



USAF GeoBase Data Architecture Workshop Meeting Minutes

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1. Workshop Summary

As USAF installations develop new GeoBase databases and applications, the Headquarters Air Force Geo Integration Office (HAF GIO) is helping the USAF establish consensus guidelines to guide implementation efforts. To help achieve this objective, the HAF GIO hosted a GeoBase Data Architecture Workshop 28-30 November 2001 in Herndon, Virginia.

This 3-day workshop addressed the following significant GeoBase data architecture issues:

- GeoBase Common Installation Picture (CIP) contents.
- Use of the Spatial Data Standards (SDS) and other DoD data standards for GeoBase.
- Recent SDS developments and activities (e.g., the SDS Geodatabase).
- GeoBase data modeling (logical, physical) and metadata creation and management.
- Integrating the CIP with mission systems (e.g., ACES, LOGCAT).
- Relevant and viable data storage formats and data sharing protocols.
- Timelines and action items to complete GeoBase data standards and guidelines.

Several Air Force organizations have already made significant investments in GeoBase technologies and are continuing to develop GeoBase capabilities. The USAF faces a challenge in ensuring that these investments are coordinated, adhere to USAF-wide guidelines, and are neither in conflict nor redundant. To that extent the GeoBase Data Architecture Workshop was a significant step in ensuring geospatial data are collected and served in a fashion facilitating consistency and interoperability across all Air Force installations.

2. Workshop Agenda

Each agenda item was directly and explicitly related to an objective or task in the [HAF GIO GeoBase Strategic Plan](#). The workshop agenda is attached as Appendix A. The [HAF GIO GeoBase Strategic Plan](#) can be provided upon request.

3. Workshop Attendees

The workshop was attended by 22 individuals representing PACAF, AFSPC, USAFE, AFMC, AFSOC, AMC, ACC, AETC, USAFA, AFCEE, and the AF-CIO. Individuals representing several Air Force information systems including IDW, NGL, and IRCAT were also in attendance. A complete attendee list is provided in Appendix B.

4. Workshop Objective

This workshop served as the formal starting point for the USAF GeoBase community to organize and bring coherence to GeoBase database development. The objective of the GeoBase Data Architecture Workshop was to begin addressing significant data architecture issues and to gain consensus and set direction for establishing formal guidance and policy on GeoBase data development and sustainment.

The GeoBase data architectures identified and addressed in the workshop will directly support a USAF GeoBase C4ISP, to be submitted to the Air Force Communications Agency (AFCA) and Chief Information Officer (CIO) by the HAF GIO in FY2002.

4.1 Workshop Outcomes

The following outcomes were projected for the workshop:

1. Propose revisions to the USAF GeoBase CONOPS (Concept of Operations) requirements
2. Draft a USAF GeoBase Data Architecture Document to guide development of C4ISR architecture documentation for a C4ISP submittal
3. Draft the outline of a USAF GeoBase Data Management Plan, establishing guidelines for MAJCOMs and installations to sustain GeoBase databases.
4. Begin addressing data architecture issues identified in Section 1 above.
5. Increase collaboration and communication between organizations participating in the USAF GeoBase community.
6. Develop a list of action items for further consideration.

Available time did not permit for the full completion of items (2) and (3). However, the HAF GIO will prepare and distribute these documents using inputs from this workshop.

5. Meeting Minutes

While the meeting generally followed the planned agenda, many topics of discussion were interrelated and many discussions addressed multiple topics simultaneously or shifted between agenda topics. Significant notes from the workshop are recorded here and are organized by the scheduled meeting agenda. Individuals responsible for specific comments or inputs are omitted from these minutes.

NOTE The following are minutes summarizing the Data Architecture Workshop and should not be interpreted as formal recommendations, policy, or endorsements on the part of workshop attendees.

Update on HAF GIO Strategic Plan, CONOPS, IL IS Data Strategy, and Recent HAF GIO Activities

- HAF GIO initiated the workshop with a summary of objectives and tasks in the HAF GIO Strategic Plan relevant to data architecture, outlined relevant requirements as defined in the USAF GeoBase CONOPS, summarized the IL IS Data Strategy (guiding GeoBase development), and shared recent HAF GIO activities including completion of the Strategic Plan and CONOPS, preparation for the USAF GeoBase inventory, initiation of integration efforts with ACES-RP, LOGCAT, and Command Core. HAF GIO also summarized the significant role GeoReach has played in supporting Operation Enduring Freedom to date.
- These presentations are available in MS PowerPoint format and can be downloaded from <http://www.geobase.org>.

GeoBase Inventory

In preparation for the USAF GeoBase Inventory to be administered by the HAF GIO in 1Q FY02:

- HAF GIO should investigate the System Compliance Database (SCD) maintained by AF/CIO for relevant information (first, to ensure that HAF GIO does not pose questions that are already answered, and second, to help shape the content of the GeoBase inventory questions).
- The AF/CIO established the SCD to inventory all AF information systems and their related Y2K compliance status.
- The SCD is still maintained (post-Y2K) to inventory AF information systems.
- HAF GIO should work collaboratively with the AF/CIO to establish procedures to integrate GeoBase inventory results into the SCD.

Role of GeoBase Data Architectures and the C4ISP

- The Command, Control, Computers and Communications Intelligence Support Plan (C4ISP) is the formal mechanism by which Air Force information systems – such as GeoBase – are defined. GeoBase architectures – operational, system, and technical – must be defined and documented for GeoBase systems to be fielded on AF network and communications infrastructure.
- While there is no formal “Data Architecture” component of the C4ISP, many C4ISR architectural views (submitted as part of the C4ISP) require a fundamental understanding of what data the system will support and how those data are stored and managed. Additionally, several C4ISR architecture views including (but not limited to) OV-3 (Information Exchange Matrix), OV-5 (Activity Model), and OV-7 (Logical Data Model), require a comprehensive understanding of data nature, content, and format.
- The HAF GIO will be developing an AF-wide GeoBase C4ISP. This will be submitted to the Air Force Communications Agency (AFCA) and the Chief Information Officer (CIO) for the purposes of obtaining an Air Force-wide Certificate to Operate (CtO).

- Are the MAJCOMs required to submit their own C4ISP? → This will depend on the Acquisition Category (ACAT) assigned to the GeoBase program, which to date is not yet defined:
 - GeoBase requirements are not yet fully defined.
 - Existing GeoBase investments are not fully known.
 - GeoBase funding strategies are still being investigated.
- Should individual MAJCOMs need to submit a C4ISP, they can draw heavily from the HAF GIO capstone C4ISP for their own submittals.
- Estimated Completion Date for the HAF GIO C4ISP in Aug 02.
- A GeoBase System Program Office (SPO) will lead the C4ISP development effort. The GeoBase SPO is targeted to be stood up at Gunter AFB as soon as possible (est. Mar 02).
- C4ISR architecture “precepts” should guide GeoBase development; the USAF GeoBase community should develop a set of precepts that guide architectural and deployment configuration of GeoBase. These precepts could be generated from the 14 GeoBase foundations and from relevant DoD and USAF policy and guidance.
- To date it is believed that only PACAF has received an Interim Certificate to Operate (ICtO). However, this will be verified upon completion of the FY02 USAF GeoBase Inventory to be administered by the HAF GIO.

Validate Contents of the IOC CIP

- There were no significant concerns from attendees regarding the list of map features to be included in the IOC CIP, as defined in the USAF GeoBase CONOPS.
- Workshop attendees agreed that the CONOPS should further address CIP data accessibility (i.e., define which CIP features should be made available to the entire organization vs. which CIP features would be made available to specific portions of the organization on a need-to-know basis).
- PACAF described its efforts to address data accessibility by defining CIP “levels”. PACAF has defined four levels; level 1 including the most basic map features (what you can see from the air) and being shared with the widest audience, to level 4, including the most sensitive or functionally-specific features that would be shared with a more focused audience.
- Attendees suggested that next spiral of the CONOPS address pre-defined “functional views” that define “typical” combinations of CIP map layers for certain functional needs. These would be defined such that:
 - AF-wide applications could be developed to leverage those CIP views.
 - A GeoBase classification guide could formally define sensitivity and classification status of those views.
- AFCEE suggested that the IOC and post-IOC CIP more closely consider linkage to the base comprehensive planning process.

IOC Imagery Requirements

- Attendees agreed that panchromatic imagery (as specified in the USAG GeoBase CONOPS) for cantonment areas is preferred over true-color or multi-spectral imagery.
- Workshop attendees noted that the specification for 1-meter resolution imagery in the IOC CIP does not support the requirement for mapping at 1:1200 (1"=100') scale as per the CONOPS.
- Attendees noted that many installations already have imagery from aerial surveys that are more detailed than 1-meter resolution.
- HAF GIO → Our 1Q FY02 inventory will provide a complete picture of which bases have imagery more detailed than 1m.
- HAF GIO → Intent of 1m imagery is to support the commanders' situational awareness, not vector map feature extraction.
- Attendees questioned the value of an AF-wide purchase of 1m imagery, and suggested that available funds instead be used to support imagery at a scale that can facilitate 1:1200-scale mapping.

Recommended Mapping Scales

- Map scales for vector features as defined in the USAF GeoBase CONOPS are appropriate; 1:1200 (1"=100') for cantonment areas and 1:4800 (1"=400') for undeveloped and outlying areas of the commander's mission decision space.

Define Contents of the FOC CIP

- The contents of the CIP at full operating capability (FOC) cannot necessarily be defined at an AF-wide level, nor can they be fully defined at this time as the full range of GeoBase users and use requirements are not yet defined.
- However, HAF GIO should define additional layers that should be included in the post-IOC CIP to support known mission and system integration needs.
- Post-IOC CIP layer definition should be requirements-based (given analysis and reporting needs of different functionals, and requirements to integrate GeoBase with existing and future Air Force Automated Information Systems (AIS)).
- Post-IOC CIP features should consider and support AFI 32-7062, Base Comprehensive Planning mapping requirements.
- MAJCOMs and Wing Commanders should retain the right to define post-IOC CIP features as warranted by mission needs.
 - Will this lead to a lack of consistency from one installation to the next?

CIP Georeferencing Requirements

- The USAF GeoBase CONOPS requirement to register the CIP to UTM coordinates, WGS84 datum is acceptable. However, there is still a need to map and provide data in local coordinate systems and datums (most typically State Plane in CONUS).
- Attendees were undecided on how to address need for the USAF to utilize a common coordinate system to support “red order of battle” (UTM/WGS), yet meet requirement to map in local coordinate systems.
- Attendees expressed concern regarding:
 - Need to maintain two copies of CIP data (one in UTM/WGS, one in the local coordinate system).
 - Positional error introduced when converting between UTM/WGS and local coordinates, especially at OCONUS installations.
- HAF GIO will further investigate this issue and provide guidance in future revisions of the USAF GeoBase CONOPS.
 - In the meantime, installations should continue to register the CIP to local coordinate systems when necessary and will transform data to UTM/WGS on an as-needed basis to support data sharing and roll-up reporting requirements.
- Attendees agreed that until a single coordinate system is implemented, metadata adequately describing coordinate registration for each installation’s CIP will be critical.

CIP Data Suppliers and Data Collection Methodologies: Garrison Basing

- A set of standard procedures should be developed to guide CIP development. A stable base-line methodology should be defined for:
 - Aerial mapping and photogrammetry
 - Feature extraction
 - GIS data development
- Several MAJCOMs have started to develop and document these methodologies. HAF GIO will work with these MAJCOMs to leverage their efforts to date, and distribute an AF-standard in mid-2002.

CADD vs. GIS Mapping

- Attendees agreed that in principle, GIS will be used to map the installation “outside” buildings and structures. CADD will be used to map “in-building” facilities.
- CADD should continue to be used for detailed facility drawings and design/engineering activities.
- A capability should be provided within GeoBase applications to georeference and access CADD drawings from the GeoBase CIP (i.e., users would point at a CIP map feature and have the ability to view related CADD drawings).

Leverage Existing CADD Maps to Build the IOC CIP

- Existing CADD maps of the installation should be exploited to the fullest extent possible when building the IOC GeoBase CIP.
- However, CIPs developed from existing CADD drawings will be replaced as soon as possible with map features extracted from aerial survey (assuming existing CADD drawings are dated and were not developed from detailed recent aerial surveys).
- Attendees agreed that it is critical to first assess the spatial and temporal accuracy – and quality – of existing CADD drawings before using those data to establish an IOC CIP.
- Standards and specifications should be established to guide current and future CADD mapping efforts at the base to support development and sustainment of the GeoBase CIP. These standards would define how CADD drawings should be constructed and stored to facilitate both CADD mapping needs *and* conversion to GIS format. This specification would
 - Address what CADD elements should and should not be used to support GIS conversion.
 - Recommend that all CADD drawings be registered to a real-world coordinate system.
 - Address drawing standards (e.g., all areal features be completely closed, contours be continuous lines without breaks or gaps for contour elevation text, etc.)
- PACAF (and perhaps other MAJCOMs) have developed these specifications. HAF GIO will collect and consider these specifications and distribute an AF-wide standard CADD mapping specification to support GeoBase CIP development.
- There will be a significant cultural and change management issue to work with EAs, contractors, and other CADD users to develop drawings in a fashion compatible with GeoBase:
 - Needs to be addressed by HAF GIO in the USAF GeoBase Training and Education strategy.
 - IITA is benchmarking CADD-to-GIS conversion procedures for AutoDesk, Bentley, ESRI, and Intergraph CADD and GIS products.

Role of Commercial Data Providers

- CIP data comprising the commander's mission decision space will be acquired in most cases by the USAF rather than purchased or acquired from other sources.
- Commercially available data are most applicable and appropriate when developing the Regional Installation Picture (RIP) – those GeoBase map features that extend beyond the commander's mission decision space yet are still relevant to and in close proximity to the AF installation.
- USGS and BLM are potential data providers for AF Ranges in CONUS.
- NGOs (e.g., Nature Conservancy, World Health Organization, United Nations Environmental Program – UNEP) can provide additional data for the RIP.

CIP Data Suppliers and Data Collection Methodologies: GeoReach and Expeditionary Basing

- HAF GIO summarized recent GeoReach efforts in support of Operation Enduring Freedom (OEF):
 - GeoReach put to practice since 11 Sep 01.
 - GeoReach procedures and architectures therefore evolving extremely rapidly by necessity.
 - The CAF are establishing initial GeoReach architectures and procedures to support OEF, but are also developing more persistent architectures and procedures for long-term GeoReach capability (post-OEF).
 - Lessons learned from OEF are driving long-term GeoReach architectural decisions.

Use of NIMA Data to Support GeoReach CIP Development

- The initial mapping for potential Forward Operating Locations (FOLs) is typically provided via NIMA imagery (CIB) or commercial imagery (IKONOS 1m) purchased through NIMA.
- AAFIF and DAFIF data are being used to provide initial site-specific vector mapping of airfield runways, aprons, etc.
- ACC is populating FOL CIPs in its AOR using expeditionary site surveys rather than using other NIMA vector data products.
- Attendees agree that AAFIF/DAFIF data are of sufficient accuracy and completeness to support initial/notional FOL planning.

Initial CIP FOL Architecture

- Data structure and storage formats for FOL CIPs varies between MAJCOMs:
 - ACC → Initial mapping is being collected in AutoCAD then being converted to GIS (shapefile) format at a later time.
 - PACAF → Initial mapping is being collected in GIS (shapefile) format.
- Initial CIP data are being deployed on individual laptops in the field.
- The FOL CIP is initially used by CE, with breadth of use expanding to other functionals as additional forces are deployed at the FOL.
- CIP data format varies between CAF MAJCOMs. As part of OEF, some data are added using custom layers as an extension to AAFIF and DAFIF data, some FOL CIP data are stored in NIMA VPF format, and other data are stored in SDSFIE format.
- PACAF has developed an SDSFIE data dictionary for use on Trimble GPS data loggers, thereby facilitating direct capture of all FOL mapping using SDSFIE standards.
 - Neither PACAF nor ACC are capturing FOL data using SDSFIE in Operation Enduring Freedom; they intend to do so upon formal training of their site survey teams. In the meantime, they are converting existing FOL CIP data to SDSFIE format

- after it is initially collected. ACC is using a similar procedure at this time to back-fit site survey data to SDSFIE compliance.
- HAF GIO will obtain the Trimble SDSFIE data dictionary from PACAF and post those materials on <http://www.geobase.org>.
 - Are FOL CIP features linked to “external” (non-spatial) databases? Yes, FOL CIP data are being integrated with LOGCAT/EKB. Details of this integration were not discussed in the workshop.
 - IDW Team → The GeoBase community should consider if and how IDW (Installation Data Warehouse) can and should be integrated with the GeoReach process.

Air Force Expeditionary Site Survey Procedures

- Role of RED HORSE? ACC has provided initial GPS training in early Aug 01. RED HORSE now using GPS during construction activities at FOLs. RED HORSE Units will be trained to use and maintain GIS technologies as soon as possible.
- TALCE and Prime BEEF teams are also using GPS to provide additional mapping at FOL.
- PACAF → 613 CRS provides all mapping products directly in GIS format; no CADD is utilized during expeditionary site survey process.
- Attendees agreed that the role of the expeditionary site survey process in supporting GeoBase CIP development should be further elaborated. HAF GIO and the CAF will collaborate on and will participate in the Expeditionary Site Survey process IPT to establish these processes.

Transition to Expeditionary GeoBase Capability

- Reach-back capability for new mapping at FOLs? Both ACC and PACAF are sending new mapping data back to GeoReach servers at MAJCOM HQs via SIPRNet EMAIL. CADD drawings and shapefiles are compressed with WINZIP and then EMAILED to the GeoReach servers.
- The USAF needs to establish more formal processes to provide reach-back to GeoReach servers at MAJCOM HQ.
- Formal processes need to be established to transition FOL CIP to deployed servers when transitioning to full GeoBase capability at expeditionary bases. This will entail collaboration with:
 - The SC community
 - Prime BEEF teams

GeoBase Data Content and Format Standards

NIMA Data Formats

- NIMA data are not commonly used to build garrison GeoBase CIPs.
- NIMA data typically support “red order of battle” and tactical environments; there is little need to share map data between base support and tactical functions within the USAF.
- Therefore, GeoBase CIPs will not store data in NIMA (VPF, etc.) format.
 - The capability to translate data between the GeoBase CIP and NIMA data formats will be provided by GIS software (out-of-the-box and custom routines) at the installations.
 - MAJCOM HQ will retain (and are currently acquiring) custom NIMA data translators to support GeoReach data sharing and interoperability.
- NIMA data to support population of the RIP → Typically, USAF organizations will partner with local jurisdictions (cities, counties) to acquire local municipal data to populate the RIP.
- AF/CIO → The USAF GeoBase community needs to consider how GeoBase data will be incorporated into the GCSS, TBMCS; these systems require visibility of facilities in the rear area. Are these systems potential users of NIMA data formats? How can the GeoBase CIP be leveraged to meet this requirement? This is an issue for further consideration:
 - ACC, PACAF, and AFMC (Eglin AFB) are addressing TBMCS integration issues to date.
 - HAF GIO should collaborate on this research effort, first learning existing efforts within ACC, PACAF, and AFMC and then assist in establishing guidelines for GCSS integration.

Spatial Data Standards (SDSFIE)

- The SDSFIE is the de-facto data content standard for USAF GeoBase.
- Attendees requested a formal policy memorandum be issued by the HAF GIO requiring use of the SDSFIE. This will provide necessary written justification that MAJCOMs and installations can reference.
 - HAF GIO will research other services for similar policy and precedent (the US Army, on 16 Oct 01, issued a formal policy memorandum requiring use of SDSFIE for Army installation mapping).
- SDSFIE standards will take precedence over DoD 8320 guidance for GeoBase CIP standardization. However, the USAF GeoBase community still needs to further research DoD 8320 data standards as this will be a significant issue when integrating GeoBase with other mission information systems.

- SDSFIE is not yet registered with the DoDDS (DoD Data Dictionary). However, SDSFIE has been submitted to DISA for approval, and approx. 50 DISA-required attribute fields have been included in SDSFIE. SDSFIE is therefore effectively compliant with DISA requirements.
- Most installations are either implementing SDSFIE or are planning to do so. The 1Q FY02 GeoBase Inventory will provide a more complete picture on which installations are utilizing SDSFIE.
- Impact of the recent adoption of SDSFIE as an ANSI standard? → No direct, significant impact on USAF is anticipated as we planned to implement the SDSFIE anyway.
- Recent homeland defense initiatives may lead an increasing number of state and local governments to migrate their geospatial data to SDSFIE format. This will facilitate future collaboration and data sharing between the USAF and local jurisdictions in close proximity to our basing facilities.
- Attendees agree that SDSFIE is a viable “standard” to support OSD spatial data roll-up requirements in support of the Base Information System (BIS) or similar OSD initiatives.
- IDW Team → SDSFIE, if implemented at each USAF installation, should provide a sufficient standard to integrate spatial data into the Installation Data Warehouse (IDW) as it will support standardization of data storage and retrieval schemes and will facilitate cross-installation queries and analysis.

SDSFIE Compliance

- Attendees had different interpretations of what it meant to be “compliant” with the SDSFIE.
- Basic compliance requirements:
 - Data must be stored in a relational database (shapefiles *do* qualify, as attributes are stored in DBF format).
 - Attribute table structure matches SDSFIE guidance.
 - File naming conventions? Significant differences in interpretation within the group. See “Common (vs. SDSFIE) Names for CIP Layers” below...
- The CADD/GIS Technology Center defines “SDSFIE compliance” on its web site: <http://tsc.wes.army.mil/products/TSSDS-TSFMS/tssds/html/>
- The HAF GIO will summarize these compliance guidelines, rephrase the guidelines in the context of the USAF GeoBase and the USAF organization, and redistribute as a policy memorandum in FY02.

Common (vs. SDSFIE) Names for CIP Layers

- The issue is how CIP features are named when presented to users via the application layer (application graphical user interfaces – GUIs), not how these data are to be named when physically stored in the CIP database. The latter issue is adequately defined by the CADD/GIS Technology Center.

- There are differences in interpretation of SDSFIE file/layer naming recommendations within the application GUI.
- Several USAF organizations have, to date, attempted to develop their own “common names” for CIP map layers. There has been duplication of effort and the results of these efforts are varied.
- To ensure standardization, interoperability between USAF organizations, and compliance with SDSFIE, a single naming standard for USAF GeoBase CIP layers should be developed.
- Attendees request that HAF GIO issue guidance on a standard for geospatial layer/file names for use at all USAF installations.
- HAF GIO has provided interim guidance to AFSOC and AFCEE regarding standard names, in Dec 01. Formal guidance will be issued in spring 2002 pending further research and collaboration with the CADD/GIS Technology Center.
- Attendees suggested use of the SDSFIE *entity type name* when presenting CIP layers to users in GeoBase applications. However, the physical files themselves should continue to use the 8-letter SDS naming convention (unless using the SDS geodatabase).

USAF-Requested Changes to the SDSFIE

- A process must be established for the USAF to request additions and modifications to the SDSFIE.
 - This process will be established by the HAF GIO.
- The process will likely require that requests for additions to the SDSFIE be made by USAF organizations to the HAF GIO, and the HAF GIO will submit formal requests to the CADD/GIS Technology Center on a regular (annual? bi-annual? quarterly?) basis.
- HAF GIO will first research availability of viable alternatives in the existing SDSFIE standard prior to submitting requests with the CADD/GIS Technology Center.
- HAF GIO will determine whether or not requests made by USAF organizations are installation- or application-specific and will consider whether the request can serve a larger number of users within the GeoBase community.
- The SDSFIE accommodates most USAF mapping needs, and where it does not, many of the new features that the USAF is likely to request are likely being requested simultaneously by other sister services or other SDSFIE users.

Adding/Removing Fields from SDSFIE Tables

- SDSFIE standards and guidance allow users to add additional fields to geospatial attribute tables, as necessary. However, these fields will be added at the end (far-right) of each table.
- USAF organizations will not remove unused SDSFIE attribute fields from geospatial attribute tables. Instead, these fields will be hidden when the table is accessed from a GeoBase application or GeoBase-enabled system.

- Adhering to these rules will enable USAF installations to use the SDSFIE Generators and Update tools as new versions of the SDSFIE are released by the CADD/GIS Technology Center.

Data Formats

GeoBase CIP Data Formats

- Existing data formats in use throughout the USAF GeoBase community will be identified as part of the 1Q FY02 GeoBase Inventory to be administered by HAF GIO.
- The HAF GIO is not dictating a single technical solution at this time. Therefore MAJCOMs and installations may choose their own data format solution as long as the they retain the capability to easily share data with other organizations and users.
- It was recognized by workshop attendees that most GIS investments to date in the USAF are ESRI-based.
- Should the USAF GeoBase community adopt the SDS geodatabase?
 - Yes, but not necessarily at IOC; the SDS geodatabase is still being developed, and installations do not yet retain the resources to maintain and tune a geodatabase.
 - Would adoption of the geodatabase be an adoption of a proprietary (ESRI-only) technology? If so, how would interoperability requirements (i.e., access of those data by non-ESRI solutions) be met?
- Should the USAF GeoBase community adopt Oracle Spatial as a fundamental component of the GeoBase architecture?
- Primary value propositions of Oracle Spatial include:
 - Provides an open data storage format facilitating data sharing and interoperability between numerous GIS software platforms. The upcoming FY02 GeoBase Inventory will indicate whether or not this interoperability need exists across the USAF.
 - Provides data replication/roll-up capability. This would prove valuable for those mission systems requiring data roll-up capability (IDW, CIPS, potentially the OSD Base Information System – BIS).
 - Provides capability to query spatial data without the map (i.e., evaluate spatial properties and relationships using standard SQL constructs). HAF GIO → We don't yet know enough about integration needs to know whether this capability is required. Or desired... Upcoming efforts to define requirements to integrate USAF mission systems with the GeoBase will help answer this question.
- Several USAF installations (Eglin AFB for one) and mission systems (CIPS) are currently benchmarking Oracle Spatial.

Modeling and Implementing Spatial Integrity Constraints

- The SDS geodatabase being developed by the CADD/GIS Technology Center will likely include spatial integrity constraints between objects (layers) in the database. These are not yet implemented in the current version of the SDS geodatabase.
- For non-object oriented data formats (coverages, shapefiles, SDE simple features), spatial integrity must be applied at the application level (i.e., QA/QC and integrity constraint checks must be developed in the installations' GIS maintenance software solution and custom applications).
- Advantage of modeling spatial integrity constraints in the database rather than at the application level:
 - Database-based integrity constraints can be leveraged by numerous applications.
 - Thinner client-side solutions.
 - Less software customization required.
 - Database-based integrity constraints leverage standard RDBMS business rules and database constructs.
- HAF GIO should benchmark use of Oracle (with and without Oracle Spatial and Oracle Workflow) as a potential repository of spatial integrity constraints that can be used by a variety of geospatial products (including but not limited to ESRI, Intergraph, Bentley, and MapInfo).
 - AF/CIO → Comes back to the issue of “systems of record”; who is ultimately responsible for maintenance of data? These spatial integrity constraints are only relevant on data that are maintained primarily in GeoBase (i.e., data for which GeoBase is the system of record).

Systems Integration

Storage of Attributes (Mission Information) in Spatial vs. Non-Spatial Tables

- The GeoBase CIP feature attribute tables should store a minimal amount of attribute data:
 - Primary and foreign keys to facilitate integration with other mission system databases (SDSFIE attributes including DATALINK, MAP_ID, BUILDING_ID in the case of buildings, etc.).
 - Installation IDs to distinguish features between different installations (this will be critical in systems that reference geospatial data for multiple installations simultaneously – such as IDW).
 - Any attributes that are not formally stored in other databases (e.g., street names, speed limits for streets at an installation).
- All other attributes should be stored in related non-spatial mission systems, and these data will be made available on the map via integration with those systems.

- Several attendees requested that HAF GIO better define attributes to be stored in the IOC CIP. HAF GIO response → We will defer this level of detail to the next revision of the CONOPS in mid-2002.
- Data storage redundancy should be minimized; i.e., attributes from non-spatial databases should not be copied to spatial attribute tables in the CIP for convenience or other purpose, unless specifically warranted by a particular mission need.
- The issue of where (in what systems) data are stored bears direct and significant relevance on the issue of data ownership.
- AF/CIO → Is GeoBase considered the “system of record” for any particular set of mission data?
 - HAF GIO should lead a USAF-wide effort to define the set of data for which GeoBase will be the “system of record” (i.e., which data reside only – or primarily – in GeoBase).
 - Will this require close coordination with the MAJCOMs and USAF functional communities.

Integrating Mission System Data with the GeoBase CIP

- Some mission systems represent “key” integration data fields differently. For instance, ACES-RP represents installation identifier differently than how the SDSFIE stores installation ID.
 - Materialized views can be created in non-spatial mission systems, thereby facilitating easier integration with the CIP.
- HAF GIO and IITA are currently addressing feasibility and requirements of integrating ACES-RP and Command Core (CCS) with the GeoBase service.
 - These efforts will also address where (in which system) data are stored, and who retains ownership responsibility for those data.
- The SDSFIE Browser contains logical data models for SDSFIE and FMSFIE. System integrators can use this resource when “mapping” integration between spatial and non-spatial databases.

Integration Requirements

- To better define the USAF GeoBase data architecture (i.e., does GeoBase require Oracle Spatial and similar products as part of the core architecture) → we need to define the requirements of various USAF mission systems (ACES, LOGCAT, Command Core, etc.) to access spatial data:
 - Do these systems require a map, or alternately
 - Do these systems require capability to perform spatial queries using SQL and report results in tabular form only?
- The former is desired by HAF GIO; this is a basic GeoBase foundation → to provide the command echelon with a map to enhance situational awareness.

- These requirements should be addressed on a system-by-system basis.

Metadata Management

- The USAF GeoBase community will capture and maintain metadata for the CIP using FGDC metadata standards.
- Should the USAF GeoBase community only capture the minimum required set of metadata, or capture additional metadata? → The minimal set of metadata to be collected for the GeoBase CIP should be defined by the HAF GIO.
- Do we capture metadata at the file-level (i.e., for a shapefile) or additionally, for individual features (objects, records) within a file?
 - Depends on the extent of variability within a given data set. E.g., if building features for a given CIP were derived 50% from a 2001 aerial photo and 50% from a 1995 CADD drawing, the level of variability warrants capturing metadata for each feature describing its source and limitations.
 - The SDSFIE “META_ID” field allows us to record metadata at the feature/object (“instance”) level.
 - The decision to record metadata at the feature/object level should be left to the installation and to MAJCOM GIOs.
- Viable metadata tools include, but are not limited to, ESRI ArcCatalog, USACE CorpsMet, and SMMS. However, USAF installations may use any metadata tool that generates metadata in an FGDC-compliant Z.94 format.

GeoBase Metadata Clearinghouses

- Executive Order 12906 requires federal data to be registered in the National Spatial Data Infrastructure (NSDI).
- However, DoD and the USAF have obtained a waiver for this requirement, citing releasability, distribution, and security issues. GeoBase CIPs therefore will not be registered with the NSDI.
 - How will recent homeland defense initiatives affect this issue? → The need for the USAF to share maps of its installations with a wider audience in support of homeland defense will be better defined in the coming months.
- MAJCOM GIOs require metadata browsing capability – to access metadata on CIP data for their installations. This metadata browsing capability would be provided in lieu of keeping copies of installation CIP data at the MAJCOM.
- Should the MAJCOM require installation data:
 - MAJCOM staff would first browse existing data using the metadata library tools deployed at the MAJCOM.
 - The MAJCOM would then acquire copies of necessary data (in one of several fashions).

- A process must therefore be established for installations to post their CIP metadata to the metadata libraries at the MAJCOM.
- The USAF should develop a single metadata browser tool set and then distribute that toolset to all MAJCOMs. The HAF GIO should lead the effort to develop this capability.
 - USAFA is currently developing a metadata library and browser for its use. The HAF GIO will benchmark and evaluate this product for use across the USAF GeoBase community.

Data Deployment and Maintenance

Location of CIP Data Store / Server Consolidation

- Workshop attendees agreed that the garrison CIP should be served from the Base Network Control Center (NCC) on the NIPRNet, with SIPRNet access capability in Civil Engineering Readiness (CEX) and the Command Post.
- Attendees agreed that in the short- to mid-term, GeoBase deployment does not need to consider server consolidation efforts:
 - AF/CIO → The first issue to be addressed AF-wide is co-location of servers in the same building (NCC?) at the base.
 - EMAIL servers will be the first to be consolidated.
 - Application server consolidation is not planned for several years due to current bandwidth constraints, among other issues.
- Excessed servers: can they be adopted and used to serve GeoBase? Not likely as the AF is excessing older, obsolete, and less powerful servers. GeoBase data and computing requirements warrant state-of-the-art, more powerful servers. Therefore, should dedicated servers be required to provide the GeoBase service, these will likely need to be purchased by the GIO.
- Attendees expressed concern regarding serving GeoBase CIP data from an off-site (at the MAJCOM or at a megacenter) to the base:
 - Bandwidth constraints.
 - Observed performance of ACES (which is served from a single server at Gunter Annex, AL).
 - HAF GIO insistence that GeoBase is a “installation capability” and should therefore reside primarily at the installation.
- There must be formal cooperation and agreement between base GIO and SC community to:
 - Ensure GeoBase can be served on the base communications infrastructure
 - GeoBase can reside on (a) existing servers, or alternately (b) reside on dedicated servers owned by the GIO yet maintained by SC.
 - The GeoBase community should retain the right to administer GeoBase data and applications residing on servers in the NCC.

- ACC and PACAF have both established service-level agreements (SLAs) with their respective SC to define GeoBase hardware, software, and communications infrastructure administration responsibilities.
- ACC and PACAF SLA defines:
 - GeoBase databases and software reside on available servers in NCC.
 - The MAJCOM GIO is responsible for remote (from outside NCC) maintenance and upkeep of CIP data and GeoBase software.
 - Amount of disk space required to support GeoBase:
 - PACAF → specified 50gb for each server at each installation
 - ACC → requested 500gb command-wide from its SC community
- PACAF: Remote administration of GeoBase infrastructure residing in the NCC seems to be working very well to date.
- Currently, AFSPC is one MAJCOM considering implementing GeoBase services for its installations at the MAJCOM level. It is basing it's deployment architecture on AFRC efforts to date.
- Unlike garrison GeoBase, GeoReach requires dedicated servers due to:
 - Significant amounts of data associated with GeoReach.
 - Specific mapping and analysis applications and resulting system configurations.
 - Need to reside on SIPRnet.
 - Unique organizational and procedural requirements to support GeoReach.

Serving GeoBase on the NIPRNet and SIPRNet

- As per the USAF GeoBase CONOPS, the garrison GeoBase CIP should be served via "secure means" on the NIPRNet behind the base firewall.
- The MAJCOMs are requesting guidance from HAF GIO on exactly how this security will be ensured.
- The PACAF CIO has endorsed serving the CIP on the NIPRNet, however, DO has not, citing potential terrorism security risks.

Data Access and Security

- Workshop attendees agreed that data access and security is a critical issue and has not yet been adequately addressed.
- Two primary issues were identified, as suggested by the AF/CIO:
 - Identity management
 - Data content and access management
 - Both of these issues should be addressed by HAF GIO in collaboration with the AF/CIO.
- Access to CIP data could be controlled (procedurally) via the CIP "Level" concept applied by PACAF.

- The AF/CIO is looking very closely at the issue of “identity management”. AF/CIO vision is a single sign-on that would control access to all systems to which users have been granted permissions. Should GeoBase be fielded on the AF Portal, it could take advantage of this access protocol.
 - However, this vision is still some time off; in the meantime, the AF/CIO is looking at a “reduced” sign-on approach, where the number of required sign-ons is minimized through the AF Portal.

CIP Data Access and Permissions

- HAF GIO should investigate the concept of “levels” to define access to CIP data. In PACAF, common base map layers would be classified as Level 1 and would be served to the entire organization. Additional data layers, more specialized or sensitive in nature (such as installation restoration program (IRP) sites or security sensors, respectively), would be assigned higher CIP levels (II, III, IV). These CIP levels would govern the extent to which these data could be accessed by the organization.
- PACAF will provide more information on CIP Levels, which will be considered by HAF GIO for AF-wide applicability. Elements of PACAF’s approach will be posted on <http://www.geobase.org> shortly for consideration.

GeoBase Data Sensitivity and Classification Status

- Attendees agreed on the need for a GeoBase Classification Guide to define CIP data sensitivity and the conditions and mechanisms by which CIP data will be classified and de-classified. This classification guide should address (among other issues):
 - Risk assessment and threat assessment of releasing CIP data to wide audience.
 - Which CIP data layers are most sensitive.
 - How does the combination or aggregation of individual CIP features on a map (or GeoBase-enabled application) affect sensitivity or classification status.
 - How sensitive data will be shared at A-76 installations.
- Attendees also agreed on the need to look for precedent set in other Federal agencies and sister services.
- Several attendees felt it should be left to the installation to determine which CIP features are considered sensitive.
- PACAF noted that there are elements of the USAF organization that have already stated their belief that all CIP data are sensitive and should therefore be served only on the SIPRNet.

Data Ownership and Maintenance

- This issue is directly related to the discussion on Systems Integration. Specifically, the issue of which system (GeoBase or related mission systems) attribute data are stored within bears direct relevant to the data ownership issue.

- The USAF GeoBase community should define the set of attributes for which GeoBase will be the “system of record” (i.e., those attributes reside primarily in the GeoBase CIP, and for which the GeoBase community is responsible for maintaining).
 - We should also address the issue of “co-ownership” of certain CIP layers. For instance, SF, CE, and the Wing Commander require need information on street locations and related attributes (street length, street name, speed limits, etc.). Which of those organizations would retain responsibility to maintain that data layer and associated attributes? Do we need to define ownership down to the CIP layer or to individual attributes in CIP layer feature attribute tables (i.e., different functionals maintain different data in the same table)?
- A future GeoBase System Program Office (SPO) should collaborate closely with the ACES SPO to establish coordinated processes to acquire and maintain spatial data to support the ACES system.
 - The issue was identified of whether or not ACES-OPS will require complete asset inventories (of utility systems – water, sewer, etc. – and other AF assets) to facilitate work order management, preventative maintenance, etc.
 - The issue of who will capture these data, and how (spatially? Non-spatially? Both?) was identified.
- A formal agreement should be established between the HAF GIO and AF/CIO to establish a process by which the USAF GeoBase community can approach “owners” of AF MAIS to identify and address missing data, bad data, redundant data collection processes. The GeoBase community is in a unique position to identify these potential conflicts and issues as it’s product and service is essentially an integrating technology that touches and considers numerous AF mission systems.
- Several attendees pointed out that the more attributes that are stored in the CIP, the greater the resource requirements to maintain those data.
 - There was concern that currently there are significant funding and manpower constraints to maintain the GeoBase CIP.
 - The HAF GIO recognizes current resource constraints and envisions – and expects – that USAF organizations will acquire additional resources to maintain the GeoBase CIP and service.
- The AF Portal development team at AF/CIO have established “data stewards” at the MAJCOMs to attempt to determine and define data ownership issues for several MAIS. The HAF GIO should coordinate with the AF/CIO to extend this effort to GeoBase.
- PACAF has developed formal process models (using IDEFx notation) to document who owns geospatial data and how those data are currently updated. Additionally, new business processes are being established to define cross-functional collaboration on maintenance of the CIP at PACAF installations.
 - PACAF will provide this information to HAF GIO for its reference and consideration.

- MAJCOMs must have formally defined and chartered GIOs to facilitate these data ownership and maintenance issues.

Data Maintenance Resource and Skill-Set Requirements

- Several MAJCOM GeoBase POCs in attendance requested that HAF GIO provide guidance on manpower, skill-set, and funding requirements for a MAJCOM GIO.
- Should the GeoBase community:
 - Hire dedicated GIS application/database administrators, or
 - Partner with the SC community to leverage their administration capability and resources?
 - The former is desired, but the latter may be more viable given resource constraints.
 - *Both* approaches may be implemented, given the exact nature of GeoBase deployment at a MAJCOM or installation (i.e., GIO maintains GIS-specific applications and file-based data, and existing SC database administrators manage RDBMS-based geospatial data).
- Server consolidation may help alleviate manpower and resource needs for GeoBase administration ... should GeoBase be deployed at the MAJCOM or at a megacenter at some point in time.
- Attendees agreed it is generally easier to train a GIS specialist how to maintain an Oracle database than to teach a traditional database administrator how to maintain a GIS database.
- It was agreed that DBA skills will be critical for GeoBase administrators, as GIS and related technologies are becoming increasingly integrated with “traditional” relational database technologies.

6. Workshop Action Items

The following action items were identified by workshop attendees. These action items include near-term (1-2 months from workshop completion) action items, activities (tasks) not yet included in the HAF GIO GeoBase Strategic Plan, and elaboration to existing USAF GeoBase Strategic Plan tasks. Unless otherwise noted, the Office of Primary Responsibility (OPR) for these action items is the HAF GIO:

C4ISP/Architecture Development

1. Verify requirement for MAJCOM to prepare a C4ISP *in addition to* the HAF GIO submitting a USAF-wide GeoBase C4ISP.
2. Develop USAF GeoBase “precepts” guiding GeoBase architecture development. These foundations will guide all GeoBase implementation and sustainment efforts.

GeoBase Inventory

3. Review the AF/CIO System Compliance Database (SCD) for existing inventory and survey results relevant to the USAF GeoBase program. Doing so will enable the USAF to develop a more focused and relevant GeoBase inventory.
4. Register GeoBase in the SCD. This will facilitate action item (5) below, and is a necessary step in submitting a C4ISP.
5. Establish a process with the AF/CIO to upload GeoBase inventory results to the SCD.
6. PACAF to provide HAF GIO with its web-based inventory, for consideration when developing the USAF GeoBase inventory.

Security

7. Provide architectural and policy guidance on how to serve the CIP in a secure fashion on the NIPRNet.
8. Establish a GeoBase Classification Guide defining how the CIP and related GeoBase applications will be distributed and made available to users across the USAF organization. The Classification Guide should define how and when CIP data are considered sensitive and/or classified, and how and when CIP data can be de-classified for wider distribution.

CIP Definition

9. Evaluate concept of CIP “Levels” as per PACAF approach as a viable mechanism to define distribution and classification of GeoBase CIP data.
10. Establish and distribute access privileges and ownership responsibility for features in each CIP level.
11. Evaluate concept of serving “pre-defined” views (bundled combinations of CIP features) for different GeoBase applications and user groups, as per PACAF.
12. Develop comprehensive list of USAF-wide post-IOC CIP features; define what features should be included for each USAF GeoBase CIP at FOC.

1M Imagery Requirement

13. Determine which bases already have imagery at a resolution higher than 1 meter. This will be performed as part of the USAF GeoBase inventory.
14. Re-evaluate planned 1m imagery buy for all USAF installations; attendees felt funds are better spent on detailed mapping where installations already have high-resolution imagery 1m resolution or better.

CIP Registration and Coordinates

15. Investigate ability of leading mapping/GIS software to simultaneously represent data in two coordinate systems (UTM/WGS and local).

CADD to GIS Conversion

16. Provide formal guidance on CADD delivery and maintenance specifications to support conversion of CADD drawings to GIS for inclusion in the GeoBase CIP.
17. PACAF to provide its CADD specifications to HAF GIO for consideration and potential distribution to the USAF GeoBase community.

Data Collection/Acquisition Procedures

18. PACAF to provide the Spatial Data Standards (SDS) data dictionary for use on Trimble data loggers. HAF GIO will post this information on GeoBase.org for distribution to the USAF GeoBase community.

Data Content Standards

19. Provide a policy memorandum requiring use of SDSFIE for the USAF GeoBase.
20. Establish a formal process to request additions to the SDSFIE from CADD/GIS Technology Center.
21. Investigate and establish common names for SDSFIE layers for distribution and use by the USAF GeoBase community.
22. Determine data content and format requirements for GeoBase support of TBMCS and other C2 systems.
23. Coordinate and distribute information on the SDS Geodatabase from the CADD/GIS Technology Center and within other DoD services to the USAF GeoBase community.
24. Investigate requirements for integration between GeoBase and GCSS, TBMCS, and other C2 systems (including first investigating ACC, PACAF, and AFMC - Eglin AFB - efforts to date).

Metadata

25. Establish requirements for a metadata repository/browser to be deployed at the MAJCOM to query and access information on installation CIPs.

Organization and Staffing

26. Provide guidance (recommended manpower and skill set requirements) for MAJCOM GIO and installation GeoBase sustainment resources.

Training and Education

27. PACAF to provide its web-based, self-paced "Introduction to GeoBase and GIS" training course to HAF GIO for posting on GeoBase.org and distribution to the USAF GeoBase community.

Appendix A – GeoBase Data Architecture Workshop Meeting Agenda

HAF GIO GeoBase Strategic Plan tasks to which each agenda item is associated are shown in *(italics)*:

Wednesday 28 Nov 01

- 0830-0845 Welcome and Orientation
- 0845-0900 Introductions
- 0900-1000 Brief on HAF GIO Strategic Plan, CONOPS, IL IS data strategy, and Recent Activities
- 1000-1015 Group Review and Concurrence on Workshop Agenda Items
- 1015-1030 Break
- 1030-1130 Validate contents of the IOC CIP (*HAF GIO Strategic Plan Tasks 1.6.1 and 1.6.2*)
 - Vector data layers
 - Imagery formats (panchromatic, multispectral), spatial extent, and resolutions
 - Digital Elevation Models (DEMs)
 - Recommended mapping scales
- 1130-1200 Define contents of the FOC CIP (*Task 1.6.2*)
- 1200-1300 Lunch (provided)
- 1300-1330 Validate CIP Georeferencing Requirements (*Tasks 1.6.1, 1.6.2, and 1.6.3*)
 - Coordinate systems, projections, datums
 - Ground control (GCP) requirements
- 1330-1430 CIP Data Suppliers and Collection Methodologies (*Tasks 1.6.2 and 1.6.3*)
 - Recommended data collection procedures for garrison bases
 - Vector data
 - Imagery
 - Recommended data collection procedures for FOLs and expeditionary basing
 - Role of RED HORSE, Prime BEEF, and equivalent units
 - Vector data
 - Imagery
 - Identify data suppliers - NIMA, DoD Services, commercial data providers
- 1430-1445 Break
- 1445-1500 CIP Data Suppliers and Collection Methodologies (continued)
- 1500-1545 Define data quality assurance / quality control (QA/QC) standards and procedures (*Task 1.7.5*)
- 1545-1600 Review and Adjourn

Thursday 29 Nov 01

- 0800-0815 Administrivia and review
- 0815-0945 Data Content Standards for GeoBase Data (*Task 1.7.1 and 1.7.2*)
- NIMA Data Standards (DFAD, VPF, etc.)
 - Spatial Data Standards (SDSFIE)
 - Recent CADD/GIS Center Activities (object-oriented SDS data model, SDFSIE approved as ANSI standard - impact on GeoBase?)
 - Use of SDS Content Standards
 - SDS vs. USAF-Derived Naming Conventions
 - SDS entity sets, classes, types, attributes, domains - are they sufficient for USAF GeoBase
 - Data content standardization across USAF organizations
 - Alternatives (required and/or recommended) to the SDS
- 0945-1000 Break
- 1000-1130 Data Formats (*Tasks 1.7.1 and 1.7.2*)
- File-based - advantages and disadvantages
 - RDBMS/object oriented - advantages and disadvantages
 - Common data formats - experiences to date, pros, cons, impact on interoperability:
 - ESRI - coverage, shape, SDE, geodatabase (personal and multi-user/versioned)
 - Intergraph
 - AutoDesk
 - Oracle Spatial
 - Modeling business rules and integrity constraints
- 1130-1200 Systems Integration - Integrating the CIP with mission system data sets (*Tasks 2.1.3 and 2.2.1*)
- Define critical data integration issues
 - Establish definitions and recommend storage locations for spatial (CIP) and non-spatial (mission systems) attribute data
- 1200-1300 Lunch (provided)
- 1300-1330 Systems Integration (continued)
- 1330-1400 Metadata Management (*Task 1.7.4*)
- FGDC standards - fields required and recommended for GeoBase CIP data
 - Procedures to capture / update metadata - Who? When? Tools?
- 1400-1415 Break
- 1415-1515 Data Deployment and Maintenance (*Tasks 1.4.3, 1.6.3, and 1.7.3*)
- Location of CIP data store (MAJCOM vs. base level vs. megacenter? NCC)
 - Garrison GeoBase
 - GeoReach FOLs and expeditionary GeoBase
 - Data architecture impacts on secure communications protocols
 - Data ownership/stewardship issues - who should "own" process to update a given map layer
 - Data summary/roll-up capability
 - Relevant USAF AFI and policy guiding data ownership

- 1515-1600 Define initial outline of a USAF GeoBase Data Management Plan (*Task 1.7.3*)
1600-1615 Review and adjourn

Friday 30 Nov 01

- 0900-0930 Review proposed revisions to HAF GIO CONOPS (*Task 1.2.1*)
0930-1030 Draft and review outline and primary topics for GeoBase Data Architecture Recommendations Document (*Tasks 1.6.3 and 1.7.2*)
1030-1045 Break
1045-1115 Draft and review Data Architecture Document (continued)
1115-1145 Draft action items for further consideration by the GeoBase community
1145-1200 Workshop review and adjourn

Appendix B – Meeting Attendees

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