AuScope

AN ORGANISATION FOR A NATIONAL
EARTH SCIENCE INFRASTRUCTURE PROGRAM

The AuScope VLBI Array

IVS General Meeting

Madrid
March 2012

Jim Lovell, Jamie McCallum, Stas Shabala,
John Dickey, Christopher Watson

University of Tasmania

Oleg Titov

Geoscience Australia

Cormac Reynolds, John Morgan, Hayley Bignall,
Steven Tingay

Curtin University of Technology

Possible broadband feed upgrade option?

Museo Nacional Centro De Arte Reina Sofia

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Thank you

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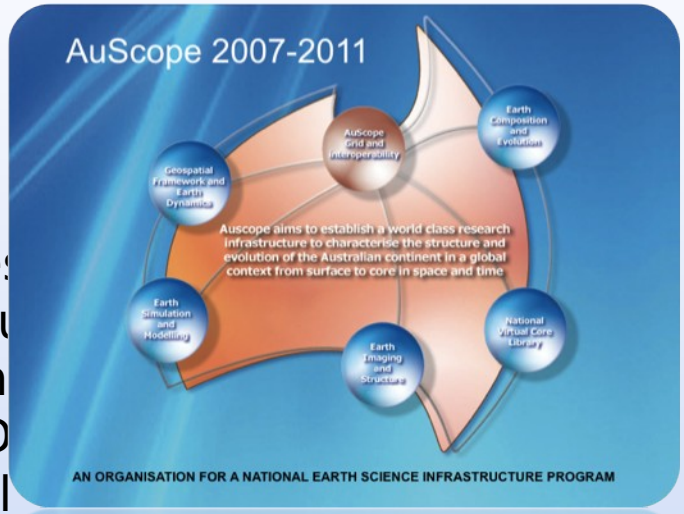
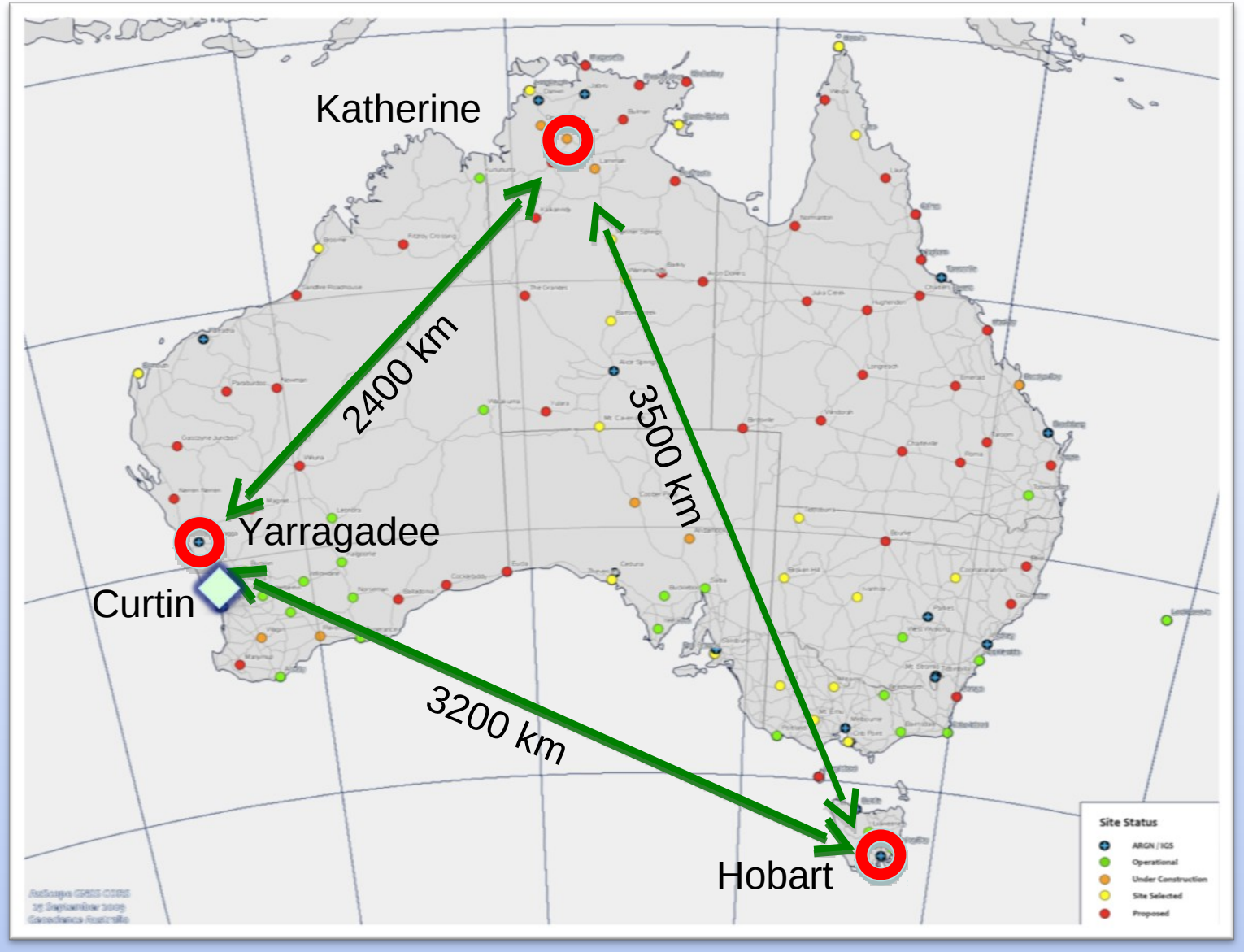
AuScope: Structure and Evolution of the Australian Continent



- AuScope is funded through the Federal Government's National Collaborative Re Infrastructure Strategy (NCRIS). Infrastru to provide an integrated spatial position system spanning the whole continent. D into 5 components, including Geospatial
- The Geospatial component received $15.8M in NCRIS funding plus funds from Universities and State/Territory government. Infrastructure includes
  - 3 x 12m radio telescopes and a correlator
  - ~100 GNSS receivers spanning the continent
  - SLR upgrades
  - An absolute gravimeter and 3 tidal gravimeters
  - Improved computing facilities
- UTAS to construct and operate the VLBI array. Correlation of some experiments at Curtin University of Technology
- Main partners are Curtin University of Technology and Geoscience Australia.


Katherine
2400 km
3500 km
Yarragadee
Curtin
3200 km
Hobart
Site Status
ARGN / IGS
Operational
Under Construction
Site Selected
Proposed

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Co-location

- Hobart
  - VLBI, GNSS, Gravity (mobile)
  - VLBI with 26m for ~20 years
- Katherine
  - VLBI, GNSS
- Yarragadee
  - SLR (MOBLAS-5), GNSS, DORIS, Gravity and now VLBI
- Regular local-tie surveys by GA (initial surveys done)

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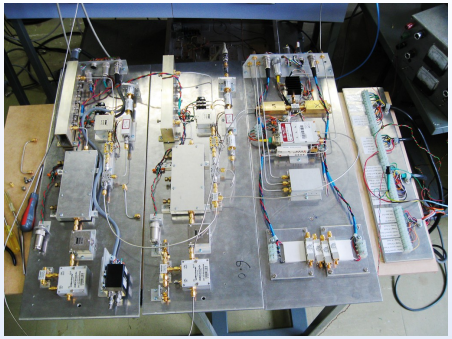
Antenna infrastructure & hardware



- Aim to meet VLBI2010 recommendations if possible, or ensure an upgrade path
- 12m “Patriot” antennas from Cobham
  - Surface RMS 0.3 mm
  - Slew rates 5 deg/s Az, 1.25 deg/s El (accel: 1.3 deg/s/s)
  - Coaxial S/X feed
- Room temperature, dual polarisation receiver (UTAS).
- SEFD 3500 Jy. See poster 2.20
- DBBC (HAT Lab)
- Mark5B+ (Conduant) 2 Gbps
- A Vremya H maser (VCH 1005A)

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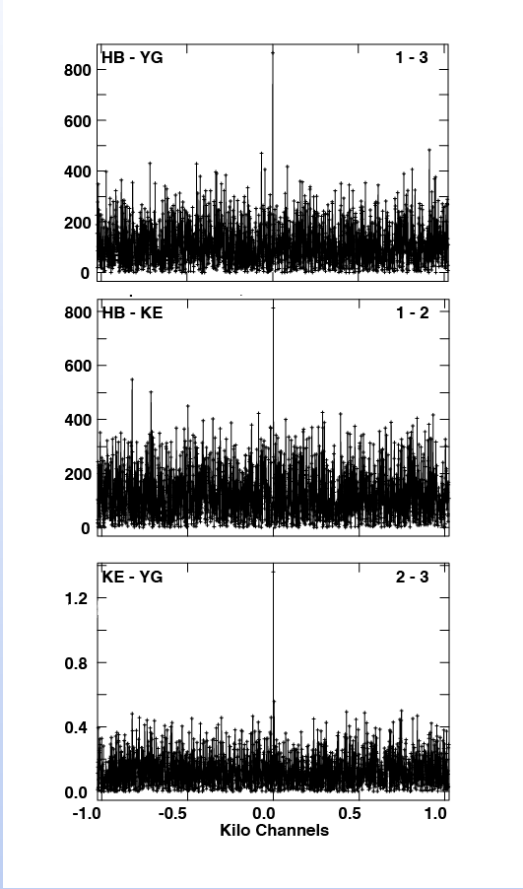
Highlights

- April 2010 : first intercontinental fringes Hb-Ts-Kk, correlated at Washington
- September 2010 : Hb feed upgrade
- November 2010: Katherine completed
- December 2010: First Ke fringes
- April 2011: Yg completed and first Yg fringes
- 9 June 2011: First network-wide fringes, correlated at Curtin
- 16 June 2011 First IVS observation with all three antennas : R4487
- Sep 2011: Hb participated in CONT11



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HOBART12 (Hb/H): OK

KATH12M (Ke/B): Low pcal amplitude in the upper 4 X-band channels leading to H-codes. Manual phasecal applied at KATH12M

Manual phasecal applied at KATH12M

YARRA12M (Yg/Y): Low pcal amplitudes in X-band leading to H-codes. Manual phasecal applied at YARRA12M.

Manual phasecal applied at YARRA12M.

Project Status

Hobart 12m	Operational since Sep 2010
Katherine 12m	Operational since June 2011
Yarragadee 12m	Operational since May 2011

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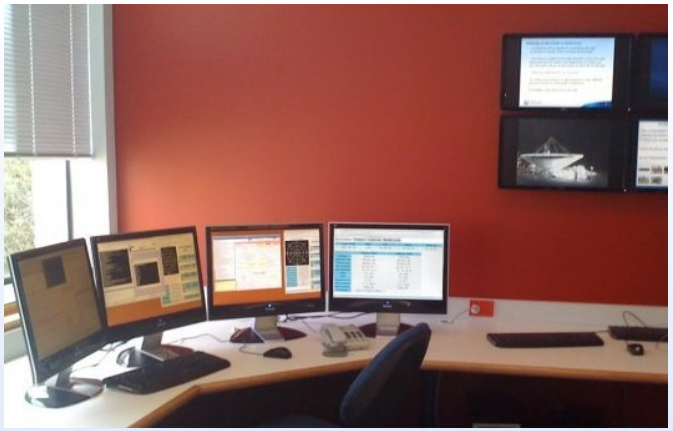
Operations

- All telescope operated remotely from UTas. Using eRemoteCtrl
- 71 days / year, no Curtin correlation
- Hobart 26 m co-observes with 12 m for 12 days/y
- IVS scheduled
- Includes 4 AUSTRAL sessions per year
  - AuScope antennas plus Warkworth
  - Exercising antennas to max capacity
    - More scans/day (2 x R1/R4)
    - 1 Gbps (2 bit, 16 MHz Ifs, 4 x R1/R4)
- eTransfer of almost all Hobart data to correlators, shipping from Katherine and Yarragadee



Operations room

AUSTRAL

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Environmental Space Geodesy group at UTas

John Dickey
Jim Lovell
Christopher Watson
(Oleg Titov)

ARC Super Science Fellows:
Stas Shabala
Jamie McCallum
Anthony Memin

TDRA6000 3D Point Accuracy*:
U_{XYZ} ≤ 30 m: ± 0.5 mm
U_{XYZ} > 30 m: ± 0.3 mm + 13 µm/m
*Maximum Permissible Error (MPE) ~±3σ, Typical accuracies are ½ MPE)

0.5" TBR Targets:
Acceptance angle ± 20°
Magnetic mounts, rotating stands for each TBR (Fig 5).

Fig 4: Robotic total station (Leica TDRA6000) specifications and 0.5" TBR reflector selected for targeting over the telescope.

Use of space geodetic tools applied to
•climate change and sea level,
•crustal strain and seismic deformation,
•Hydrology

Initially focus on characterization and mitigation of systematic error sources within VLBI and GNSS data analyses.

Current projects:
•12m antenna deformation study (Poster 2.19)
•Source structure and variability (Stas Shabala's presentation, Wednesday)

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Initial Results

- Positions
- The Hobart Twin Telescopes
- Baselines and AUSTRAL
- EOP determination

Initial Results

- Station positions now at cm-level precision

Station	Latitude	Longitude	Height (m)
Hobart	−42 48 20.06380 (±0.0004, 0.0004)	147 26 17.3055 (±0.0005, 0.0008)	40.971 (±0.011, 0.012)
Katherine	−14 22 31.66897 (±0.00024, 0.00033)	132 09 08.5430 (±0.00044, 0.0005)	189.257 (±0.013, 0.013)
Yarragadee	−29 02 49.72375 (±0.00044, 0.0004)	115 20 44.2564 (±0.0009, 0.00054	248.239 (±0.014, 0.012)

- Hb position in good agreement with local tie survey. Hobart 12m – 26m baseline
  - VLBI 295.92 ± (σ = 0.007, wrms = 0.020) m
  - Local tie 295.918 ± 0.001 m (Ruddick & Woods 2009)

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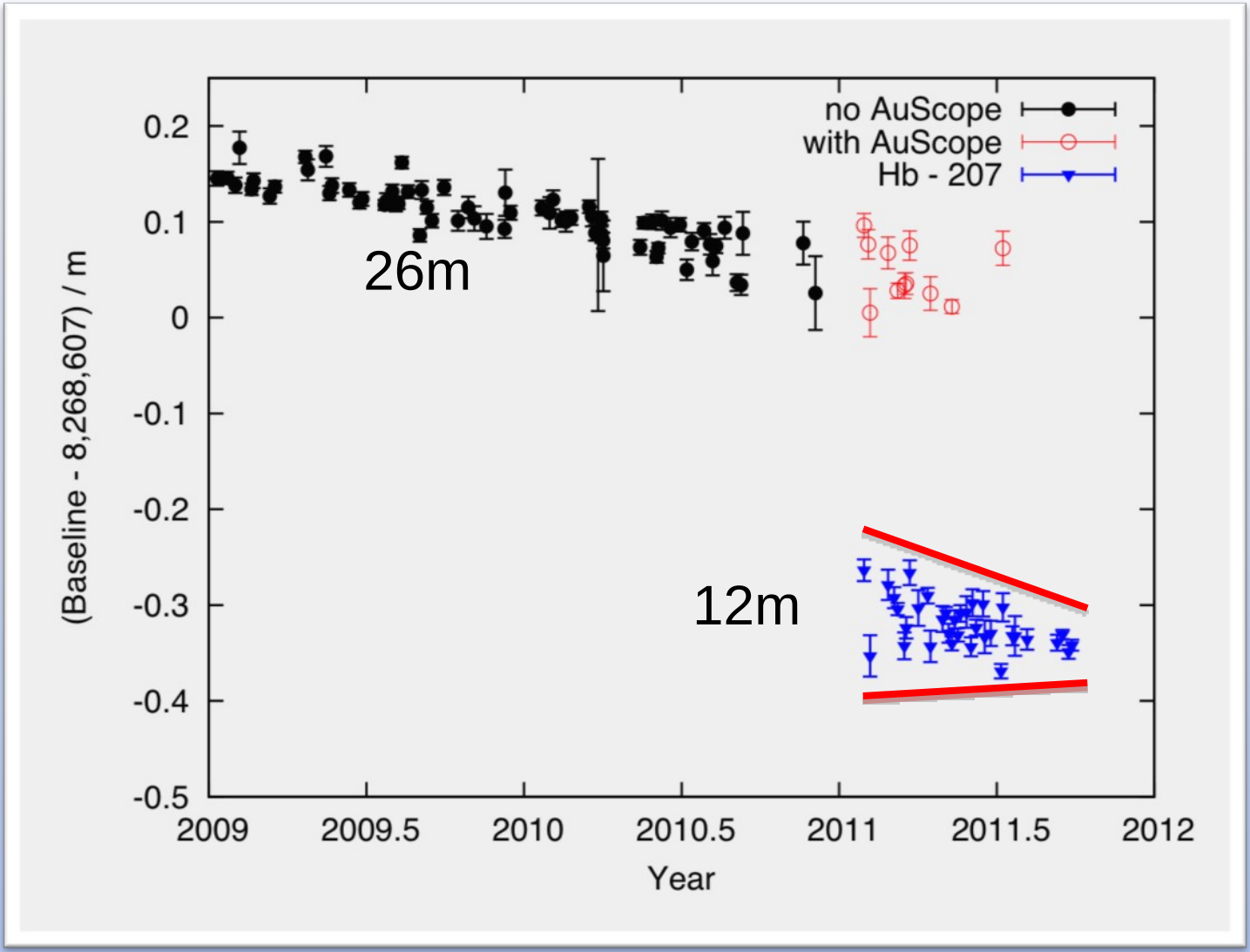
Hobart to Kokee



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AUSTRAL

Early analysis of AUSTRAL experiments indicate improvement in solutions, especially in vertical component (~factor of 2). Better atmospheric solutions due to more frequent observations.

Ultra-Rapid EOP

- 10 Gbps link out of Hb
- Hobart 12m has joined with the Ultra-Rapid EOP project with Tsukuba, Onsala
- Near-real-time data transfer, correlation and analysis
- On-Ts gives dUT1
- Hb-Ts baseline provides axis orientation (Xp, Yp)
- First successful observation in Nov 2011. More observations this year.

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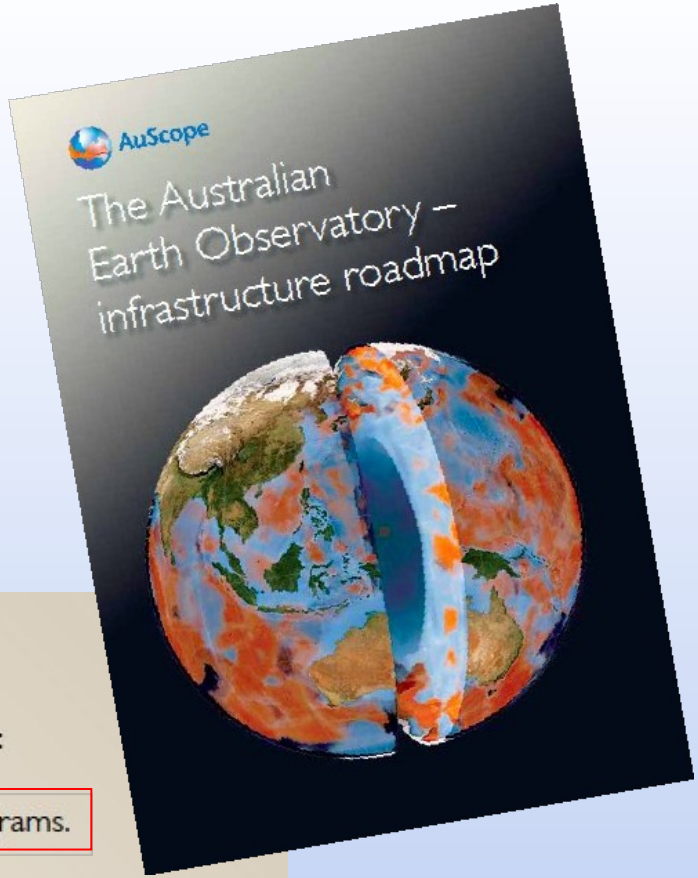
The future

AuScope roadmap

www.auscope.org



Priorities for AEO-Geospatial Strand

Funding priorities for $5 – $15 million cost point opportunity:

- Operation of the AuScope VLBI and gravity observing programs.
- Establishment of GNSS stations along Australian plate boundaries.
- A national facility for the development of geodetic analysis, modelling and delivery systems.
- Upgrade of AuScope VLBI array to broad-band cryogenic receivers.

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