



# **Determination, Control & Improvement of an SKA Radio Environment in South Africa**

**Three potential SKA core sites were chosen in a sparsely populated part of South Africa, in the Northern Cape Province**

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# Strategy to determine the Radio Environment



- **Quantification & evaluation the potential 3 core sites with reference to Recommendation ITU-R RA.769-2**
- **RFI prediction and measurement - 150 MHz to 25 GHz**
- **All transmissions exceeding the spectral-line threshold level at the potential core sites centres**
- **Creation of a database on MS Excel**
- **Involving & obtaining data from broadcasting signal distribution & telecommunications network operators**
- **Calculation of predicted signal levels by operators**
- **Provisional determination of saturation level at -100 dBm**

# Calculation & Prediction of Signal Levels



- **Use of expertise & computerised frequency assignment & network planning systems at operators**
- **Based on ITU Recommendations iro propagation**
- **Free space & topographical path loss with 50% probability**
- **Determined 6 highest signals on each used frequency**
- **Determination of aggregate RFI signal levels**
- **Each signal entry includes station name, location, operator, antenna height (asl), distance to core site centre, signal level & signal bandwidth**

# SKA Core Site Analysis – Number of signals exceeding the relevant levels



<b>Site</b>	<b>Saturation</b>	<b>VLBI</b>	<b>Spectral-line</b>
<b>Kalahari</b>	<b>60</b>	<b>275</b>	<b>1195</b>
<b>Karoo</b>	<b>44</b>	<b>278</b>	<b>1045</b>
<b>Namaqua</b>	<b>49</b>	<b>239</b>	<b>828</b>

# SKA Core Site Analysis – Distances of Interfering Transmitters

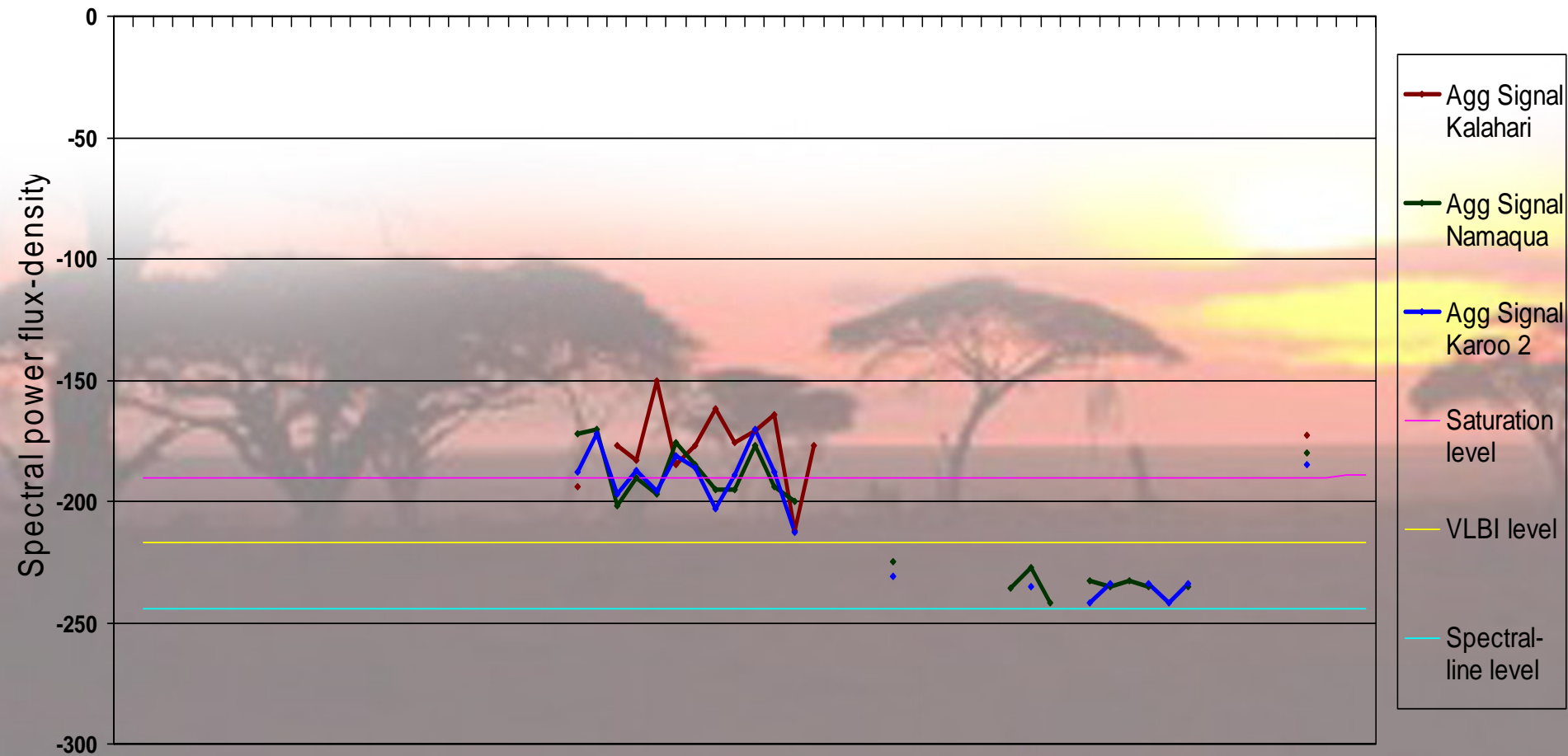


Site	Saturation		VLBI		Spectral-line	
	Min	Max	Min	Max	Min	Max
Kalahari	66	184	66	552	67	822
Karoo	14	270	65	576	52	871
Namaqua	63	315	53	665	78	900

# SKA Core Site Analysis – Comparison of aggregate signals – 150 to 174 MHz



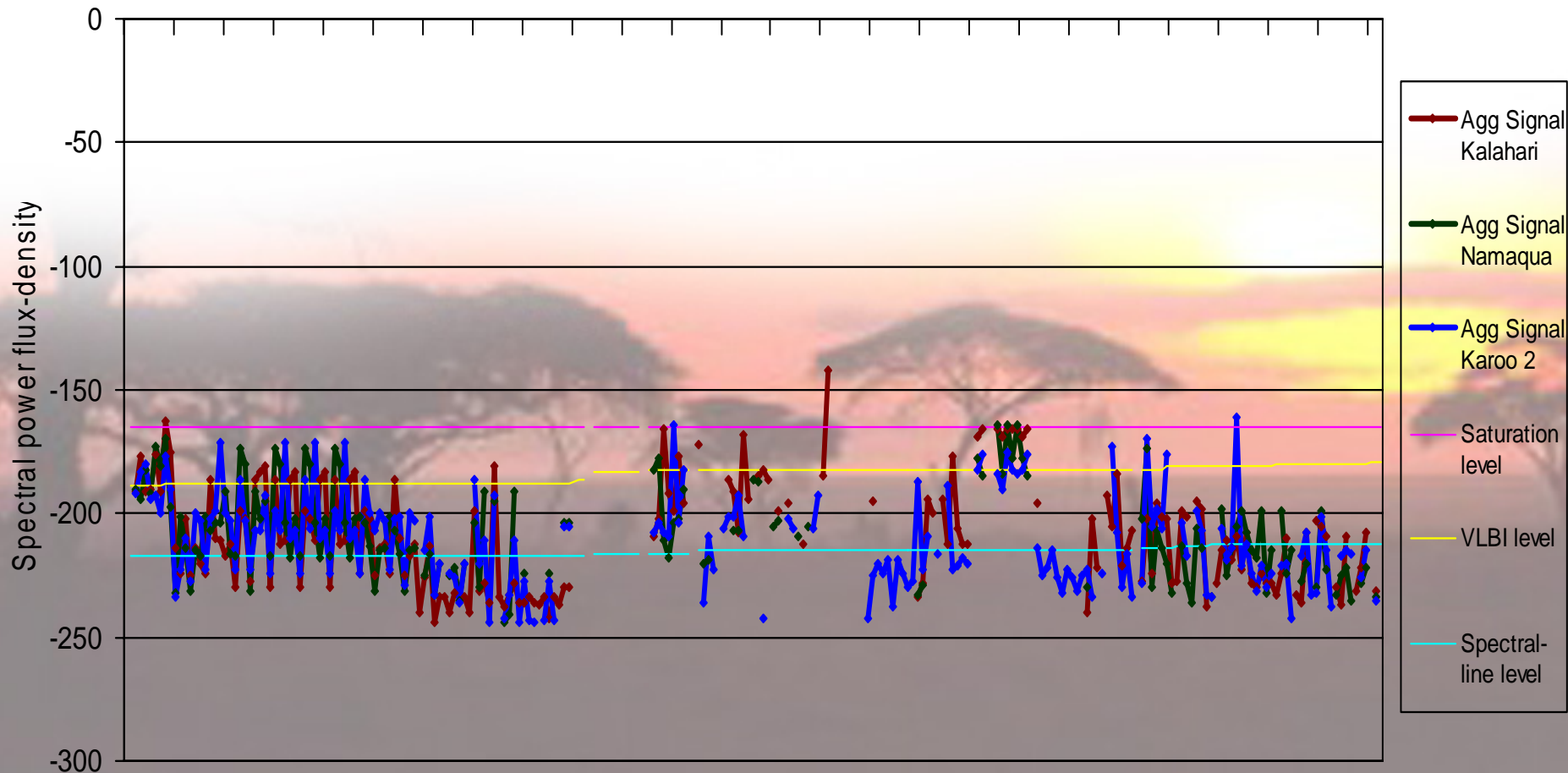
Frequency spectrum 150 to 174 MHz



# SKA Core Site Analysis – Comparison of aggregate signals – 174 to 854 MHz



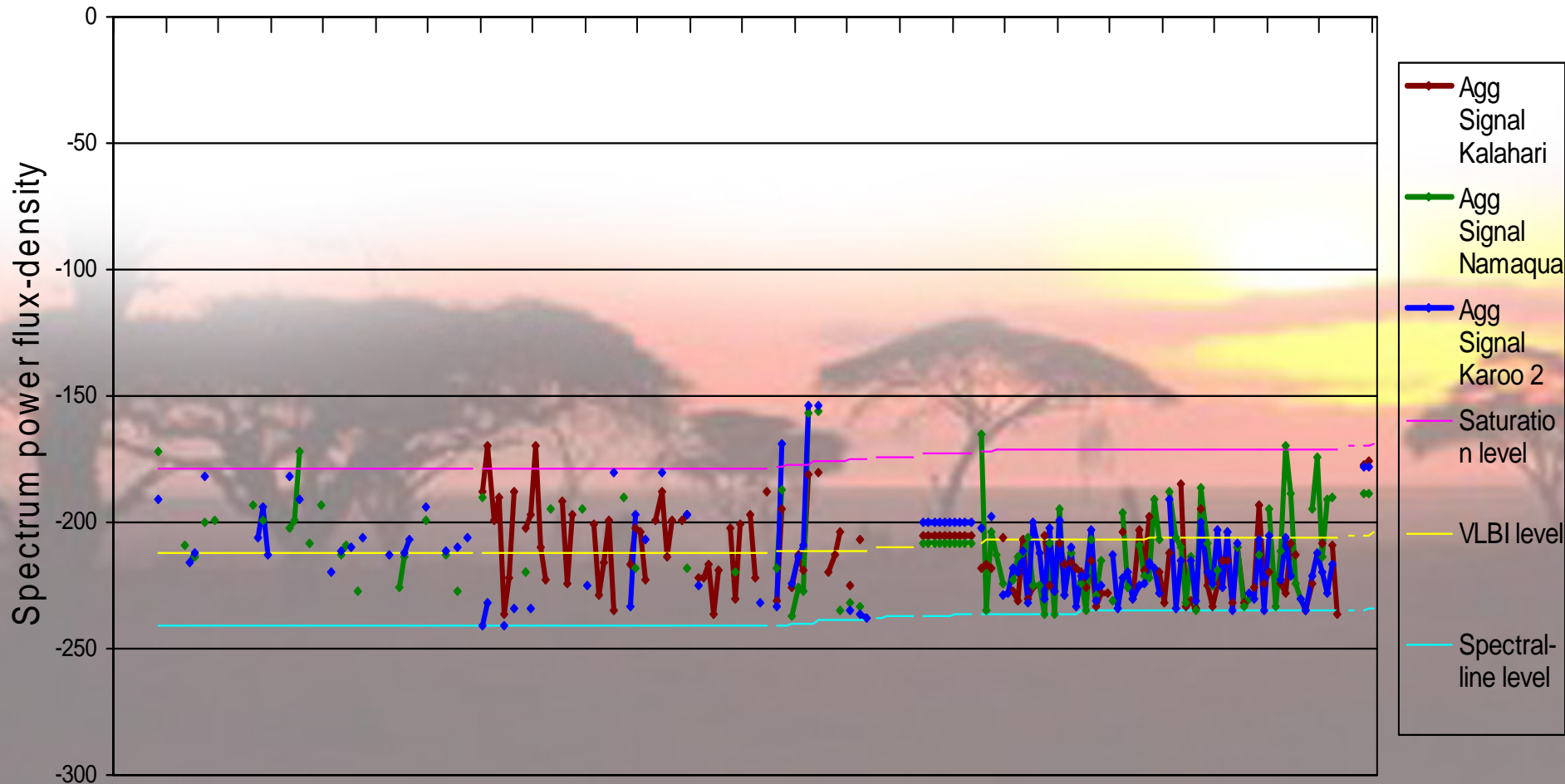
Frequency spectrum 174 to 854 MHz



# SKA Core Site Analysis – Comparison of aggregate signals – 854 MHz to 3.0 GHz

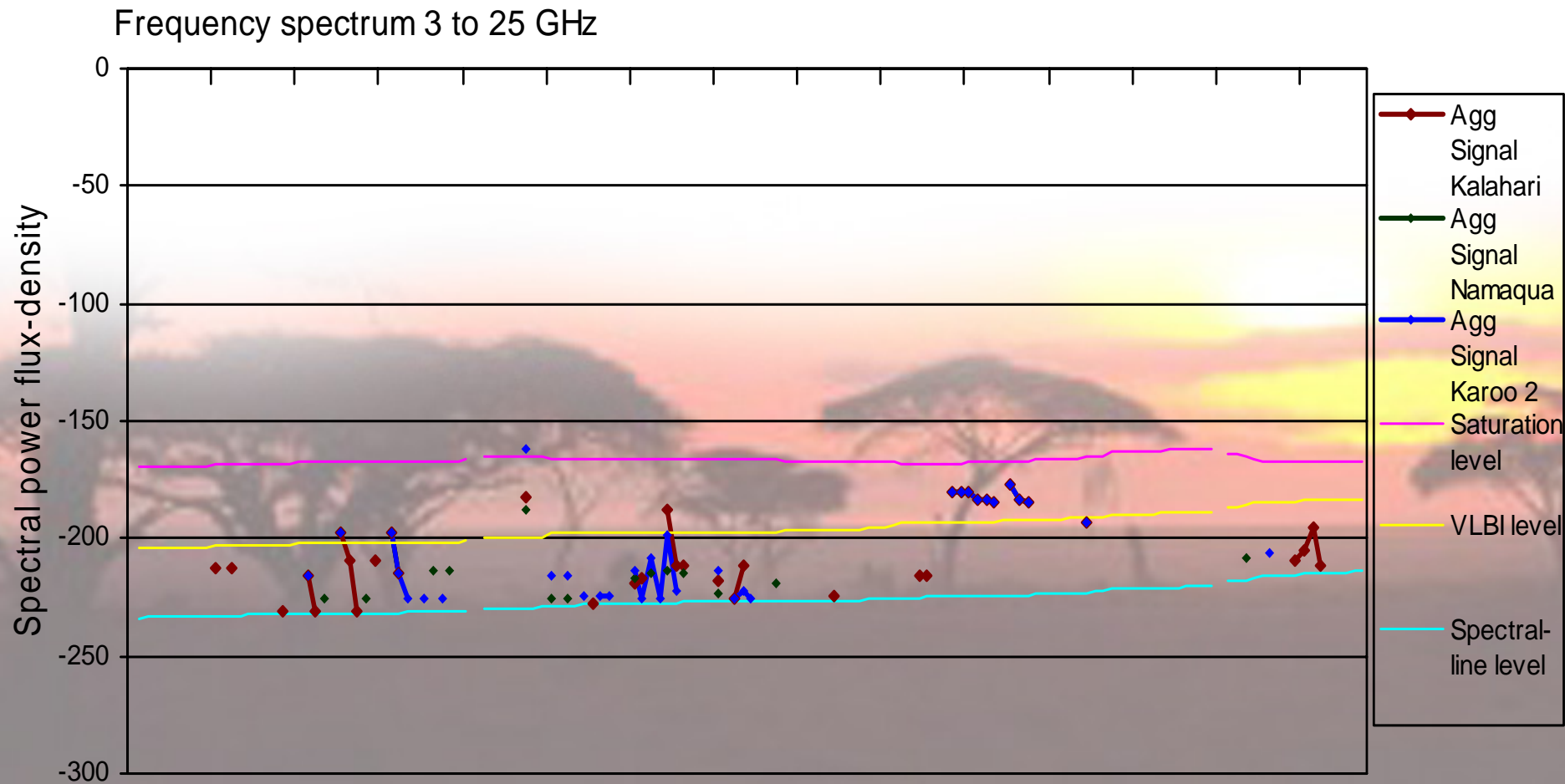


Frequency spectrum 854 MHz to 3 GHz





# SKA Core Site Analysis – Comparison of aggregate signals – 3 to 25 GHz

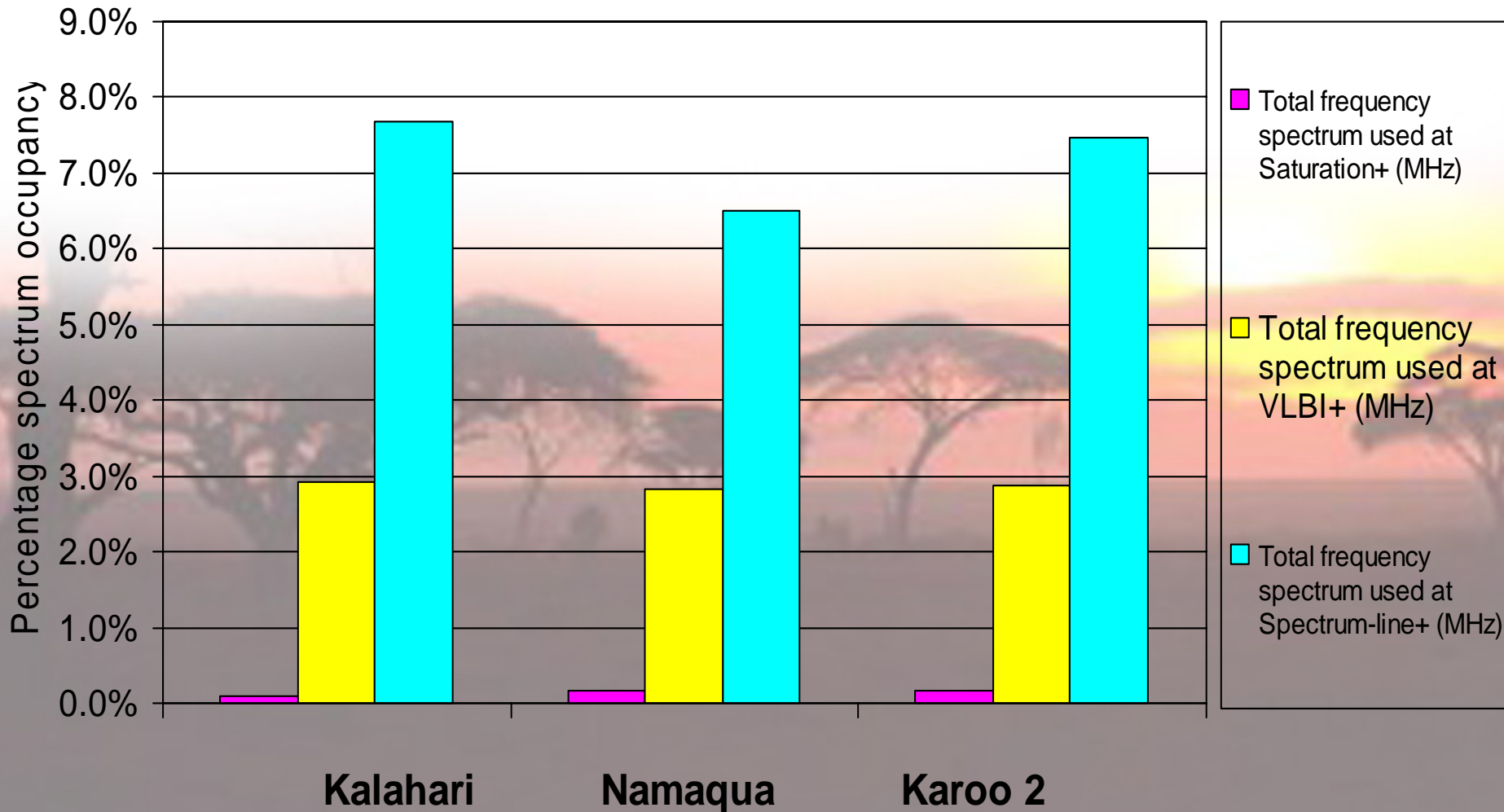


# SKA Core Site Analysis – Number of signals at certain bandwidths



<b>Bandwidth</b>	<b>Satura- tion</b>	<b>VLBI</b>	<b>Spec- tral-line</b>
<b>12 &amp; 25 kHz land mobile</b>	<b>32</b>	<b>136</b>	<b>526</b>
<b>200 kHz cellular telephony</b>	<b>0</b>	<b>19</b>	<b>38</b>
<b>0.5 to 3.5 MHz wireless local loop and digital links</b>	<b>0</b>	<b>37</b>	<b>299</b>
<b>6 MHz analogue television broadcasting</b>	<b>8</b>	<b>41</b>	<b>119</b>
<b>28 to 40 MHz microwave and satellite</b>	<b>0</b>	<b>15</b>	<b>45</b>

# Frequency Spectrum Occupancy at the Saturation & RA Threshold Levels



# Control of the Radio Environment



- **Formal & legally sound measures required for control**
- **Mandate for the establishment of the SKA in SA**
- **Proclamation & demarcation of radio quiet zones**
- **Review and amendment of existing communications legislation to provide for the control needed**
- **Participation in ITU activities to provide for new generation radio astronomy**
- **Coordination of South African Regional Regulation to facilitate an acceptable cross border radio environment**
- **Review and amendment of SA regulations for radio-communications & promulgation of new regulations**
- **Review of existing frequency spectrum licences to include provisions for the SKA**

# Ongoing Regulatory Activities



- **Completed regulatory study**
- **Considered requirements of ISSC and Radio Regulations, Recommendations & Resolutions of the ITU**
- **Reviewed SA communications law & regulations**
- **Determined matters requiring attention**
- **Submitted a report to Independent Communications Authority of SA (ICASA)**
- **Participated in a public enquiry conducted by ICASA on the 20 MHz to 3 GHz frequency band plan**
- **ICASA established a Special Committee to attend to radio astronomy and SKA requirements**
- **A meeting has been held at Regional Ministerial level and further meetings are being planned at regulatory level**

# Improvement of the Existing Radio Environment



- **Need for improvement – removal of saturation level signals & minimisation of the need for mitigation**
- **Understanding of the need for universal service & role of radio communications in sparsely populated areas**
- **Interaction with operators, ICASA and Government**
- **Improvement scenarios (examples):**
  - **Digital satellite DTH blanket coverage & digital terrestrial low power transmission to communities in lieu of high power terrestrial analogue large area coverage**
  - **Aeronautical secondary surveillance radar in lieu of high power primary surveillance radar**
  - **For radio communications – use of frequencies below 150 MHz and/or use of broadband digital systems in lieu of narrow band (12.5/25 kHz) analogue or digital systems**



# Conclusion

**The radio environment & the regulatory system are inextricably linked and are critical elements in the development, establishment and operation of an SKA radio telescope. The existing radio environment should be improved and the regulatory system needs to be developed to provide for the new radio astronomy**

**Thank you for listening**

