An Overview of AMSAT Opportunities for Communications Interoperability

A White Paper discussing interfacing the ACP Emergency Response Ground Station with the National Incident Management System

Introduction

The team working on the ground station segment of the 5 GHz uplink – 3 GHz downlink Eagle/Phase IV Advanced Communication Package have started to explore the possibility of adding a feature to support communications interoperability for emergency services. Support of the APCO P-25 protocol has been specifically mentioned although no actual user base has been defined. Understanding your customer's needs is a key to developing a successful product.

So, who is AMSAT's interoperability customer? The most common communications interoperability problem arises when multiple agencies are required to respond to an incident. Each responder may have different radio frequencies, digital vs. analog modulation, or limited ability to retune. At times, the geographic realities of the response environment impose additional constraints.

The standard model for most local, state, and federal emergency response is the Unified Command/ Incident Command System (UC/ICS). Modern emergency management includes pre-planning as many likely emergency and disaster scenarios as possible. Many times logistical support is enhanced when emergency responder's equipment is pre-positioned based on these pre-planned scenarios.

When an incident occurs, activating the responding agencies, the key participants are those included in the UC/ICS pre-planned scenarios and have taken part in training and drill situations. The ACP ground station offers a unique communications tool to enhance an Emergency Manager's capability to stay in touch with a diverse team operating as a segment of Incident Command System.

This paper will propose AMSAT uses the UC/ICS model for our first phase of requirements to define our ACP ground station as a communications interoperability solution. Our ACP ground station's capability needs to be introduced to the UC/ICS community and become a part of their disaster planning scenarios (1) as a means of securing the interest and support of launch funding sources in the new launch environment; and (2) gain acceptance by the responder community as a viable communications solution.

The assumption is that ACS based operation remains within the amateur radio service with a licensed control operator. Until the receipt of actual requirements from a government or funding group, we should not presume that the ACS will directly carry commercial or government radio traffic. This analysis is based on opportunities to inject an amateur radio operator into the national UC/ICS system.

AMSAT Faces a New Launch Environment

The newest generation of launch vehicles with improved lift capacity, along with changes in government policy allowing ridesharing by secondary payloads which are compatible with the primary mission, have brought about new opportunities to get AMSAT payloads into orbit. However, even in this launch environment these launch opportunities will not simply be given away. AMSAT has received ballpark quotes of $2M to $6M as our cost for rides to high-earth orbit or geosynchronous orbit.

In the case of the Intelsat rideshare opportunity for AMSAT's Phase IV Lite and Eagle missions we will need to find ways to fit in with the business case models of the primary company. AMSAT will need to cover certain costs of adding our payload to the launch and we need to make our own business case to secure this funding through grants.

AMSAT will need to generate a mission that excites potential funding sources. We have to justify our use of the resources beyond launching a platform that supports casual conversations by a group of hobbyists. A geosynchronous orbital slot will allow AMSAT an opportunity to offer a leap forward in amateur radio emergency communications capability. The Advanced Communications Package will be designed to be within reach of average amateur radio operators. The system design, based on adequate communication coverage with small dish antennas, will allow for a portable satellite radio system to be easily and quickly deployed to disaster areas.

For $6M who will we provide emergency communications for? Most municipalities have already spent considerable funds to ensure their local responders have communication capability within their jurisdictional boundaries. Amateur radio based systems will require licensed control operators for anyone using our systems. Clearly we cannot make a good business case by proposing the addition of a satellite link, staffed and controlled by "outsiders", to many local communication scenarios.

While almost all emergency response is initiated at a local level, if the emergency is large enough additional resources need to be added. Local response can initiate the Incident Command System (ICS) to bring additional resources to the emergency scene. The ICS is a well-known and standardized tool for most modern emergency response today.

It is usually at the point of introducing additional resources to an emergency response where local communication systems are discovered to be incompatible with the communication systems of the assisting agency or agencies. AMSAT's ACP should be considered as an opportunity to allow communications coordination between the well-known ICS functional blocks defined in the National Incident Management System (NIMS), regional response teams, and the unified command concept of major disaster response. The concept of the Incident Command System will be discussed in further detail below.

National Response Overview

Of the multitude of disaster scenarios likely to affect the civilian population most may be managed by the agencies participating in the National Response Team. This is an organization of sixteen federal agencies with emergency resources who are empowered via legislative authority to plan, coordinate, and participate in emergency response. These agencies are named in Table 1 of the Appendix.

The National Response Team

Natural disasters such as hurricanes, tornados, earthquakes, wildfires will require the resources of several local, state, and federal agencies. The Department of Homeland Security (DHS) and the Federal Emergency Management Agency (FEMA) have taken the lead in responding to these.

Expanding the scope beyond natural disasters, the U.S. National Response Team provides technical assistance, resources and coordination on preparedness, planning, response and recovery activities for emergencies involving hazardous substances, pollutants and contaminants, hazmat, oil, and weapons of mass destruction in natural and technological disasters and other environmental incidents of national significance.

The response system is flexible, allowing agencies best equipped to handle specific events to assume the lead. For example, a hurricane response may likely require more FEMA involvement than Department of State. At times geographic demarcation of the disaster area may require specific response of certain agencies or assets.

The major building blocks of the response system are pre-planned and rehearsed by the responsible agencies within their own jurisdictions and with the entire Response Team. These building blocks are defined by the Incident Command System. For AMSAT to provide an effective solution as a communications asset the associated pre-planning should include the capability of amateur radio operators equipped with the ACP link in the Incident Commander's toolbox.

The sections below will first provide an overview of the Incident Command System and then introduce AMSAT-capable solutions that excite our potential funding sources.

Incident Command System

 The Incident Command System allows for systematic, standardized on-scene management that adopts an integrated organizational structure growing to match the complexity and demands of any single incident or multiple incidents and is not hindered by jurisdictional boundaries.

The basic structure of an Incident Command System is shown in Figure 1. Each of the functional sections of the UC/ICS provides an opportunity to introduce an interoperability radio link. Additional radio links may be required within individual sections when they are composed of several teams or are geographically separated. The ICS is designed to telescope outward as resources are brought to bear and to telescope inward as the incident is resolved. Additional examples of interoperability opportunities are presented after the higher level description. As an extension of the ICS concept, an example of interoperability in a Unified Command structure is presented after the basic structure is discussed.
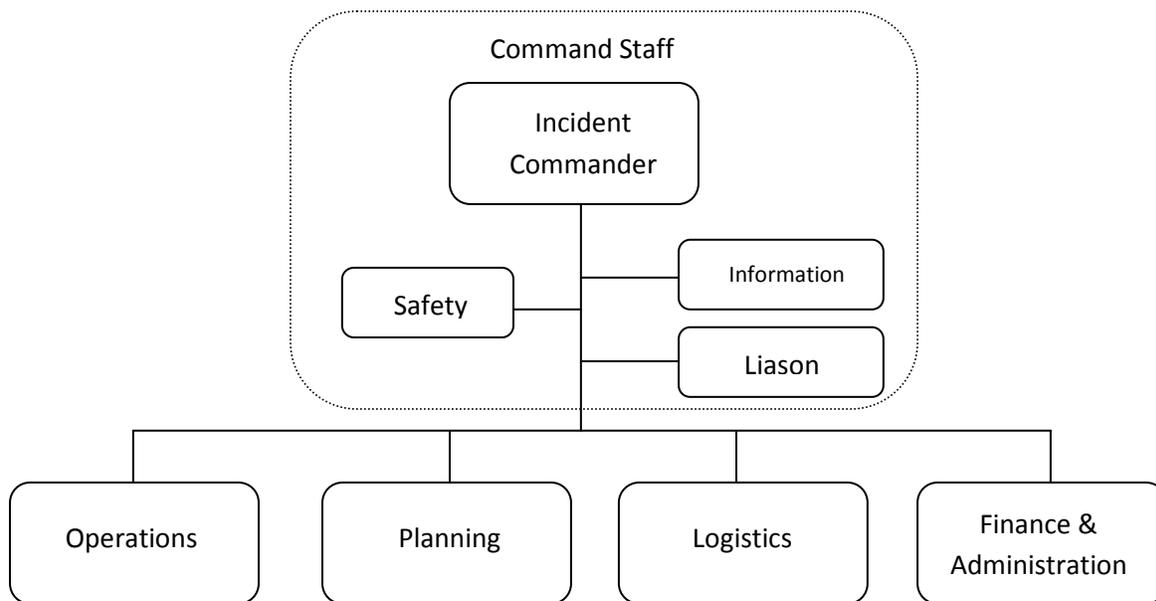
Figure 1: Basic Incident Command System Structure

Originally developed to manage rapidly moving wildfires, ICS was designed to address problems such as:

- Too many people reporting to one supervisor
- Different organizational structure for every responding agency
- Incompatible and inadequate communications
- Uncoordinated planning capability for multiple agencies

Many local and federal agencies have endorsed the use of ICS and several have mandated it use. Almost all emergency response is initiated at the local level when a problem is discovered. The ICS allows the scope of the response to telescope outward as additional resources are added. The emergency response maintains a manageable span of control by dividing the key tasks:

- **Command Operations Staff** – The Incident Commander is responsible for developing the incident objectives and managing all incident operations.
    - Information Section – the Information Officer's role is to develop and release information about the incident to the media.
    - Liaison Section – the Liaison Officer serves as the point of contact to coordinate activity between the Incident Command and groups such as law enforcement, Congress, etc.
    - Safety Section – the Safety Officer assures the health and safety of the responders and affected public population.
- **Operations Section** – responsible for all work directly applicable to the primary mission of emergency response. This section usually includes the firefighters, search and rescue teams, emergency medical system, law enforcement, etc.

- **Planning Section** – responsible for collecting, evaluating, and reporting the tactical information related to the incident, and for preparing and updating the Incident Action Plan.
- **Logistics Section** – responsible for providing facilities, services, and materials for the incident response. This section provides vehicles, staff, shelter, food and water, and manages the staging areas.
- **Finance and Administration Section** – responsible for all financial, administrative, and cost analysis of the incident.

Each of the operating sections may be co-located in a command post with the Incident Commander or may be located elsewhere in the field. Staffing of the sectors may be provided by a single agency or by several agencies. Inter-sector communications may be relatively simple in the co-located, single agency response.

Communications become more challenging when the Incident Commander needs to add more agencies to the incident team and to move operational components out to the field. The added agencies may not have compatible radios; remote sites will require a solid communications link back to the Incident Commander.

Figure 2 illustrates an interoperability opportunity between the Incident Commander and a remote Operations Sector. This example assumes that this response requires the Incident Commander to remain in a centralized location but the Operations Sector's work is spread over several miles.
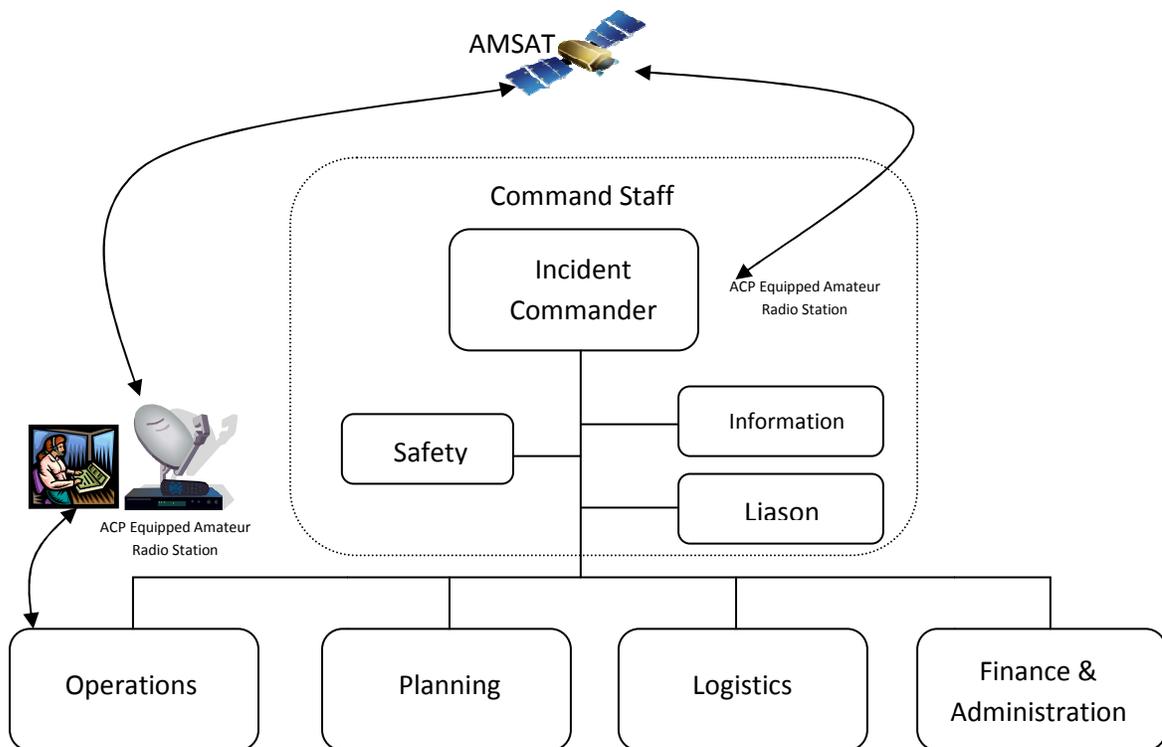

Figure 2: Communications support scenario – Incident Commander with remote Operations Sector

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Discussion of Interoperability Scenarios

This section provides examples where AMSAT can add value within the UC/ICS model. The Operations Sector will be expanded to include its likely teams; the Logistics Sector will be expanded to its likely teams. In addition to enhanced communications within a sector's span of operation, communication with the Incident Commander is maintained.

Operations Sector

The types of agencies that could be included in the Operations Section include fire, law enforcement, public health, public works, and emergency medical services, working together as a unit or in combinations depending on the situation. Many incidents may also involve private individuals, companies, or non-governmental organizations, some of which may be fully trained and qualified to participate as partners in the Operations Section.[1]

The Incident Commander and staff decide upon the best organization of the Operations Sector depending on the type of incident and their operating plan. The organizational layout of the Sector may depend upon geographic divisions; other times it may make sense to organize the Sector according to functional responsibilities.

Geographical division is driven according to natural separations of terrain such as mountains or rivers and also according to the distance separating cities or regional areas involved in the incident.

In the diagram at the right, communications problems due to the terrain or distance separating the teams can be overcome with the availability of an amateur radio operator equipped with an ACS ground station.

The ACS equipped amateur radio station may also assist the Operations Sector Chief to maintain communication with the Incident Commander via the satellite link in this organization.

Functional division can be used with areas of related activity such as:

- Fire Fighting
  - o Fire suppression
  - o Water Supply
- Law Enforcement
- Emergency Medical Services

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[1] NIMS-9.0, National Incident Management System, Department Homeland Security, March 1, 2004, pages 67-71.

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- o Search and rescue
- o Triage
- o Mass immunization
- o Associated Hospitals or treatment areas
- Shelter operations

In the diagram at the right, incompatible communications between the participating functional areas can be overcome with the availability of an amateur radio operator equipped with an ACS ground station.

The ACS equipped amateur radio station may also assist the Operations Sector Chief to maintain communication with the Incident Commander via the satellite link in this organization.
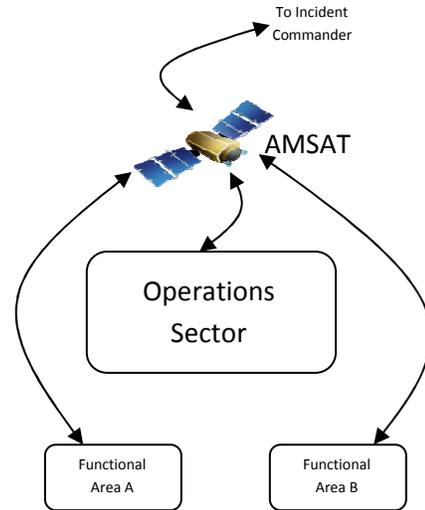
Logistics Sector

The Logistics Sector meets the support needs for the incident, including ordering resources. It provides services for:

- Food service
- Operating facilities
    - o Staging areas
- Transportation
- Fuel
- Maintenance
- Communications
- Medical Services
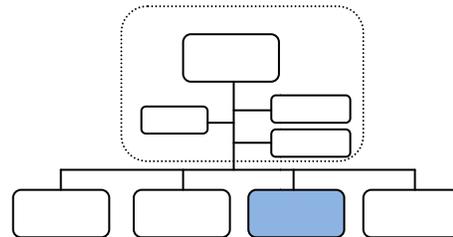
Effective communications depend upon a Communications Plan designed for multi-agency operation. This includes design of incident based communications centers, selection of equipment/frequency inventories/ frequency coordination, and pre-positioning inter-agency communication resources. Training for all sectors is required in advance of the incident.[2]

Incident communication plans generally establish radio networks organized as:

- **Command Net** – links together the incident commander with the command staff and section chiefs.
- **Tactical Net** – several networks may be organized to support the multiple functions or geographic areas of the Operation Sector.
- **Support Net** – tracks the status of resources and logistical response to handle resource requirements.
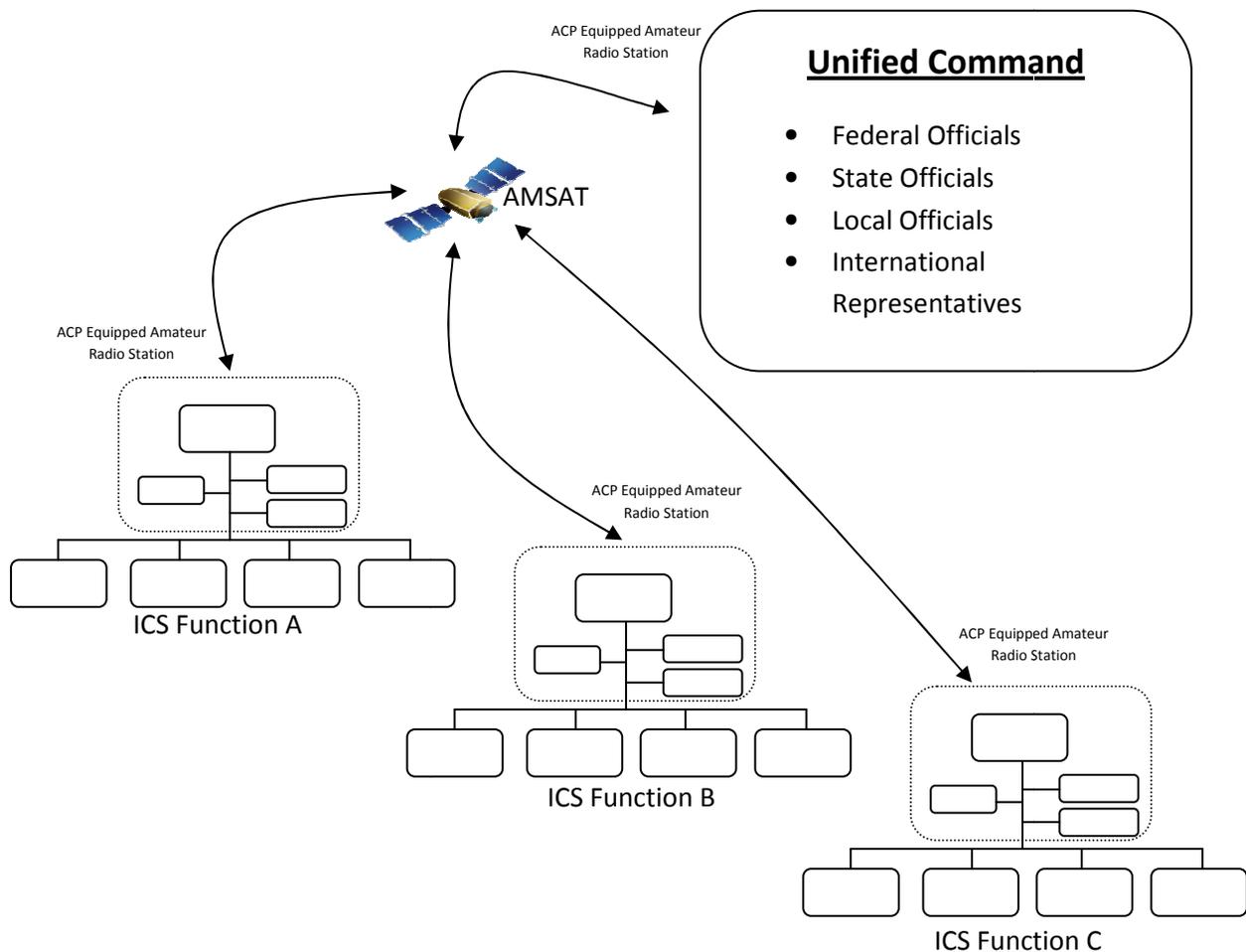
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[2] NIMS-9.0, National Incident Management System, Department Homeland Security, March 1, 2004, pages 81-85.

Operation in a Unified Command Environment

Although a single Incident Commander normally handles the command function, an ICS organization may be expanded into a Unified Command (UC). The UC is a structure that brings together the "Incident Commanders" of all major organizations involved in the incident in order to coordinate an effective response while at the same time carrying out their own jurisdictional responsibilities. The UC links the organizations responding to the incident and provides a forum for these entities to make consensus decisions. Under the UC, the various jurisdictions and/or agencies and non-government responders may blend together throughout the operation to create an integrated response team.

The UC may be used whenever multiple jurisdictions are involved in a response effort. These jurisdictions could be represented by:

- Geographic boundaries (e.g., two states, Indian Tribal Land)
- Governmental levels (e.g., local, state, federal)
- Functional responsibilities (e.g., fire fighting, oil spill, Emergency Medical Services (EMS));
- Statutory responsibilities

ACP Equipped Amateur
Radio Station

AMSAT

Unified Command

- Federal Officials
- State Officials
- Local Officials
- International Representatives

ACP Equipped Amateur
Radio Station

ICS Function A

ACP Equipped Amateur
Radio Station

ICS Function B

ACP Equipped Amateur
Radio Station

ICS Function C

International Response

The U.S. National Response Team has established planning for international coordination with Canada, Mexico, Canal Zone, and other international agencies:

- Canada
    - Canada-U.S. Joint Inland Pollution Contingency Plan, Annex III
    - Canadian Coast Guard
    - Environment Canada
    - Emergency Preparedness Information Exchange
    - Public Safety and Emergency Preparedness Canada
    - CANUTEC - Canadian Transport Emergency Centre of the DOT
    - Canadian/US Atlantic (CANUSLANT) Joint Response Team
- Mexico
    - U.S. Mexico Joint Contingency Plan (1999)
- Canal Zone
- Additional International Agencies
    - Organization for Economic Co-operation and Development (OECD)
    - Environmental Media Services (EMS)
    - United Nations Environment Programme
    - European Space Agency (ESA)
    - International Federation of Red Cross and Red Crescent Societies

The international coordination presents additional opportunities for AMSAT to offer ACS ground station equipment and amateur radio assistance. Some of these agencies may also be potential funding sources when the AMSAT's emergency communications capability is discussed with them.

Conclusion

The National Incident Management System and the Incident Command System provide AMSAT with the opportunity to offer communications interoperability between several responding agencies. Our satellite link may prove most useful and more interesting to Emergency Managers when offered in the context of international, national, regional response, and in multiple agency scenarios. A satellite link may offer little additional value to local tactical communications.

When AMSAT explores communication interoperability with interested agencies we should attempt to determine their respective participation in the Incident Command System so we can offer specific interface points; or, we can modify our plan to fit the new communications interoperability requirements revealed to us.

References

1. Incident Command System/Unified Command System (ICS/UC) Technical Assistance Document, The U.S. National Response Team, http://www.nrt.org.
2. NIMS-9.0, National Incident Management System, Department Homeland Security, March 1, 2004

Appendix

U.S. Environmental Protection Agency, Chair	U.S. Department of Justice
U.S. Coast Guard, Vice-Chair	U.S. Department of State
U.S. Department of Agriculture	U.S. Department of Labor
U.S. Department of Commerce	U.S. Department of the Treasury
U.S. Department of Defense	U.S. Federal Emergency Management Agency
U.S. Department of Energy	U.S. General Services Administration
U.S. Department of Health and Human Services	U.S. Nuclear Regulatory Commission
U.S. Department of the Interior	U.S. Department of Transportation

Table 1: U.S. National Response Team Member Agencies

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