



Advantages and Disadvantages of Open and Closed UTM Software

In the UTM section we discussed the difference between conceptual and technical UTM Systems. For more on conceptual UTM solutions please see the section on the separation of airspace. In this document we will focus on the technical solutions that can be categorized into two distinct groups:

- **Closed source UTM Systems:** Offered by for-profit companies with closed-source code, limiting user evaluation and modification. Revenue is generated through system sales, updates, service packages, and contracted software extensions.
- **Open Source UTM Systems:** Provided freely and offering accessible source code, allowing for transparency and user-driven modifications, enhancements, and bug fixes. However, proficiency in programming and software management is required.

The decision between adopting open or closed source software solutions for UTM systems involves several factors that vary based on the specific needs and circumstances of each CAA. This choice significantly impacts the direction and flexibility of the UTM system's development and maintenance.

On open source foundations while others rely on proprietary solutions from commercial vendors.

This flexibility can be particularly advantageous within the framework of the Wakanda Beyond initiative, where a collective of NAAs with aligned interests and challenges exists

Given the inherent modularity of UTM systems, there's also potential for a hybrid approach, where parts of the system are built.

While neither open source nor closed source solutions may perfectly meet a CAA's requirements out of the box, customization is a necessity in either scenario. The primary consideration then becomes whether an authority prefers to invest in internal development capabilities to enhance an open source solution or to contract a commercial entity to provide a closed source solution.

The decision between open and closed source, therefore, should align with achieving this overarching objective while considering the unique needs and capabilities of each authority within the collective framework.



Advantages of Open Source Systems	Advantages of Closed Source Systems
<ol style="list-style-type: none"> 1. Transparency and Security: You have full visibility into the source code, allowing you to verify its security, understand its functionality, and potentially customize it to better suit your needs. Having total ownership of the software also offers greater independence and security. 2. No dependency on one company If once a complex software packet is build the CAA is dependent on this manufacturer. Even if they change their business model and get more expensive, or the bug fixing is not fast enough - it is not easy to change the manufacturer due to high initial costs. If the company get bankrupt no one will be responsible for update, bug fixing and adding new modules by open source the consultants can be exchanged. 3. Cost: Generally, open source software is free to use, which can significantly reduce upfront costs compared to closed source alternatives. The cost to CAAs will be limited to customization and maintenance of the software. But there are costs for external experts to help to set up the software, for consultancy and training. 4. Flexibility: With access to the source code, you have the freedom to modify and extend the software to meet your specific requirements, without being dependent on a single vendor. You can have a range of different people support you with your programming needs. This makes it easy to switch if a vendor service or pricing is not satisfactory. 5. Innovation: Open source software tends to foster innovation by enabling collaboration and sharing of ideas among developers worldwide. 6. Capacity building: Opportunity for building capacity and in-country expertise. 	<ol style="list-style-type: none"> 1. Vendor Support: Closed source software typically comes with dedicated technical support from the vendor, which can provide timely assistance and troubleshooting. 2. Ease of Integration: Closed source solutions often come with comprehensive documentation and support for integration with other systems, making them easier to implement in complex environments. 3. Stability: Closed source software tends to undergo rigorous testing and quality assurance processes before release, which can result in greater stability and reliability. 4. Legal Protection: Closed source licenses typically come with legal protections and warranties, providing recourse in case of issues related to the software's performance or compliance. 5. User Interface: Tends to comes with a nicer interface and maybe easier to use



Disadvantages of Open Source Systems	Disadvantages of Closed Source Systems
<ol style="list-style-type: none"> 1. Time required: Initially more time may be required to set up and customize a solution. A well qualified team will be needed to assist with the setup and customization and train inhouse team on maintenance. Mostly external experts must be hired as consultants. 2. User interface: The user interface tends to be less visually appealing and needs to be improved. 3. Support: While there is often a community providing support, the quality and responsiveness of this support may vary. Dedicated technical support may be limited or require a separate paid service. This means there must be in-house expertise on the system. Or there are contracts with external open source experts to be made. 4. Integration: Depending on the complexity of your environment, integrating open source solutions with existing systems or proprietary software may require additional effort and expertise. 5. Documentation: Open source projects may initially lack comprehensive documentation, making it more challenging for users to understand and effectively utilize the software. 	<ol style="list-style-type: none"> 1. Cost: Closed source software usually involves licensing fees, which can represent a significant upfront or ongoing expense. Solutions can easily cost over 1 million USD and include hundreds of thousands in yearly service contracts. 2. Vendor Lock-In: Dependence on a single vendor for support and updates may lead to vendor lock-in, limiting your ability to switch to alternative solutions in the future. This is exacerbated by the high set-up costs. 3. Vulnerability to vendor business model: The CAAs is vulnerable to changes in the business model of the company for example price hikes or products being discontinued or closure of the business. In the latter case there will be no expertise to fix bugs and provide further development 4. Track record: As UTM is quite a new field, there is not much experience and there is barely a commercial system available at the moment (March 2024) which fulfills all the advanced requirements and has been proven to run stable for 5 years. This creates more uncertainty when selecting a closed vendor as you will work with them over a long period of time. 5. Lack of Customization: Without access to the source code, customization options are limited, and you may be reliant on the vendor to implement specific features or modifications. Innovation Dependency: Closed source software development is controlled by the vendor, potentially leading to slower innovation compared to open source alternatives driven by collaborative communities. 6. National Security: Closed source, backdoors can be implemented which can compromise national security.