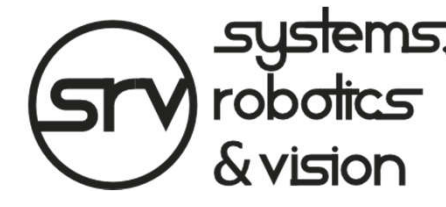


# First Analysis of the AVB's Stream Reservation Protocol in the Context of TSN

## Abstract

The Audio Video Bridging (AVB) Task Group from the IEEE proposed a series of standards to provide **Ethernet** with **soft real-time guarantees**. Later on, the group was renamed to Time-Sensitive Networking (TSN) and its scope was broadened to provide new services to more **critical applications**. The Stream Reservation Protocol (SRP) stands out among the projects developed by the groups, as it is key to **bound the transmission delay** and to **minimize frame loss** due to **lack of resources**. Nonetheless, SRP was originally designed for audio/video applications and does not take into account properties that are important for critical systems; such as termination or consistency. In this work we study the **termination and consistency** of the reservations using **AVB's SRP**. We used **UPPAAL** to model the protocol and to **verify the properties**. We see that SRP does neither provide termination nor consistency, we discuss how the lack of this properties can impact critical applications and we propose a series of solutions.



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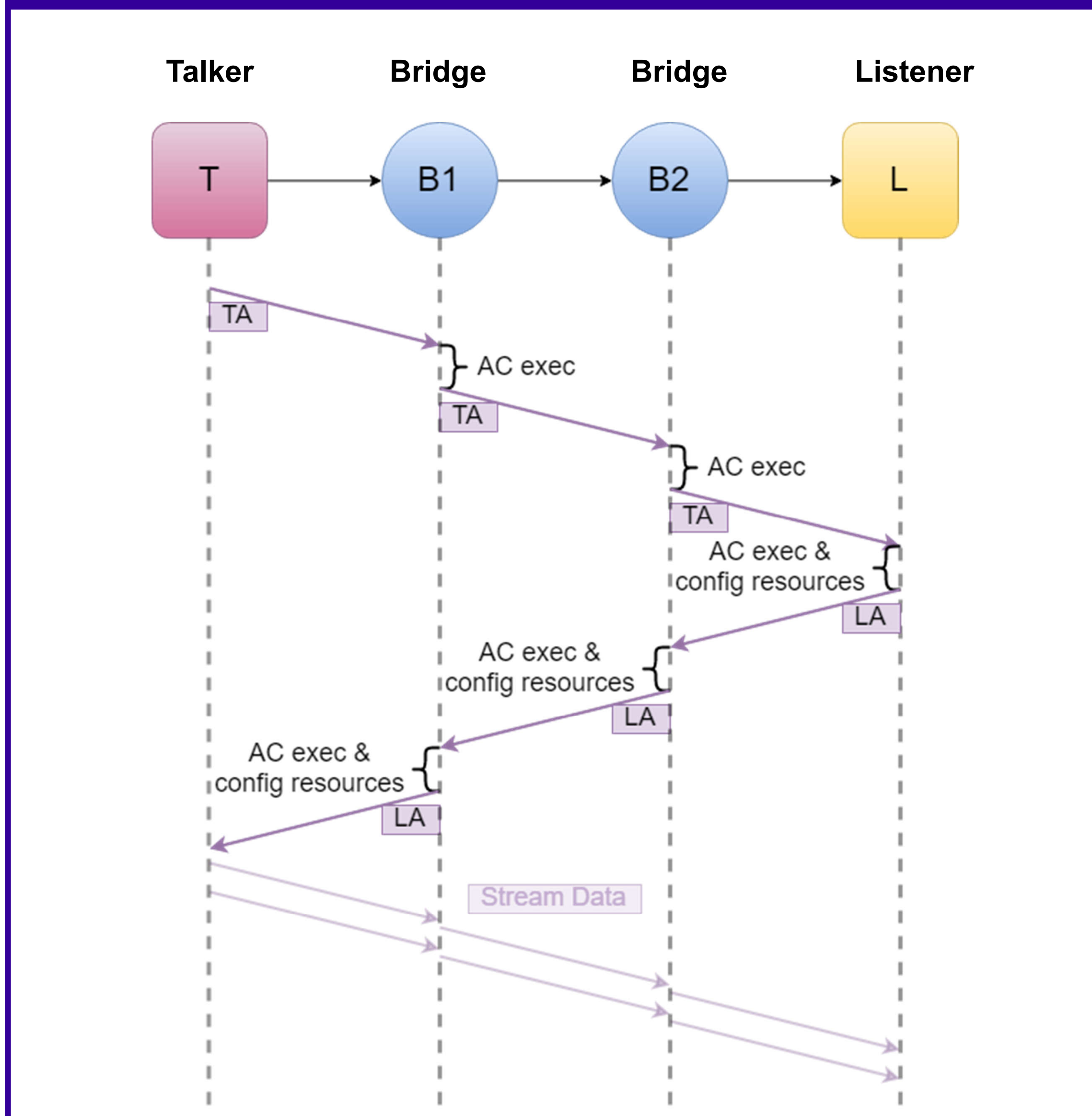
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## 1. SRP Overview

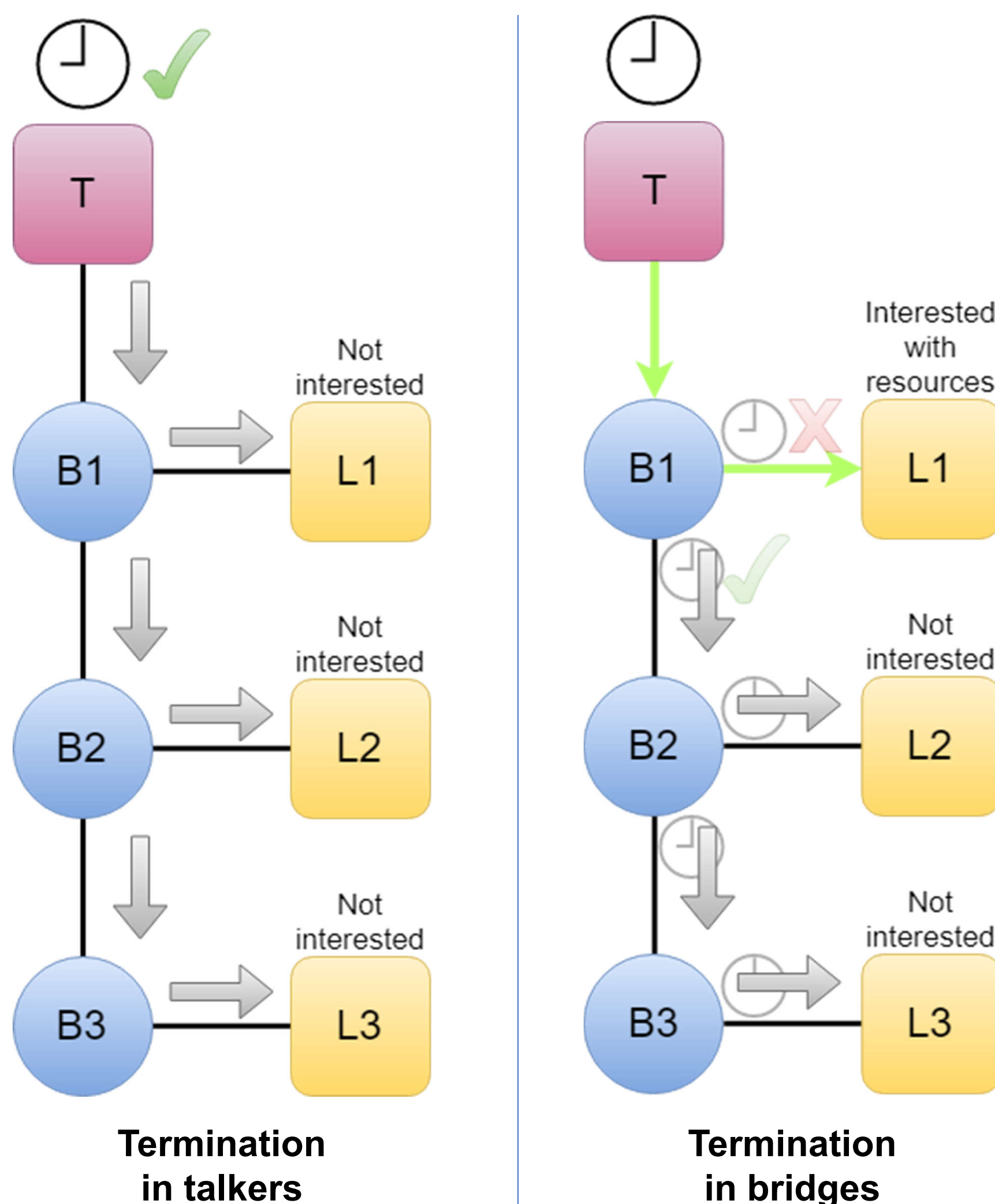


## 2. Termination Issues

**Type of issue:** Listeners not interested in the stream do **not respond** to the TA and this can cause a **termination issue** in **bridges** and in the **talker**.

### Solutions:

- Termination in talkers:** Use timeouts in talkers that are large enough to guarantee that the response of all interested listeners could reach the talker. When the timer expires the talker knows that there are not interested listeners so it can delete the stream using mechanisms already present in the SRP.
- Termination in bridges:** Use timeouts in every port of the bridges that are large enough to guarantee that the response of all interested listeners could reach the bridge. The timers must be configured to guarantee that the timer in the bridge nearest to the talker is the first to expire and we would introduce the mechanism to delete the stream also in bridges in order to delete it in the whole path.

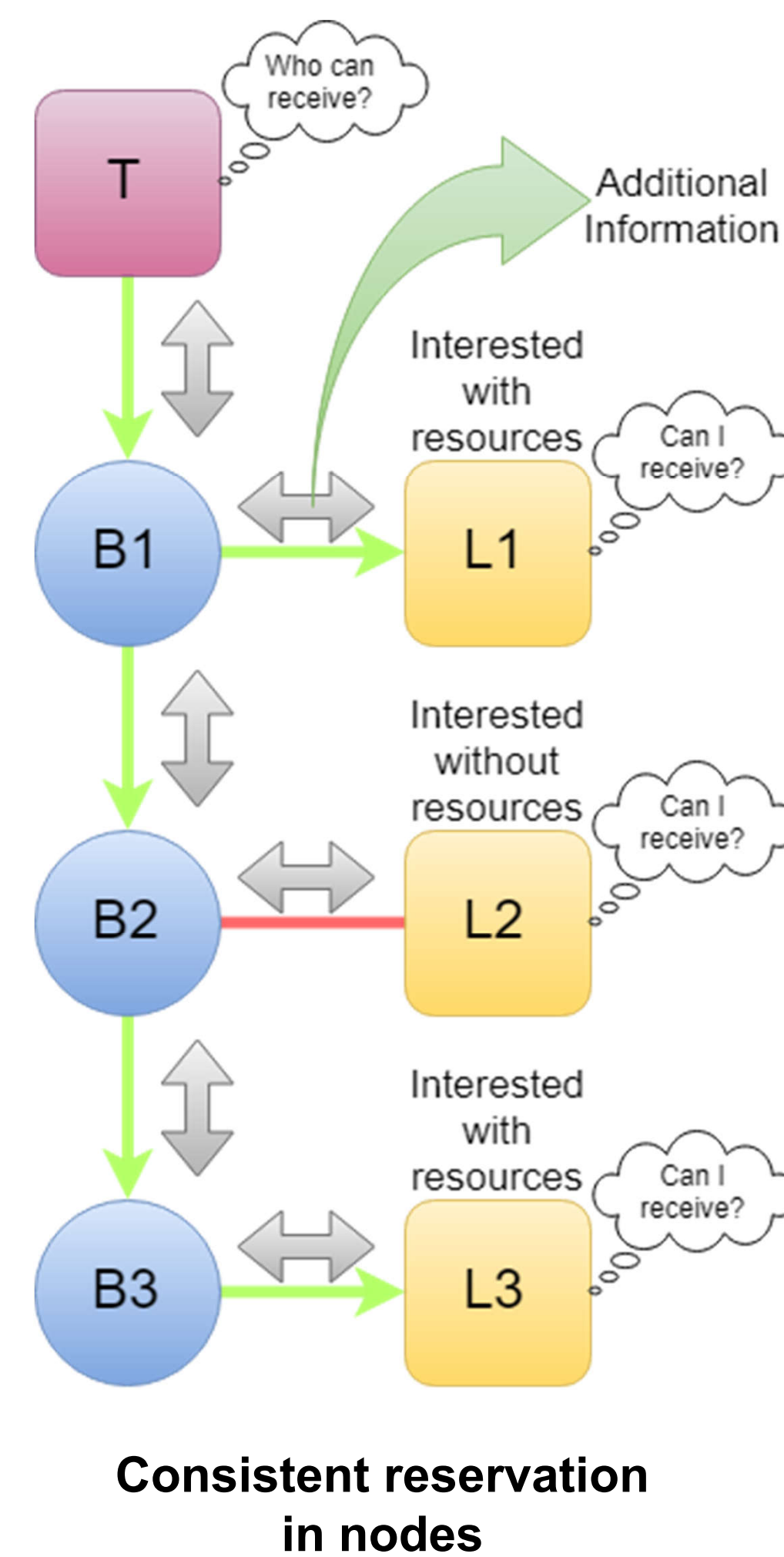


## 3. Consistency Issues

**Type of issue:** **Unidirectionality** of the transmission of the decisions is the **main cause of inconsistency**.

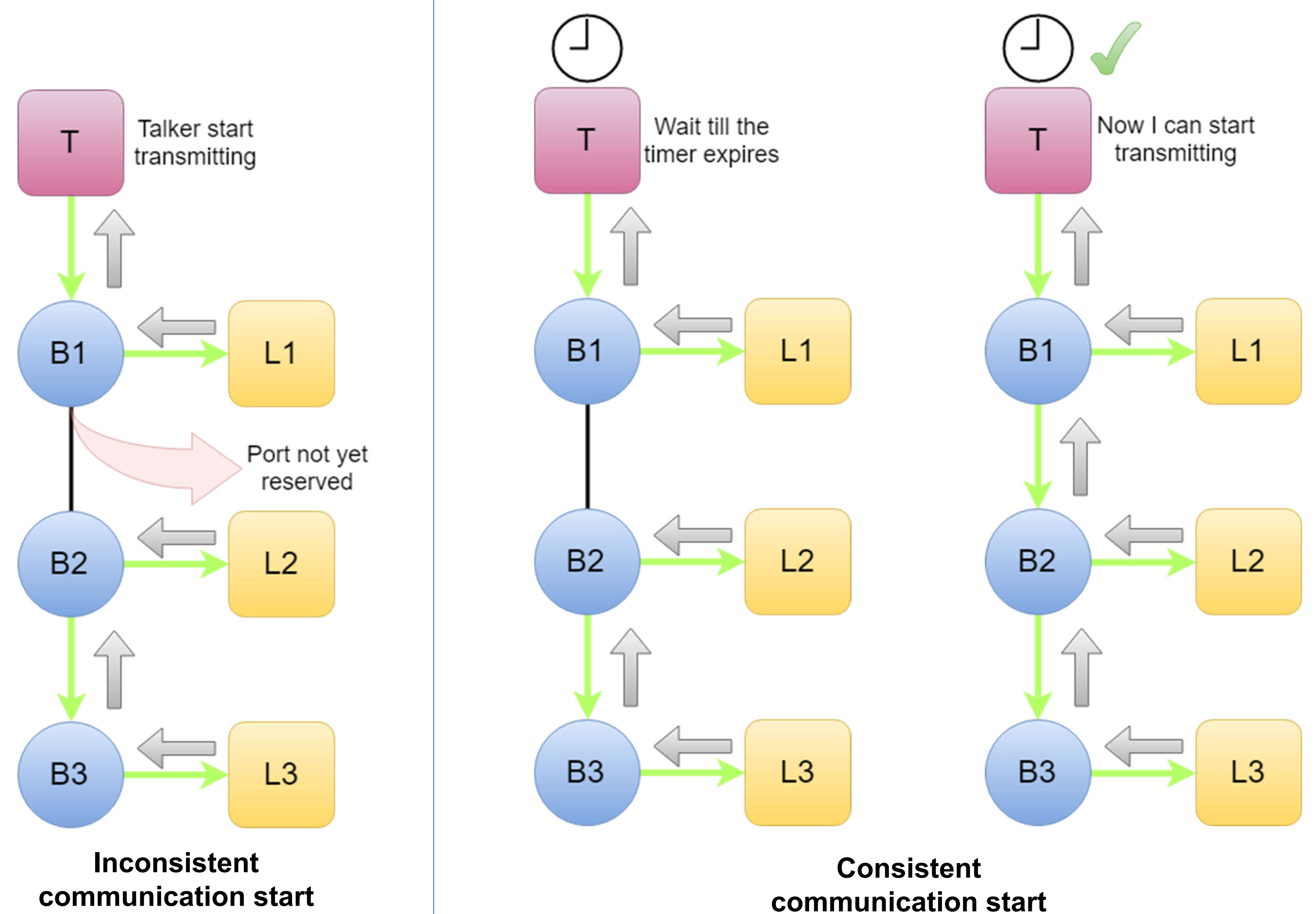
### Solutions:

- Consistent reservation in nodes:** Exchange of information so talker can know who can receive and listeners can know if they can receive.
- Consistent reservation in bridges:** Bidirectional transmission of the decisions.



**Type of issue:** Any **talker** can **start transmitting** frames through a stream **before** it receives the **response** from **all listeners**. This can happen, as the paths between a talker and different listeners may differ in length and end-to-end delay. Therefore, a **listener** willing to bind to the stream, with enough resources throughout the whole path towards the talker, **may miss the first frames transmitted by the talker**. This would lead to a lack of consistency in the input of the listeners, which could be a problem if they have to carry out coordinated actions.

**Solution:** Use timeouts in talkers that are large enough to guarantee that the response of all interested listeners could reach the talker. When the timer expires the talker knows that all listener responses had enough time to have been received so it can start transmitting.



## 4. Conclusions

We demonstrated that **SRP** does not provide **termination nor consistency**.

## 5. Future Work

We have designed some **possible solutions** and in the future we will implement them in the **model checker** to validate them.