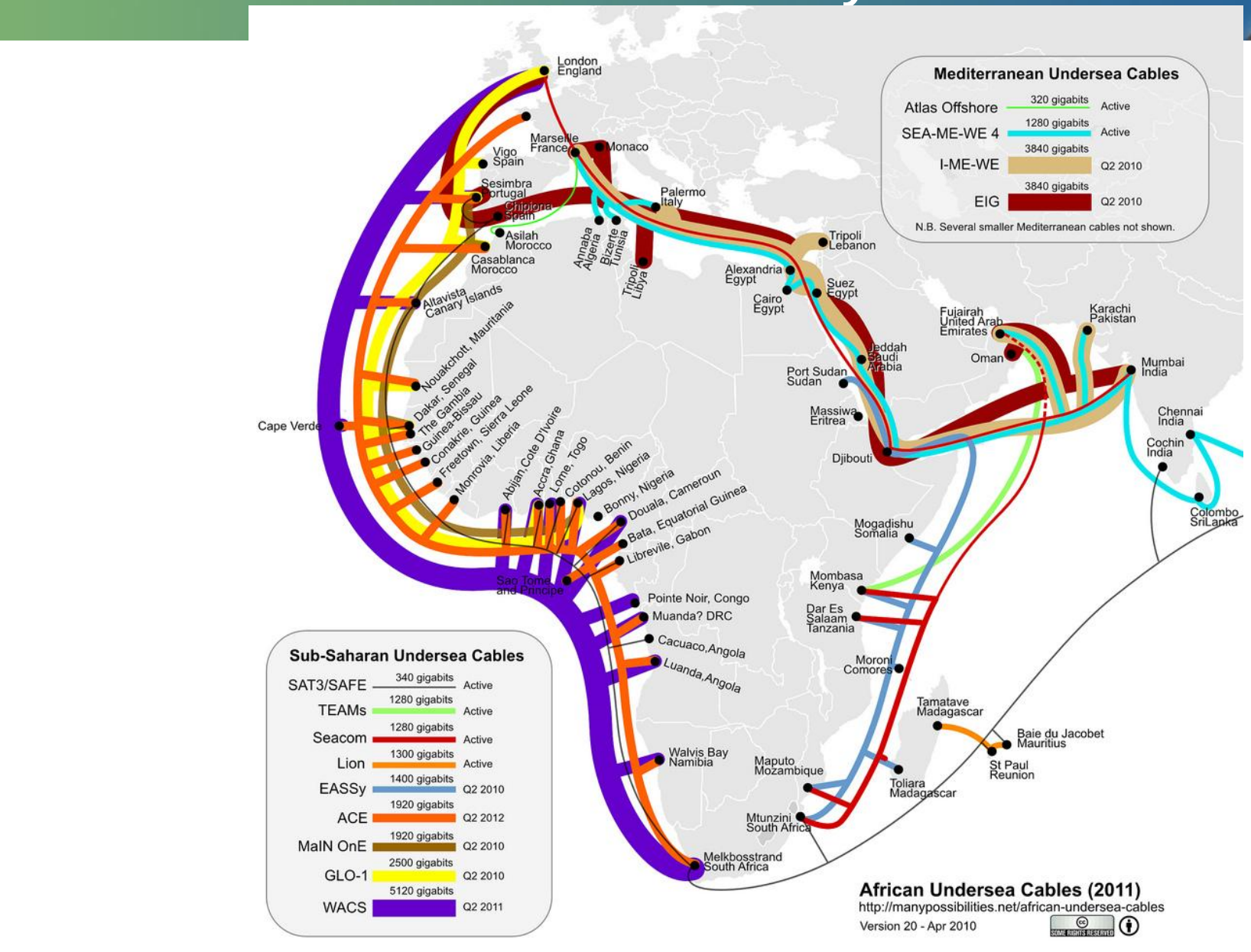
MeerKAT Data Transport National Network

New 33 kV Powerline with MASS fibre optic cable approaching Core Site

MeerKAT Data Transport

1. The current fibre network provides the foundation for the future SKA transport network from the Core Site to Cape Town or Mtunzini for connectivity to the undersea cable systems.
2. Broadband Infraco will install an additional170 kms of fibre optic cable to provide a fully redundant DWDM fibre network from the MeerKAT Site to Cape Town (as per previous diagram). An additional fibre cable will be incorporated into the power supply system required for the SKA Core site.
3. The initial Telkom SA link will be retained to provide an additional level of redundancy via a totally independent operator network
4. The fibre network will interface to the WACS (West African Cable System) submarine cable from Cape Town to Europe / United Kingdom with a capacity of 5.12 Tbit/s. 10/100 Gbit/s reserved for MeerKAT/SKA respectively. Redundancy to this system to Europe will be provided by East Coast cable systems such as SEACOM / EASY / SAFE cable systems.

African Undersea Cable Systems



Lessons learnt / Challenges

- De-link the implementation and commissioning from infrastructure development, where possible, to avoid delays and extended fibre commissioning times.
- Specify connectors to the ‘nth’ detail. On the L/D network, E2000 connectors with plastic ferrules were installed resulting in intermittent faults. In process of being replaced.
- Implement a large number of spare fibres, especially in backhaul routes - the requirement grows!
- Consider dust in arid conditions, especially during construction periods (which normally align with fibre commissioning periods). Implementation of gravel surfaces was a great improvement.
- Challenge: follow-up on all network builds and detail as-built records. Be ahead of the game to maintain in-house confidence in the record system!

MeerKAT Data Transport

Questions?

Thank you.

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