

Federated Deployment Control Protocol

State of the Art

The Federation Deployment Control Protocol (FeDeCoP) aims to manage the formation, maintenance, and dissolution of federations. As satellite networks become more complex and resource management grows increasingly critical, FeDeCoP provides a structured approach to leverage unused satellite resources through collaboration between satellites.

FeDeCoP is a protocol that addresses the technological gap left by the OSADP. While OSADP handles the publication of available services across satellite networks, it does not manage the subsequent steps required to establish a federation. FeDeCoP defines a set of directives that rule the establishment of federations, ensuring a reliable and consistent process.

The protocol operates as a connection-oriented protocol, built upon TCP. It is essential for maintaining the high reliability required for the transactions involved in satellite resource management. The protocol's operation can be divided into three distinct phases: (1) Negotiation, (2) Consumption, and (3) Closure. Figure 1 illustrates the state diagram of the protocol, with its phases and transactions.

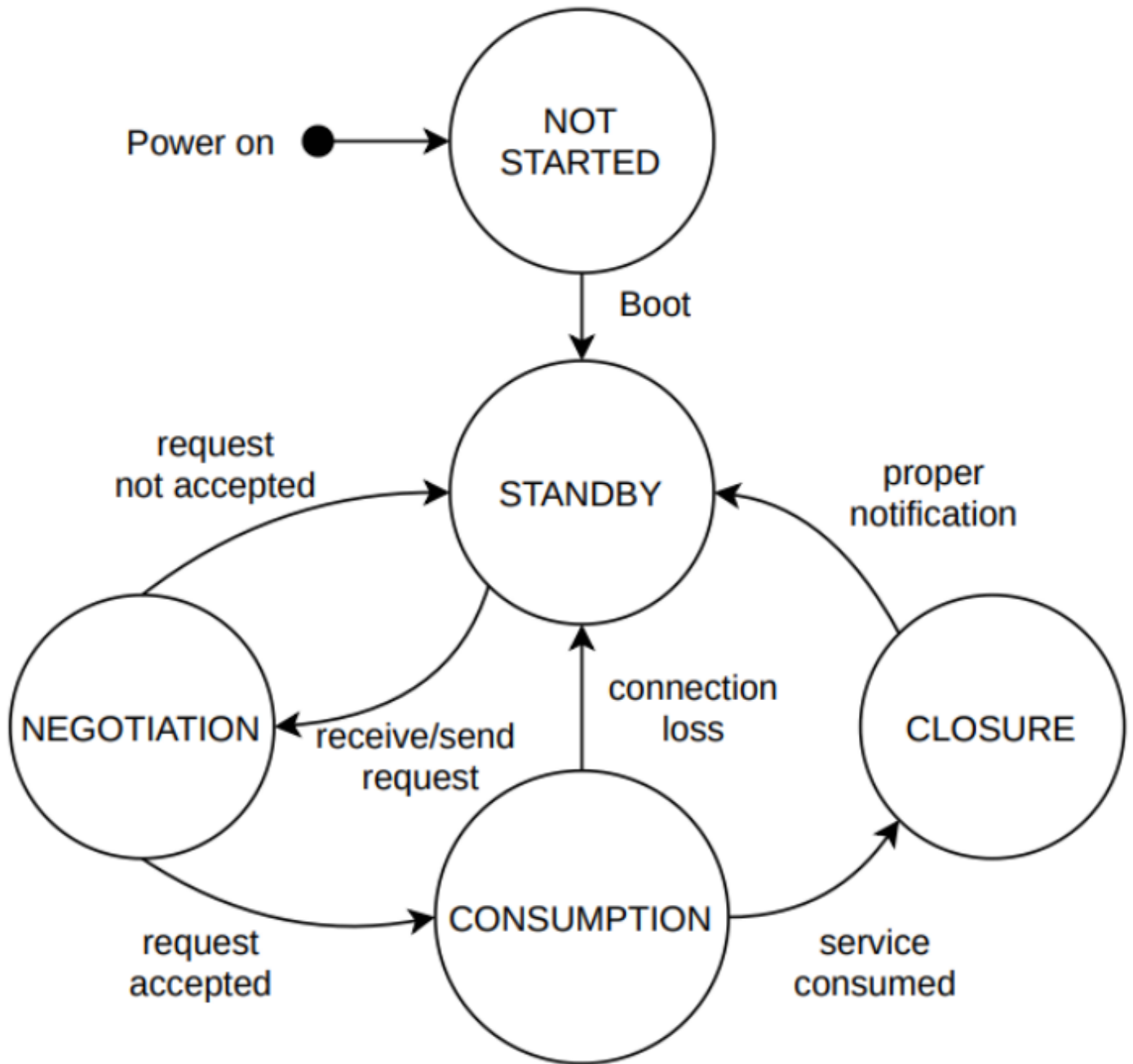


Figure 2: FeDeCoP State diagram. Reproduced from [1].

Negotiation Phase: The negotiation phase is initiated when a satellite requests a service that has been previously published by another satellite in the network. Upon receiving a publication, the interested satellite (customer) sends a request to the service-providing satellite (provider). This request includes critical information such as the type and quantity of the resource required, which is then evaluated by the provider. If the provider can meet the requested conditions, it responds with an acceptance packet, finalizing the negotiation. This phase when the terms of the federation are established. The exchange of packets during this process follows a three-way handshake, ensuring the reliability of the connection. The packets exchanged are the request and acceptance.

Consumption Phase: Once the negotiation is successfully completed, the protocol transitions to the consumption phase. This phase governs the current use of the resources agreed upon during the negotiation. The behaviour of this phase is the following: The costumer send a data packet to the provider. Once the provider manages correctly the packet (depending on the service), it replies

to the costumer with an acknowledgement packet. In other words, the transmission mechanism follows a stop-and-wait Automatic Repeat Request (ARQ) procedure. Despite not optimizing the communications, it ensures the reliability of the data transmission.

Closure Phase: The closure phase marks the end of the federation, triggered when the resources are fully consumed or are no longer available. This phase involves a three-way handshake similar to the one used during the negotiation phase, ensuring that all parties involved in the federation acknowledge the termination. To do so, they exchange close and acknowledgement packets. The closure process is critical for releasing resources and resetting the system to its initial state, ready for future federation opportunities. Overall, the FeDeCoP protocol plays a crucial role in enhancing the efficiency and effectiveness of satellite networks by enabling dynamic federations. Through its structured phases—Negotiation, Consumption, and Closure—it ensures that resources are allocated, utilized, and released in a controlled and reliable manner.

References

[1] Joan A. Ruiz-de Azua, Nicola Garzaniti, Alessandro Golkar, Anna Calveras, and Adriano Camps. Towards federated satellite systems and internet of satellites: The federation deployment control protocol. *Remote Sensing*, 13(5), 2021.

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