Evolutionary-Statistical System with Island Model for Forest Fire Spread Prediction

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Cómputo Paralelo/Distribuido

Consejo Nacional de Investigaciones
Científicas y Técnicas

Universidad Nacional de
Río Cuarto

Organization

1. Introduction
   - Models in Forest Fire Spread Prediction
2. Prediction Methods
   - Classification
   - Classical Prediction
   - Data Driven
3. Evolutionary-Statistical System with Island Model
   - ESS and ESS-IM
   - Communication and population treatment
   - CS-Monitor: three different alternatives
4. Conclusions and future work

Models

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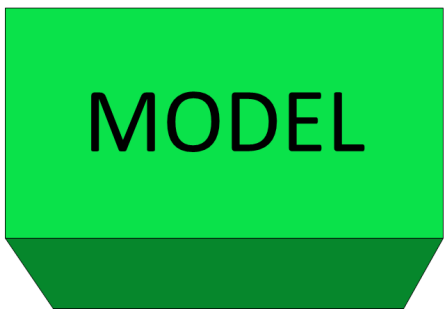
The use of models to represent different physical systems is a common practice in various areas of science.



Schema of a general model

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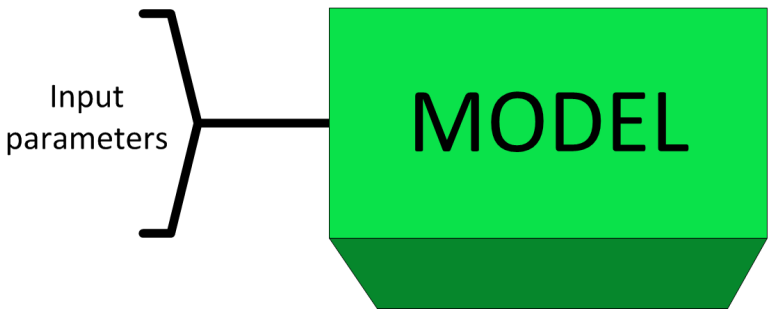

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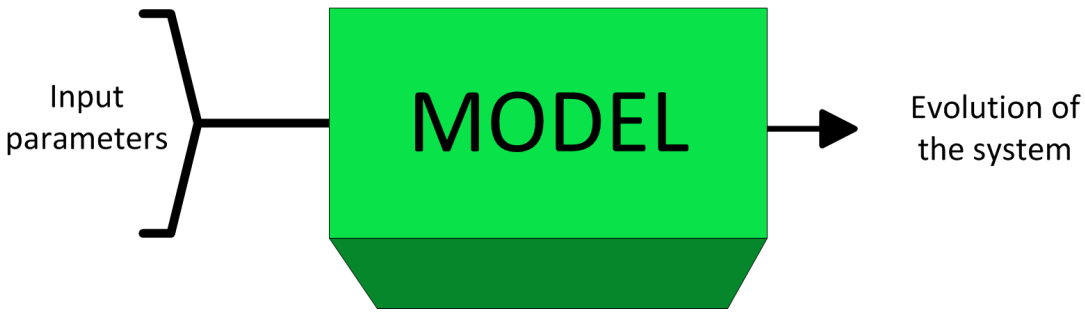
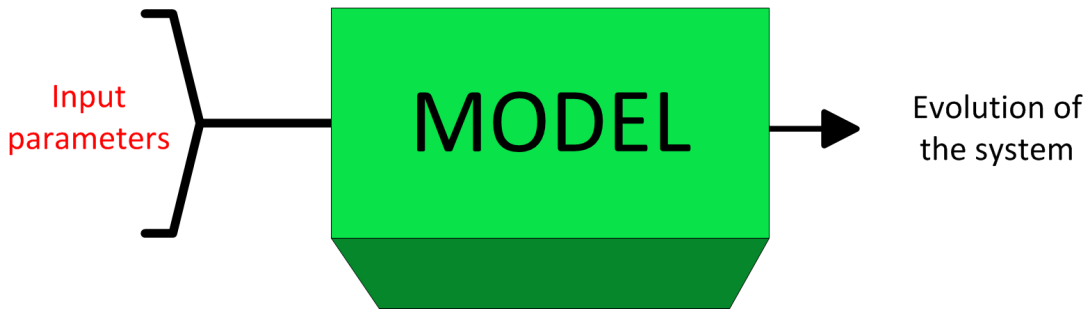


Schema of a general model

Models

Limitations and difficulties:

When the systems that implement the models are fed with fixed values that represent dynamic parameters.

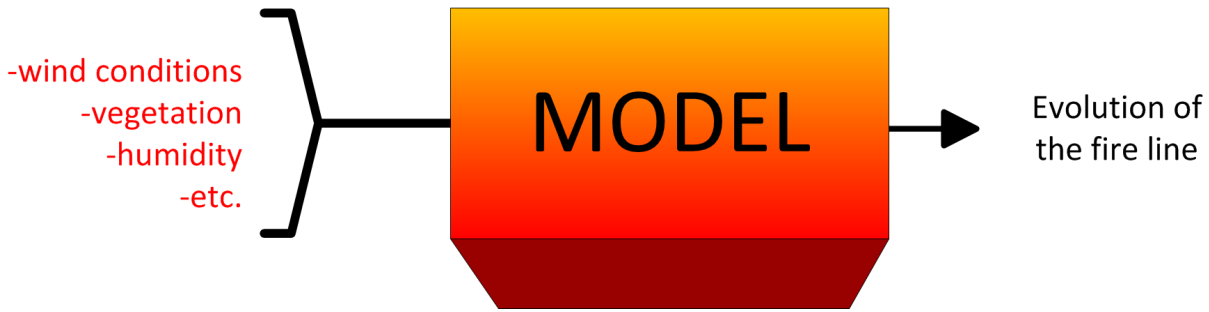


Schema of a general model

Models

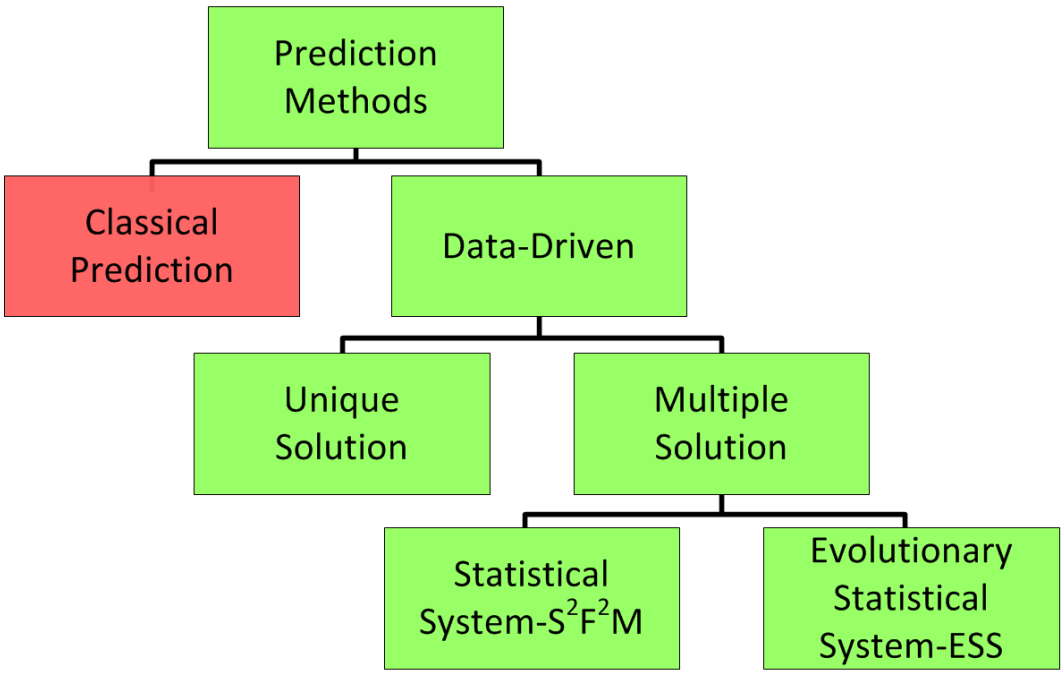
In fire predictions models:

Some input parameters must be estimated from indirect measurements, generating a prediction distant from reality.



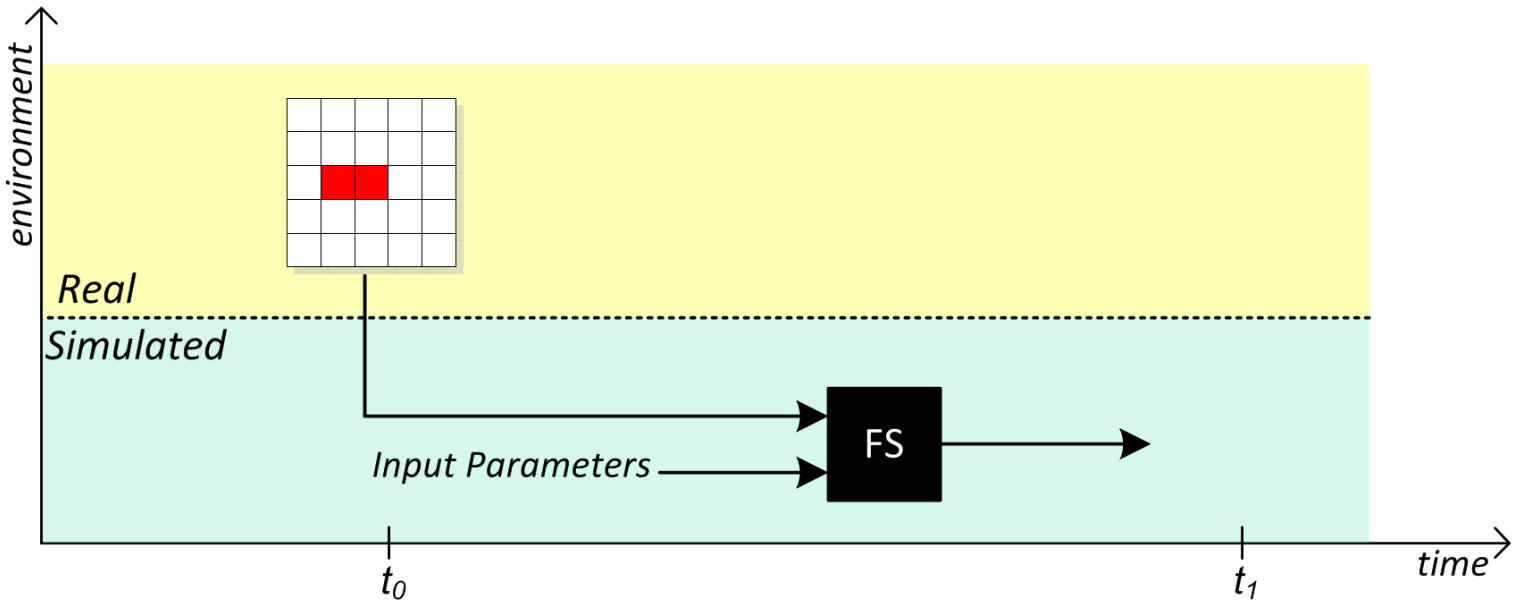
Forest fire prediction model

Classification



Classification of Prediction Methods

Classical Prediction



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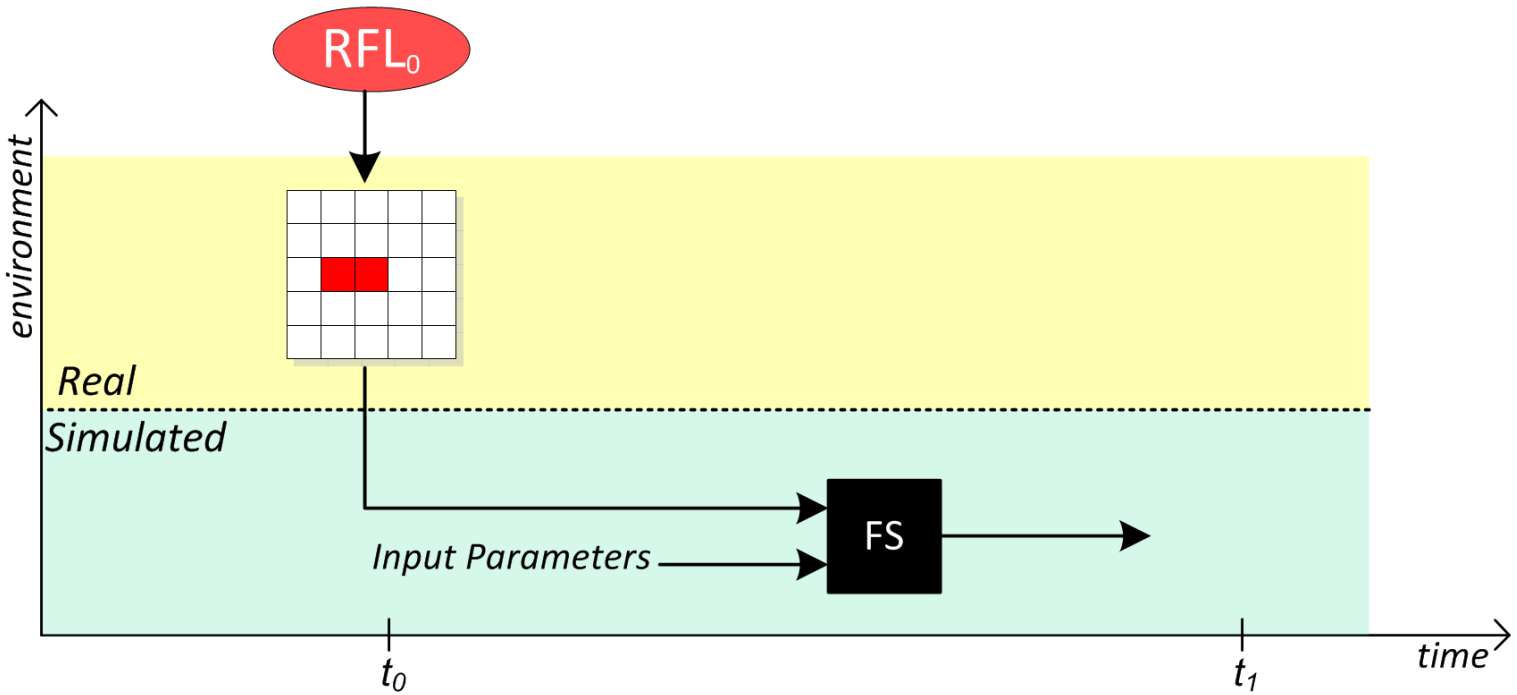

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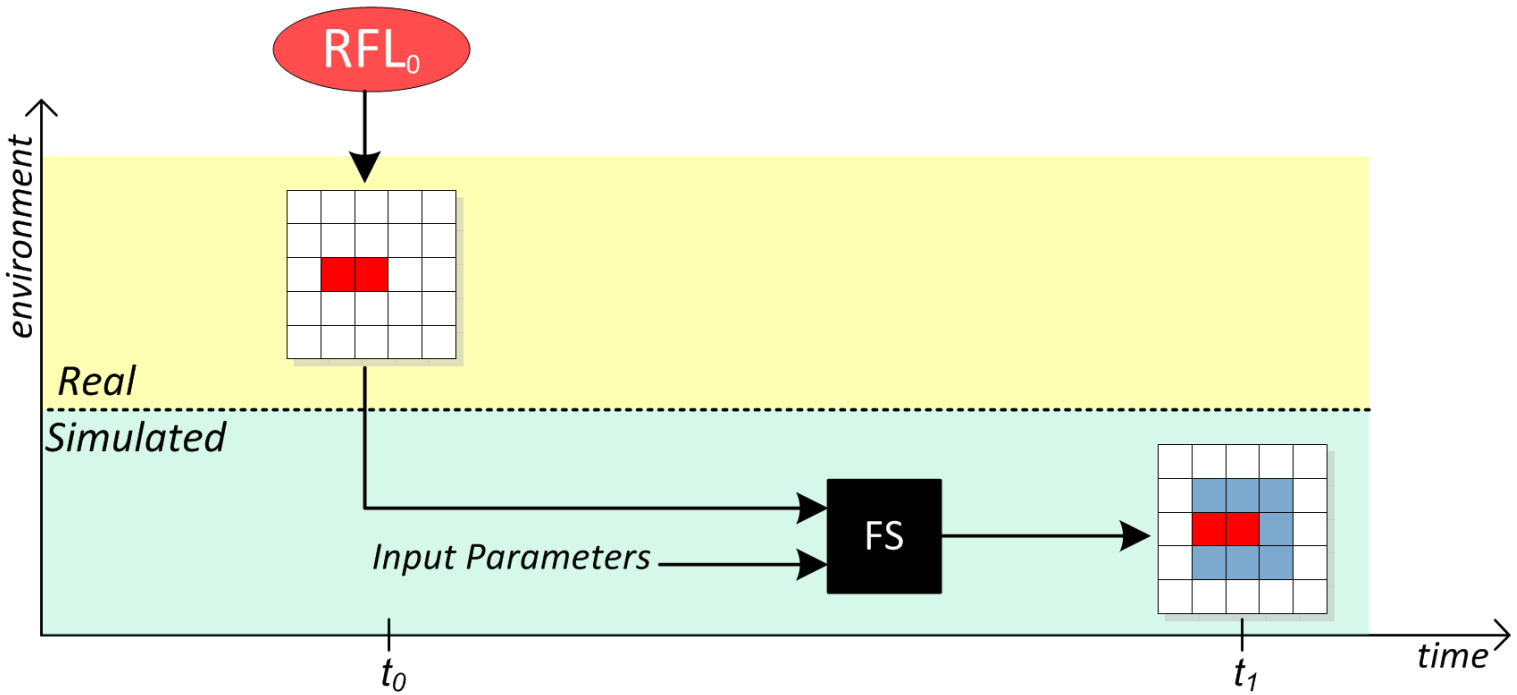

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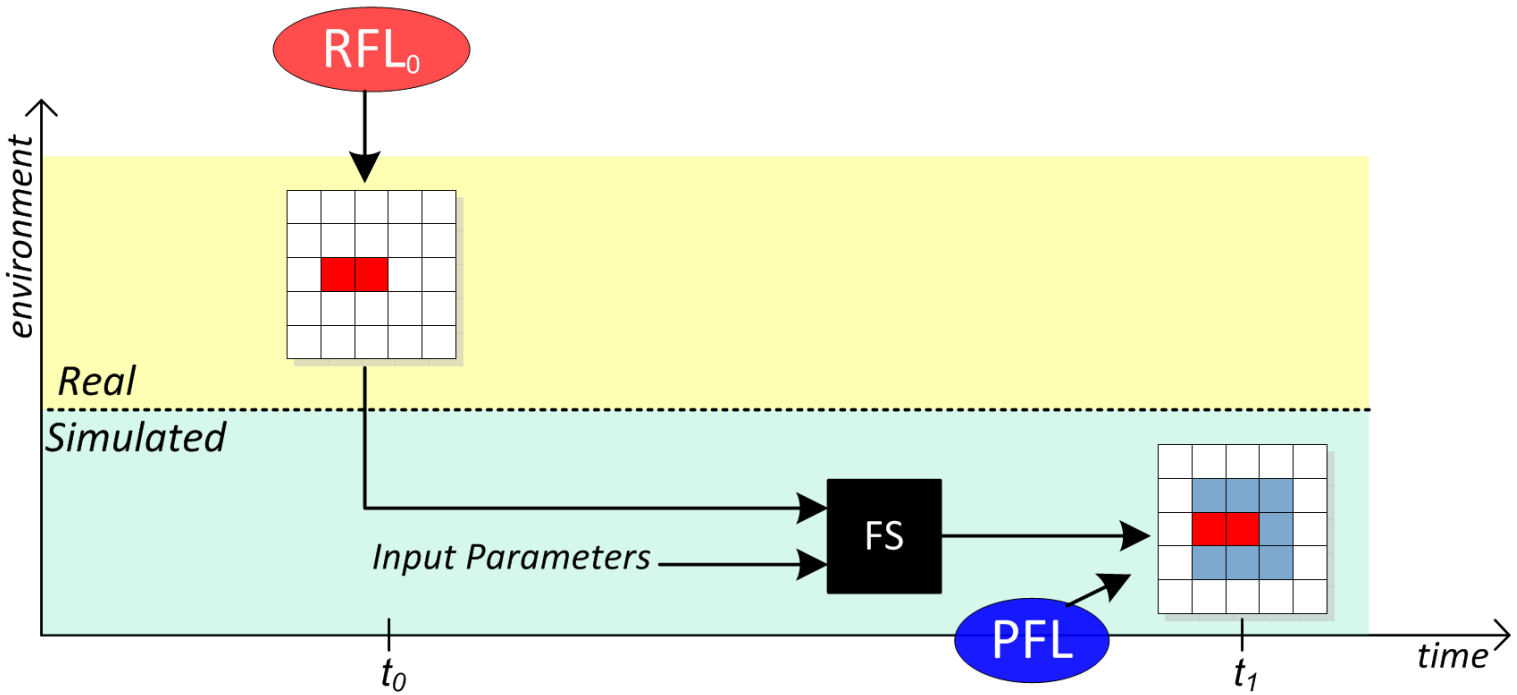

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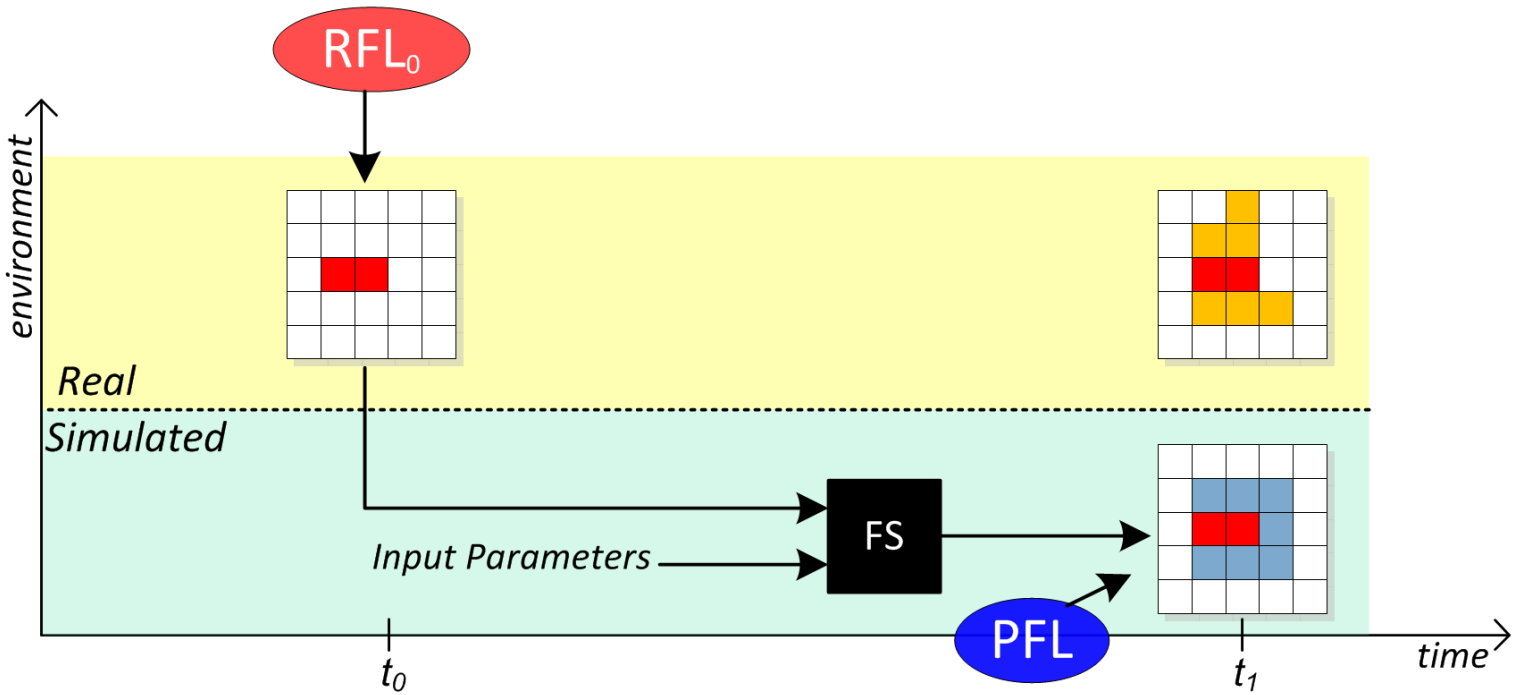

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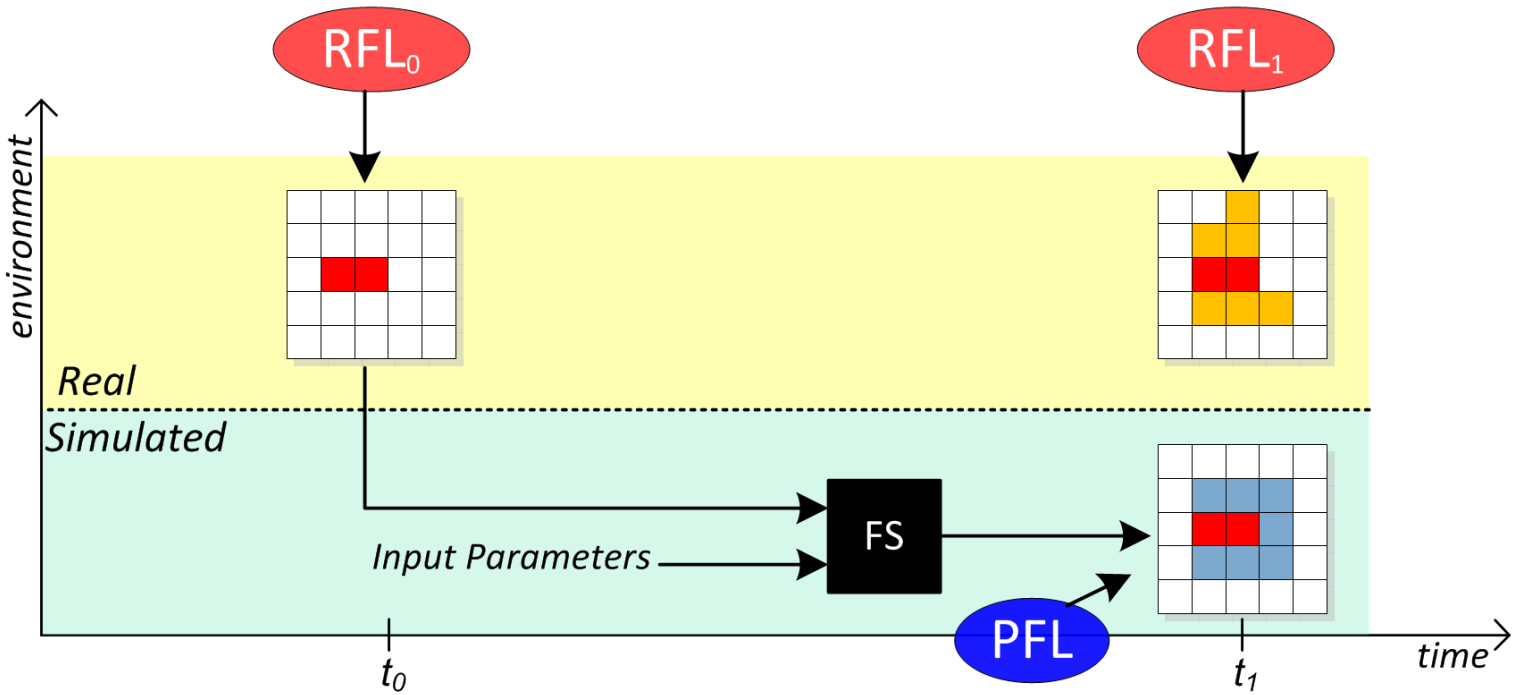

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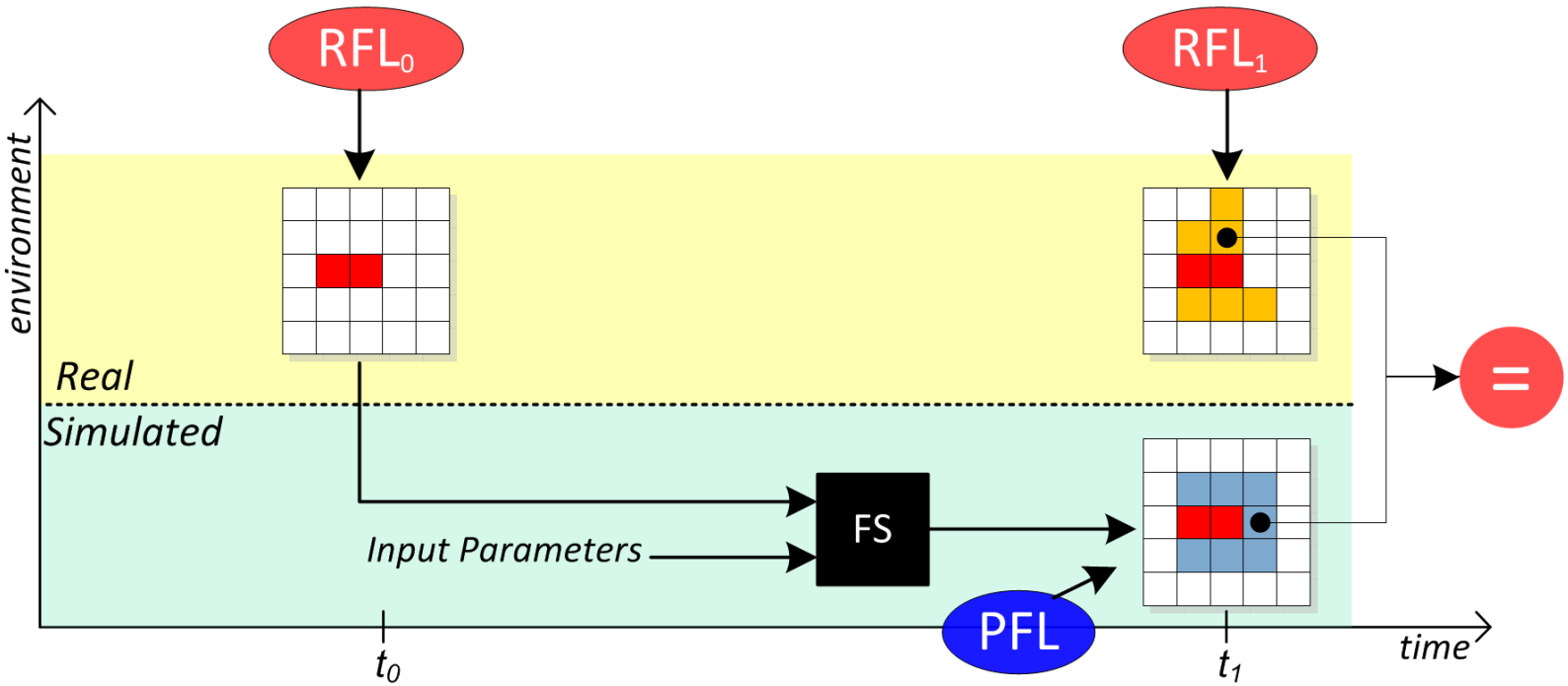

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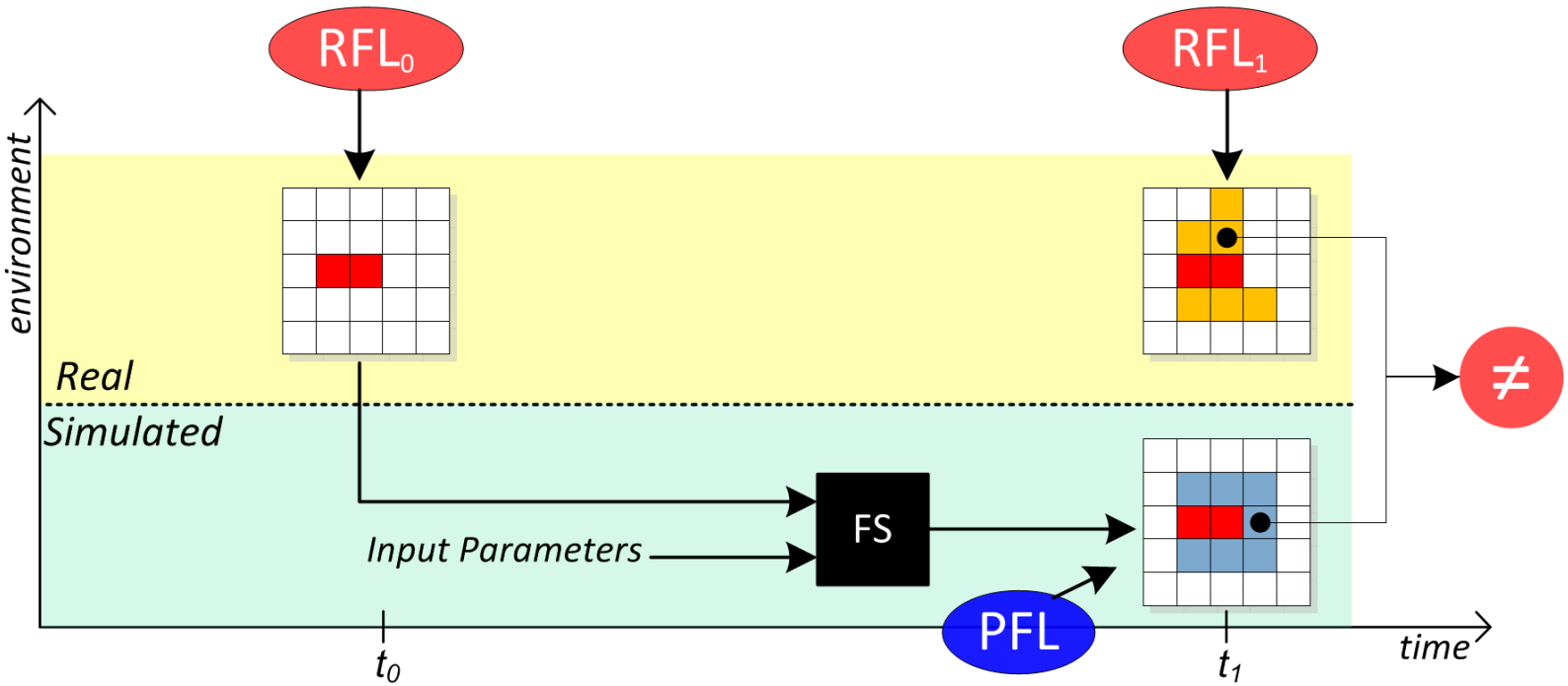

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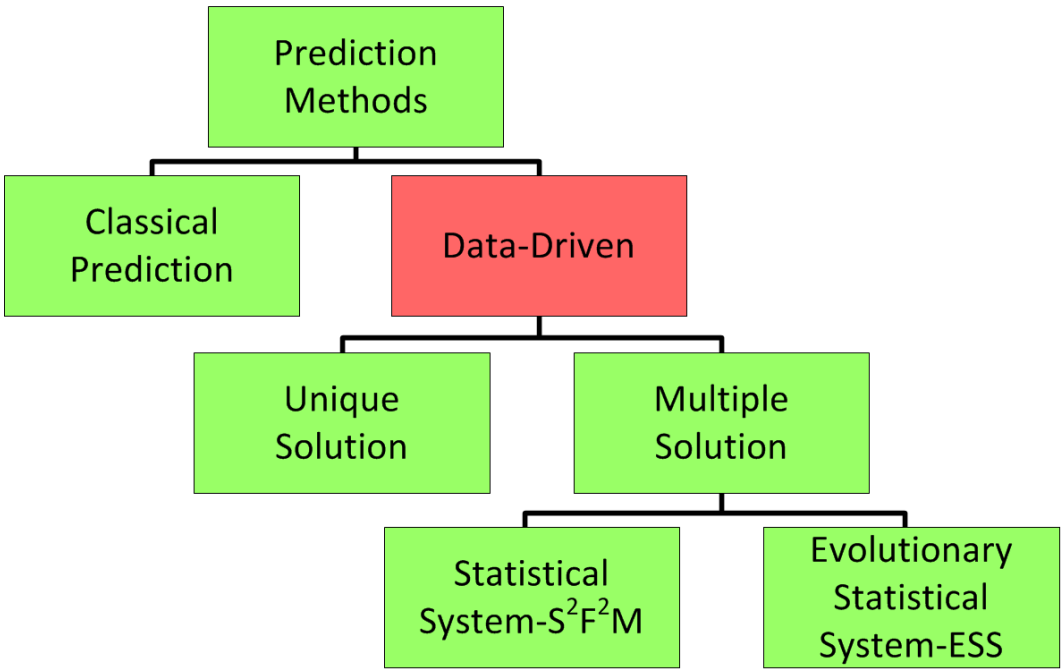
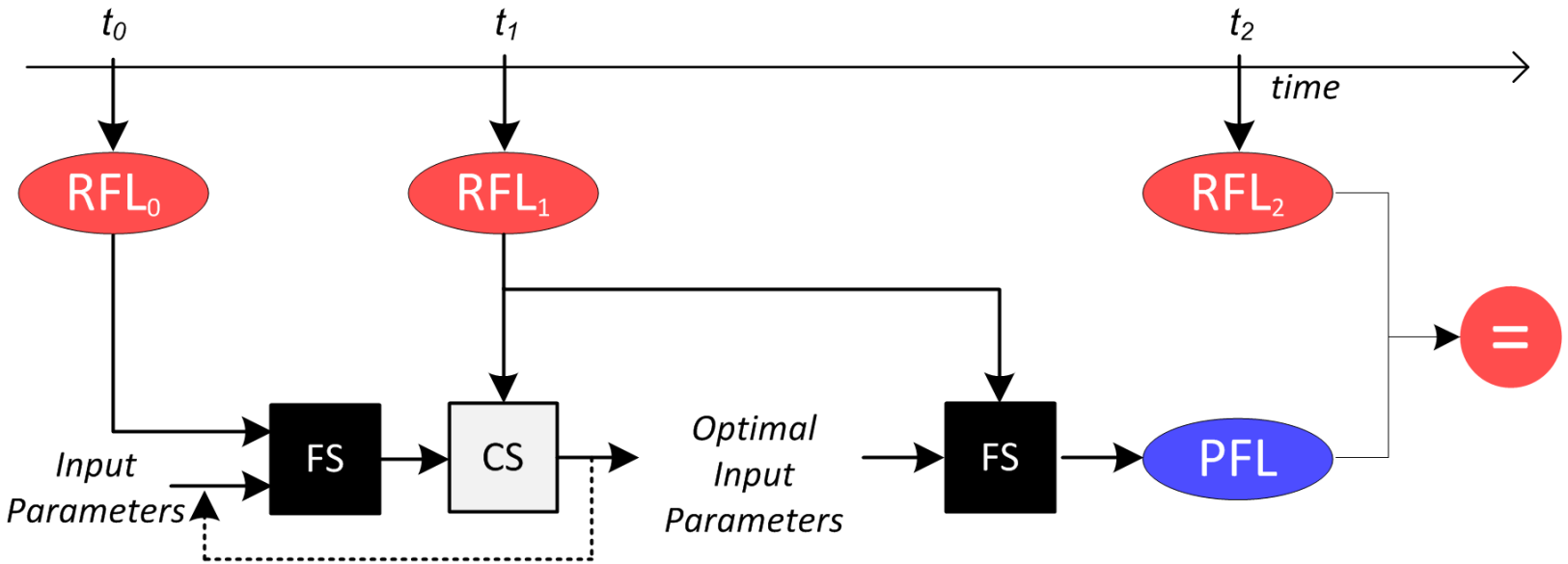
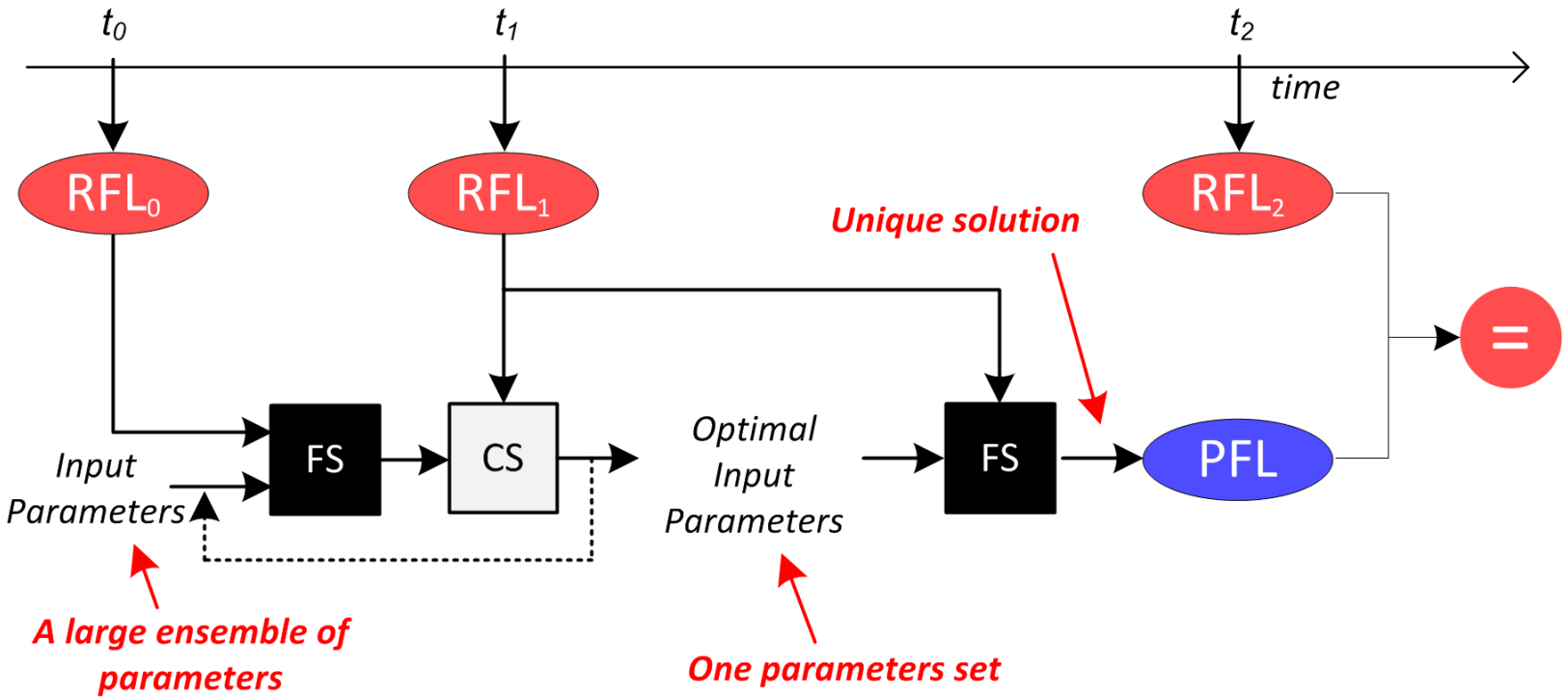


Classification of Prediction Methods



Data Driven prediction



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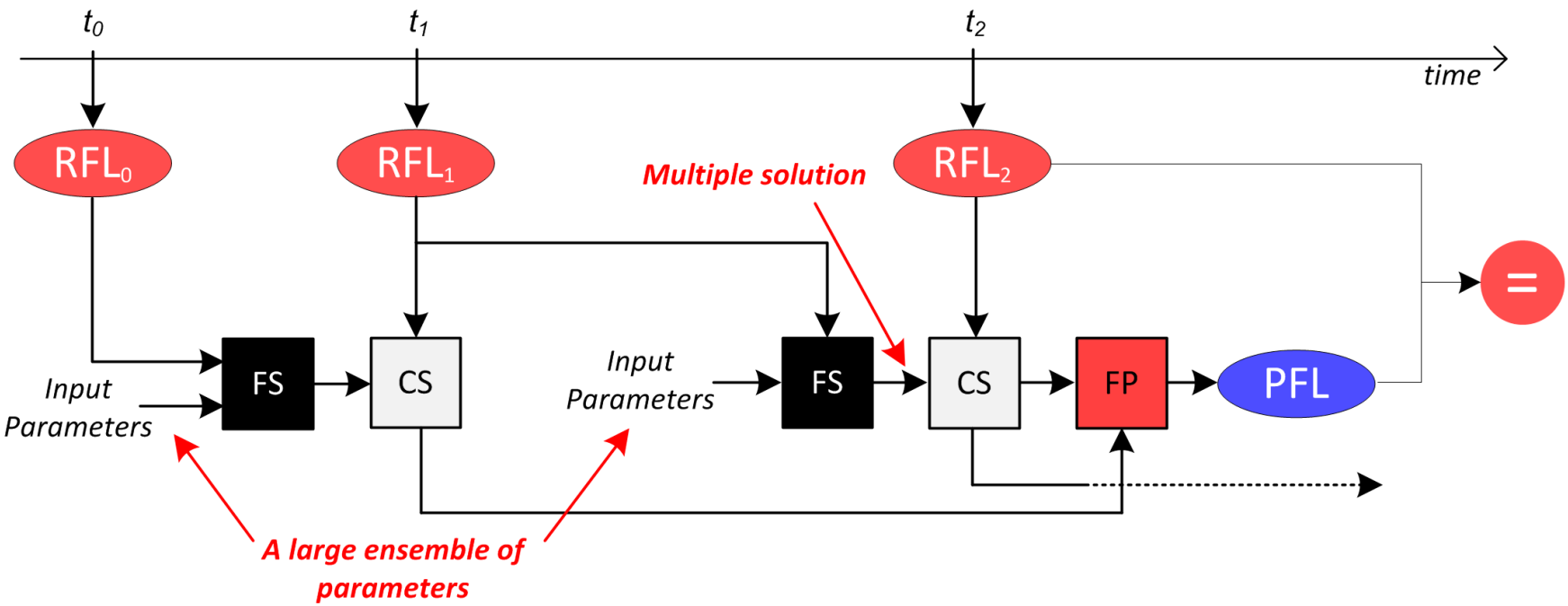
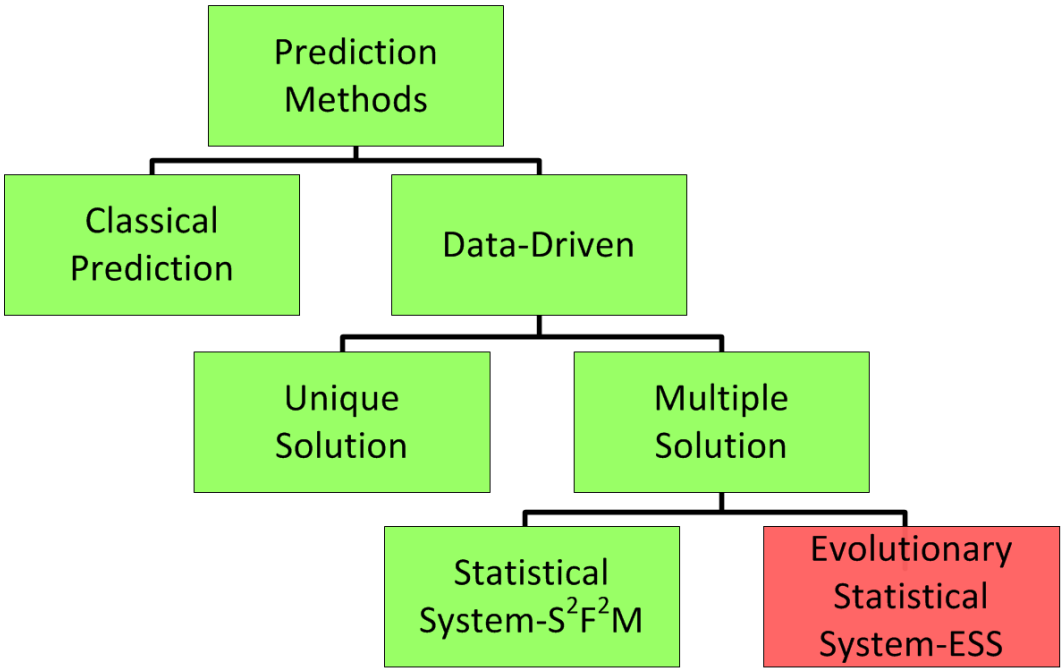


Data Driven prediction with Multiple Solution

ESS



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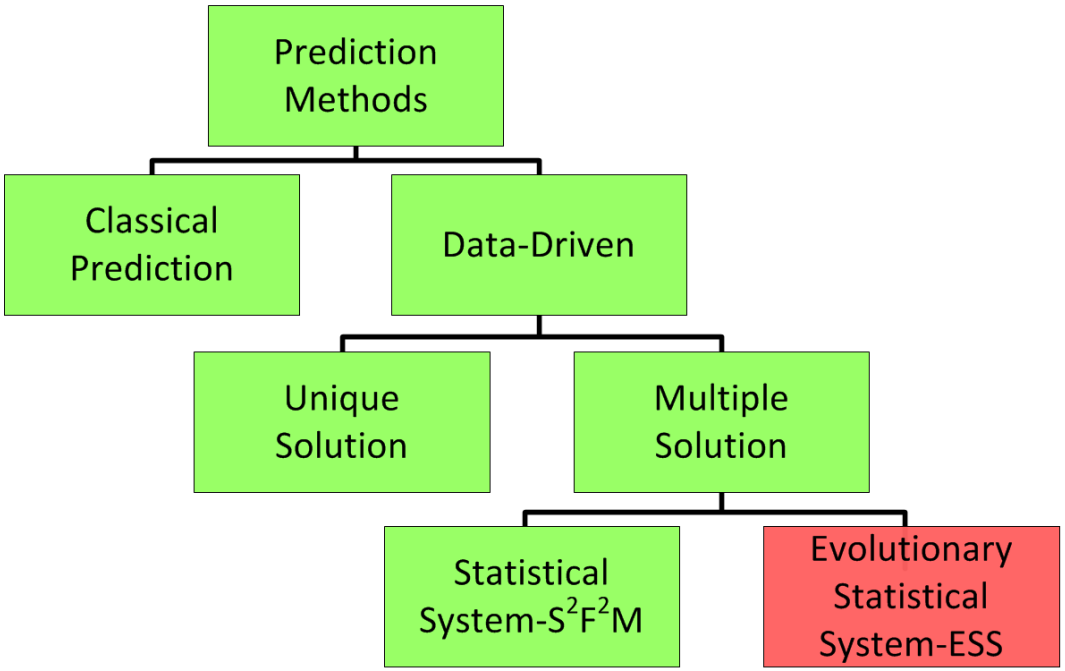

Classification of Prediction Methods

Evolutionary-Statistical System

Uncertainty reduction method based on the use of PEAs, Statistics and HPC.

ESS-IM

Objetive:

To increment the parallelism level of the ESS method by including the Island Model in the Parallel Evolutionary Algorithm (PEAs), and verify if some improvement in the quality of the prediction of ESS is reached.

Evolutionary Statistical System-ESS

Two versions of ESS: 1) Unique Population and 2) Multiple Populations

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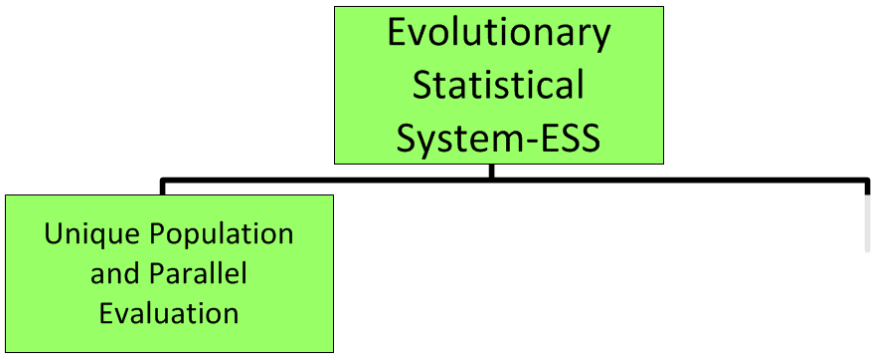

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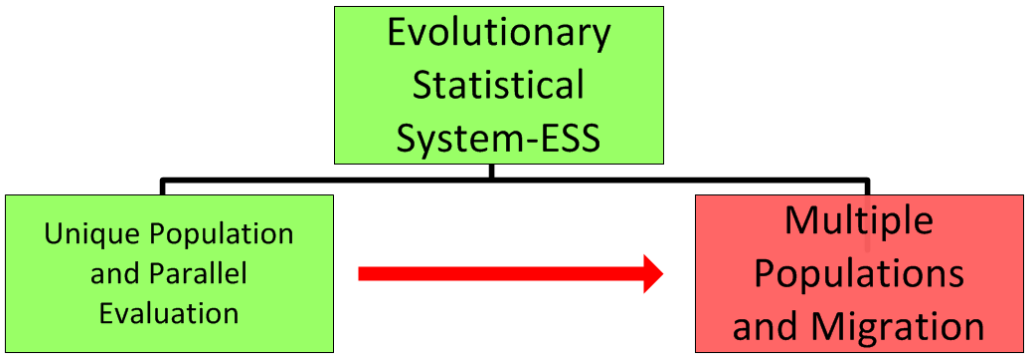
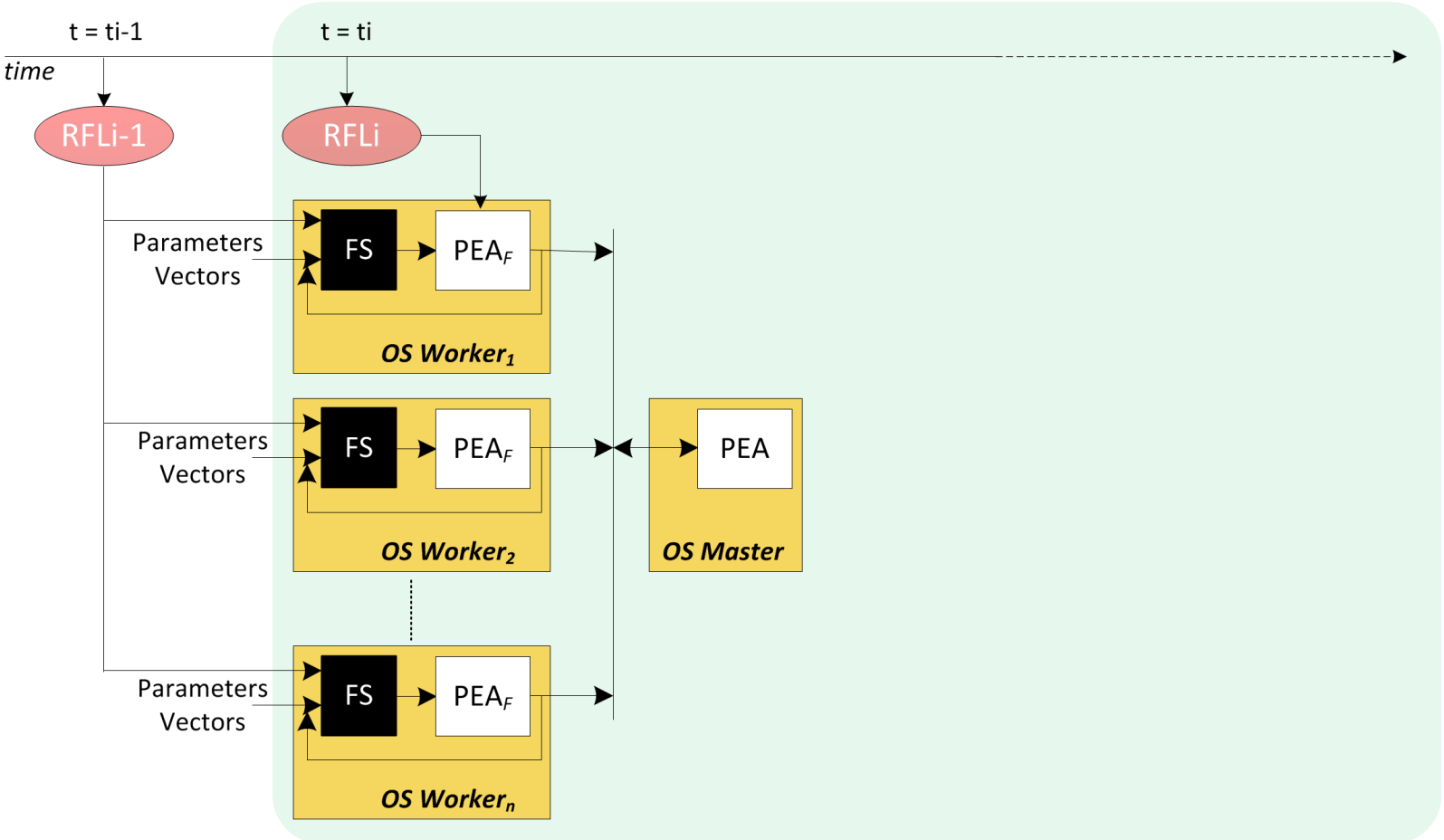


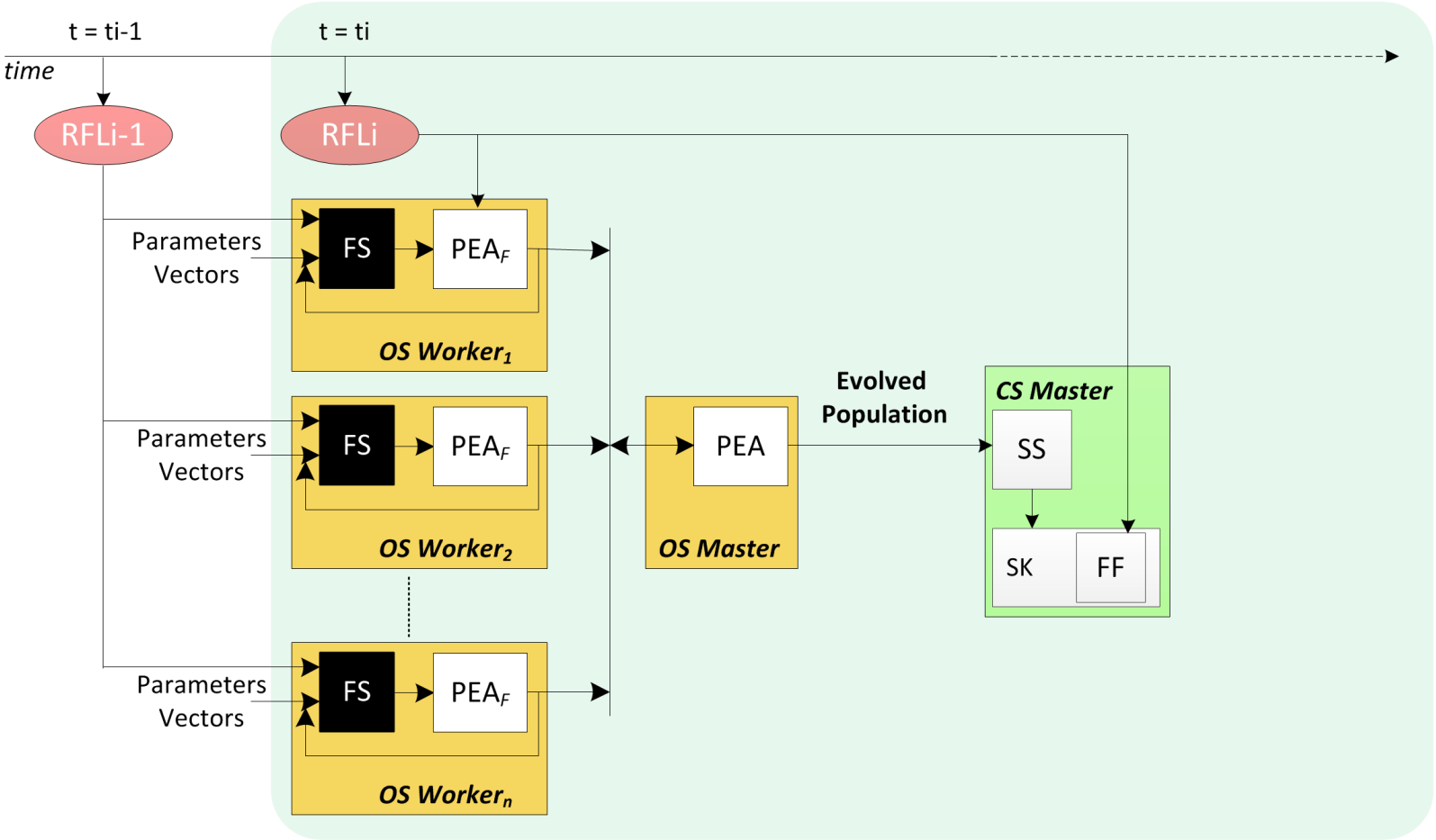
Two versions of ESS: 1) Unique Population and 2) Multiple Populations

ESS in detail



ESS: a detailed schema

ESS in detail



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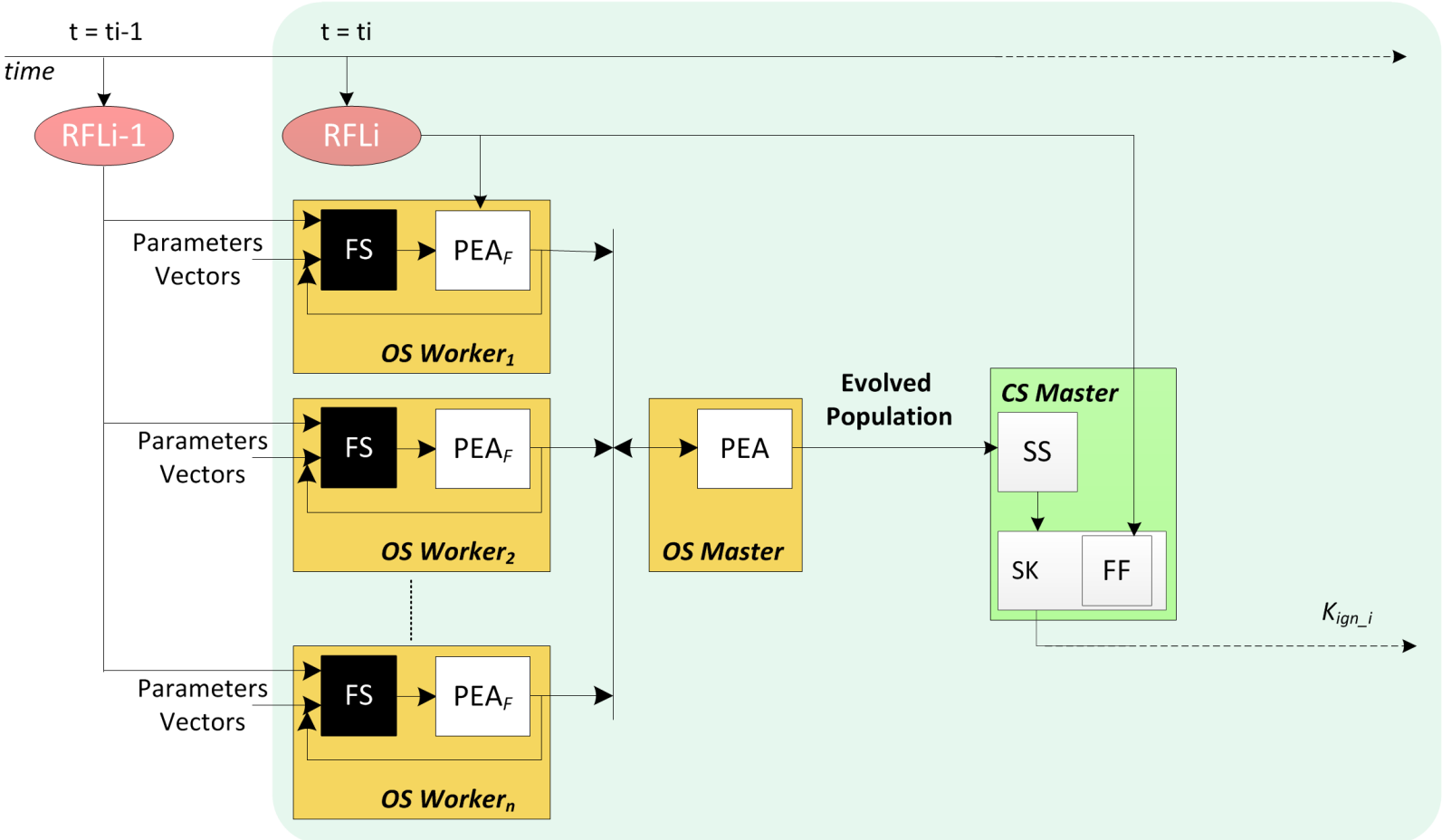

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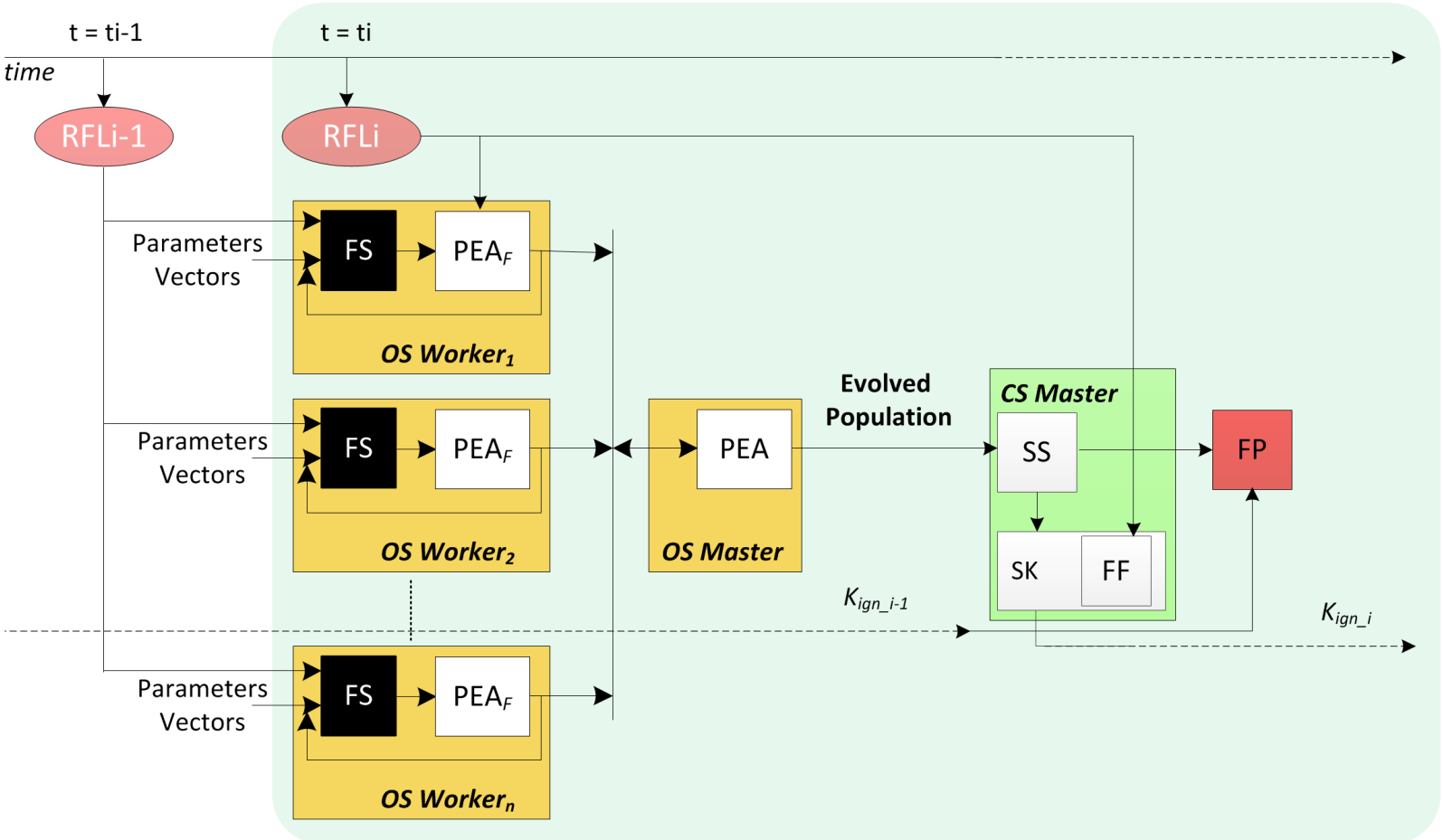

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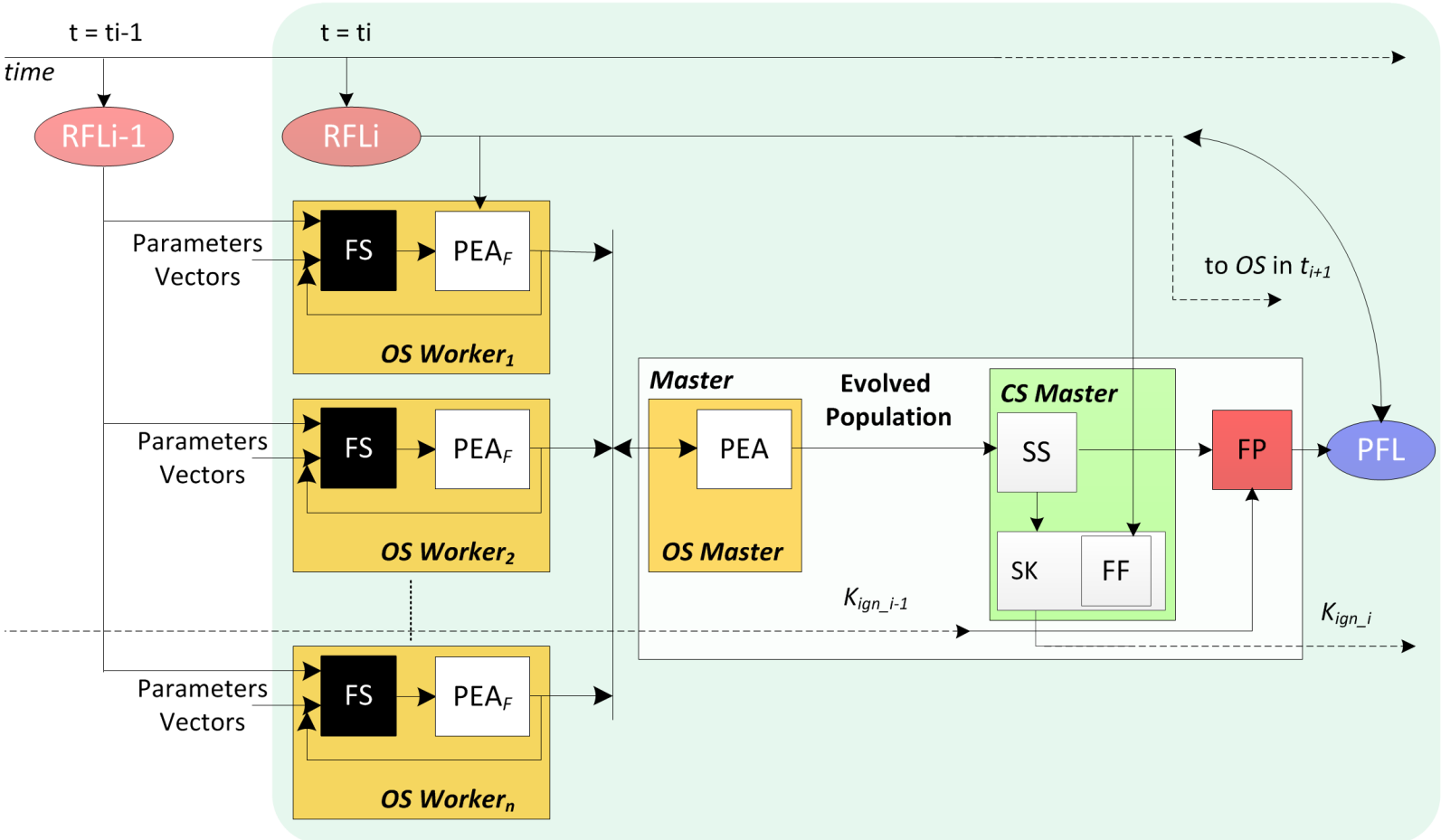

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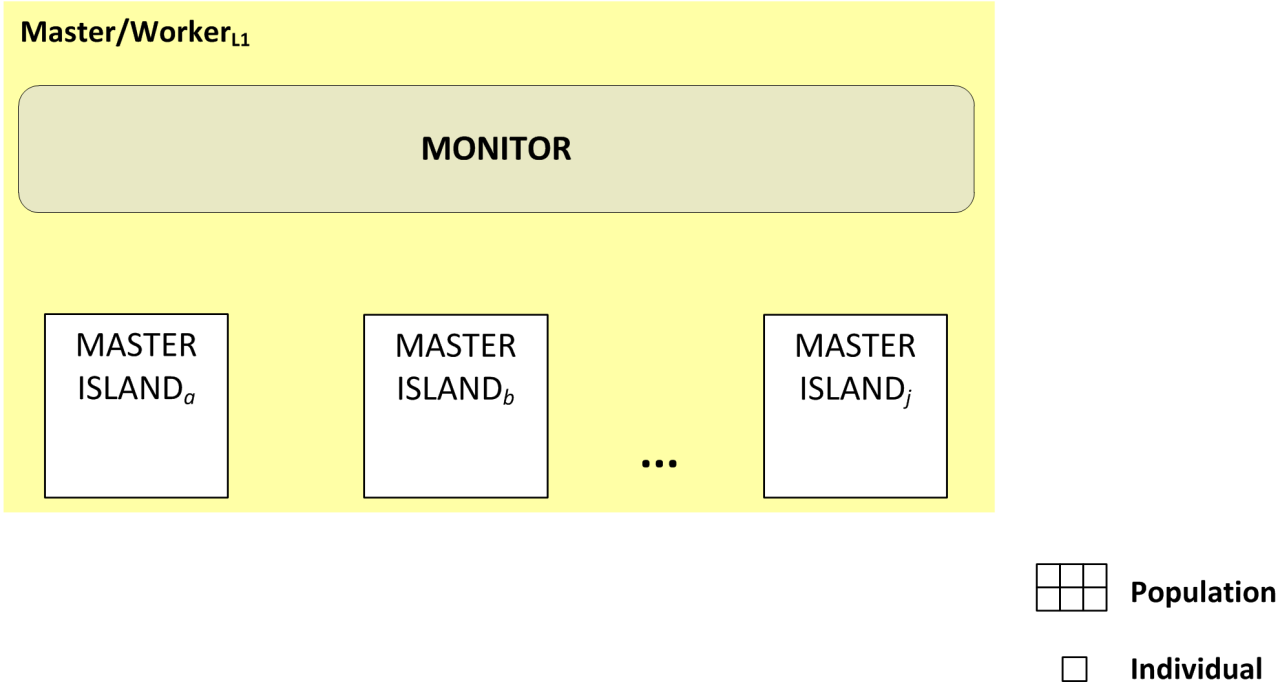
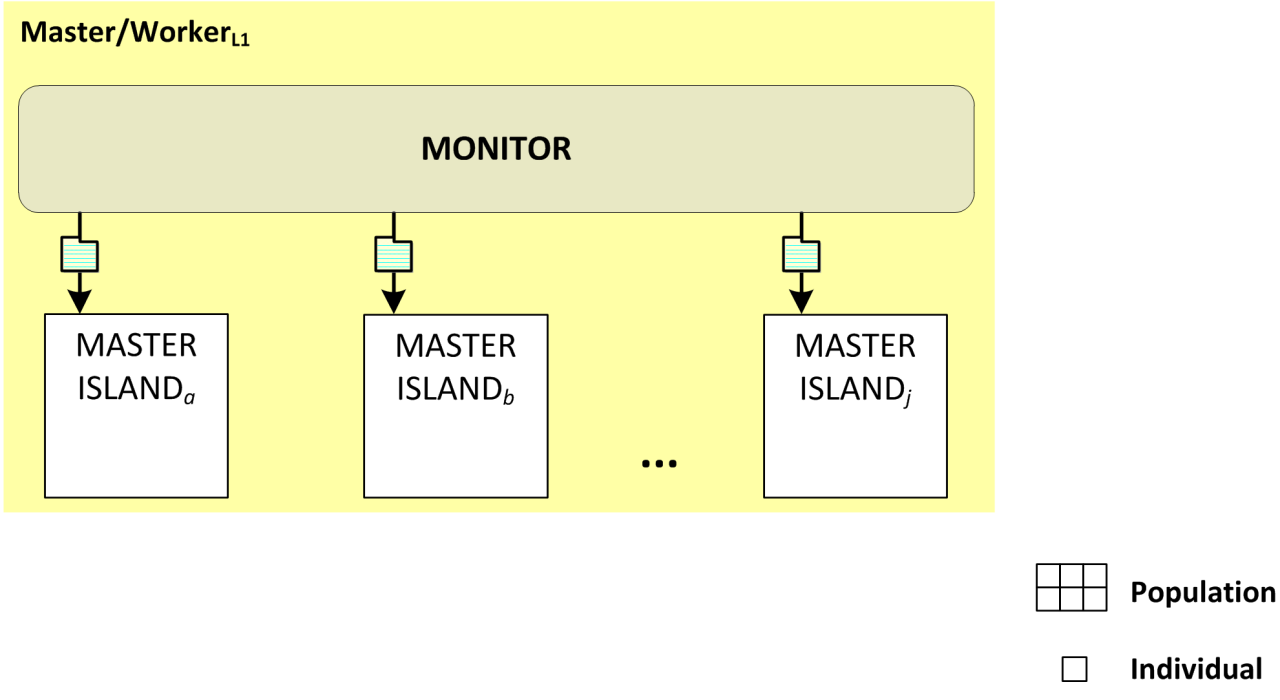
Master/Worker model



ESS-IM communication and population treatment

Master/Worker model



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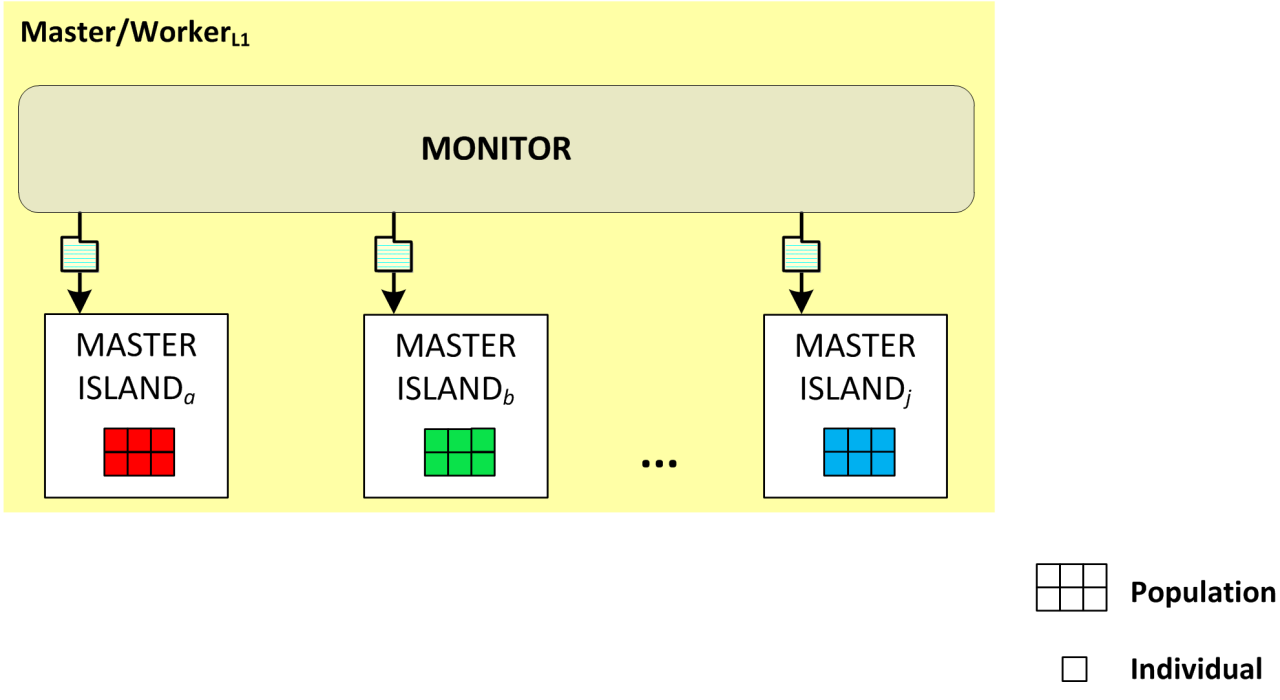

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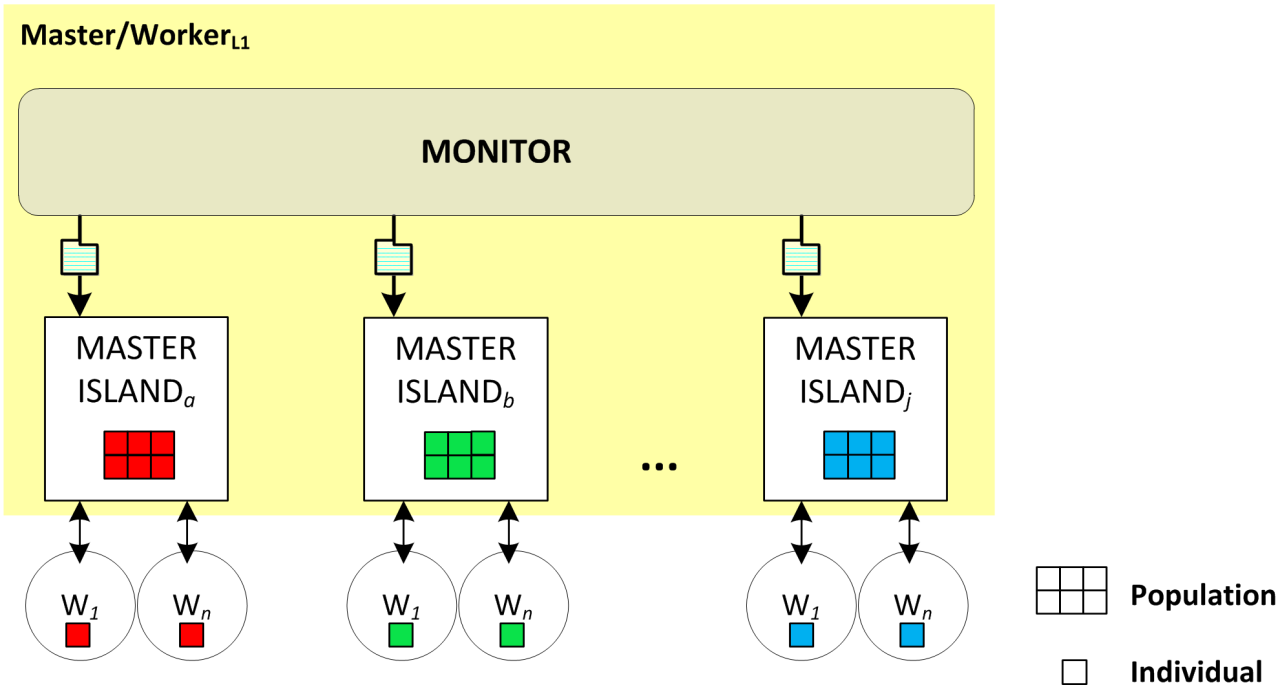

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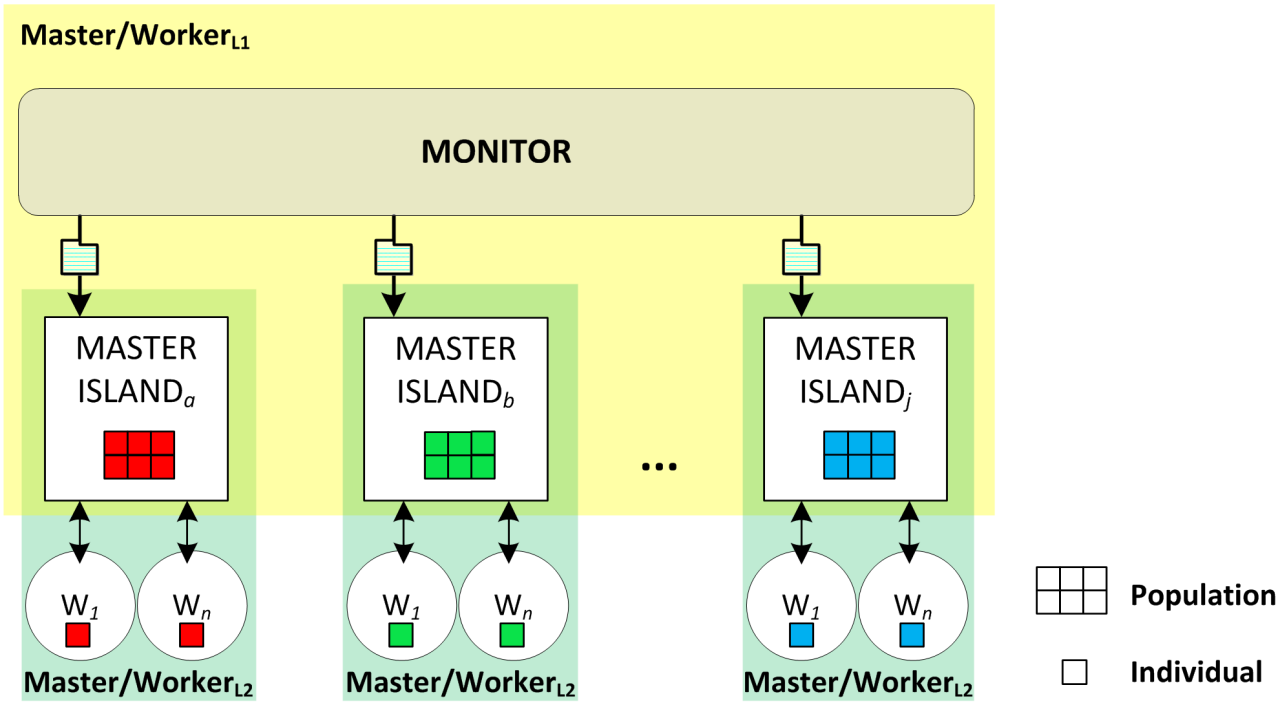

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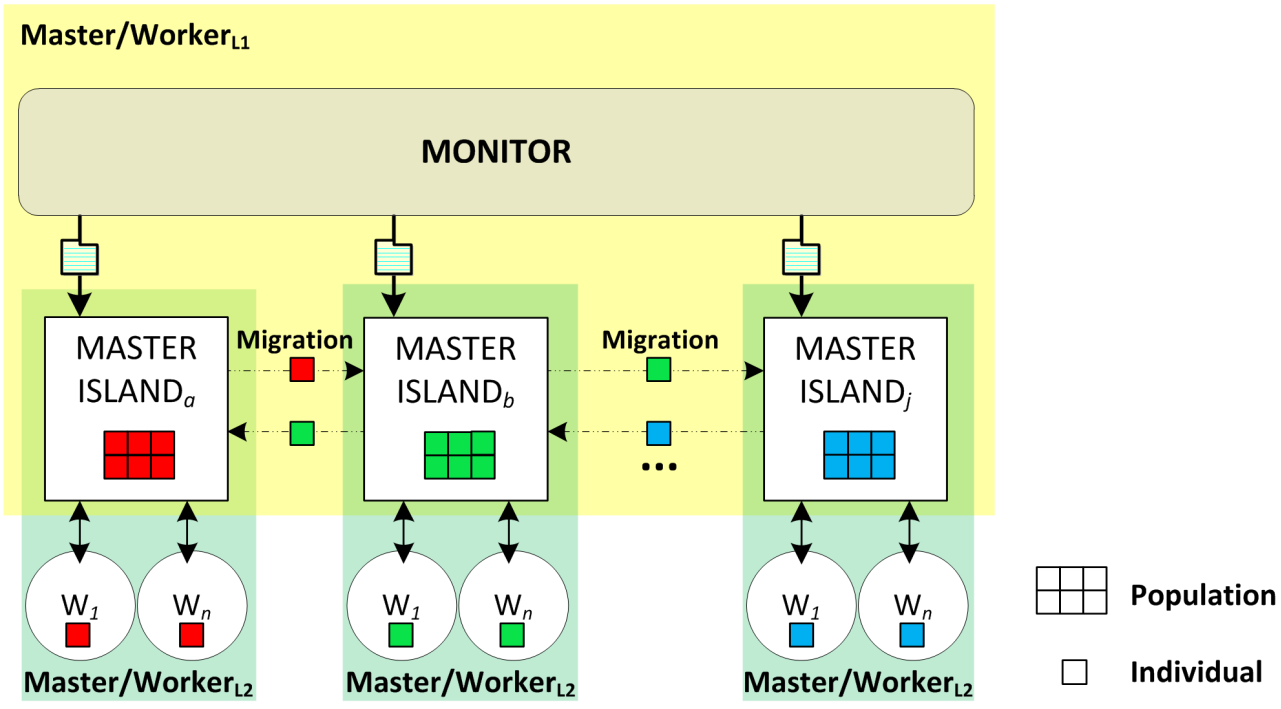

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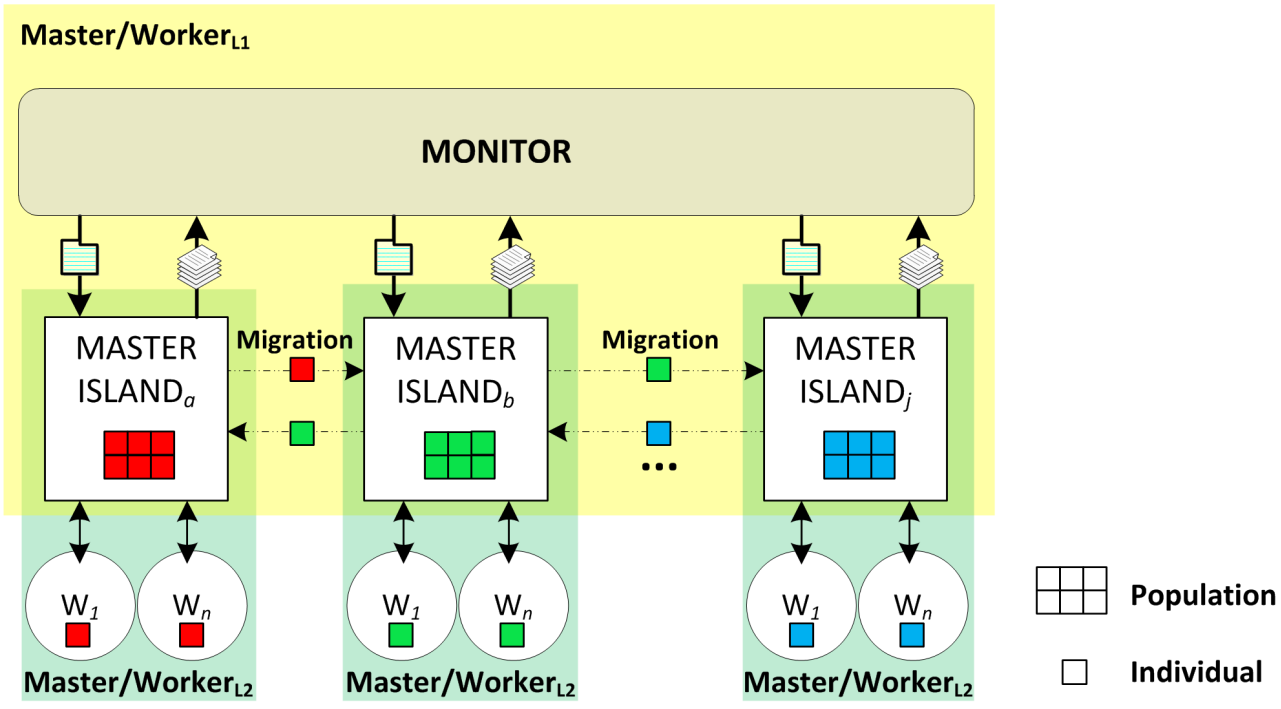
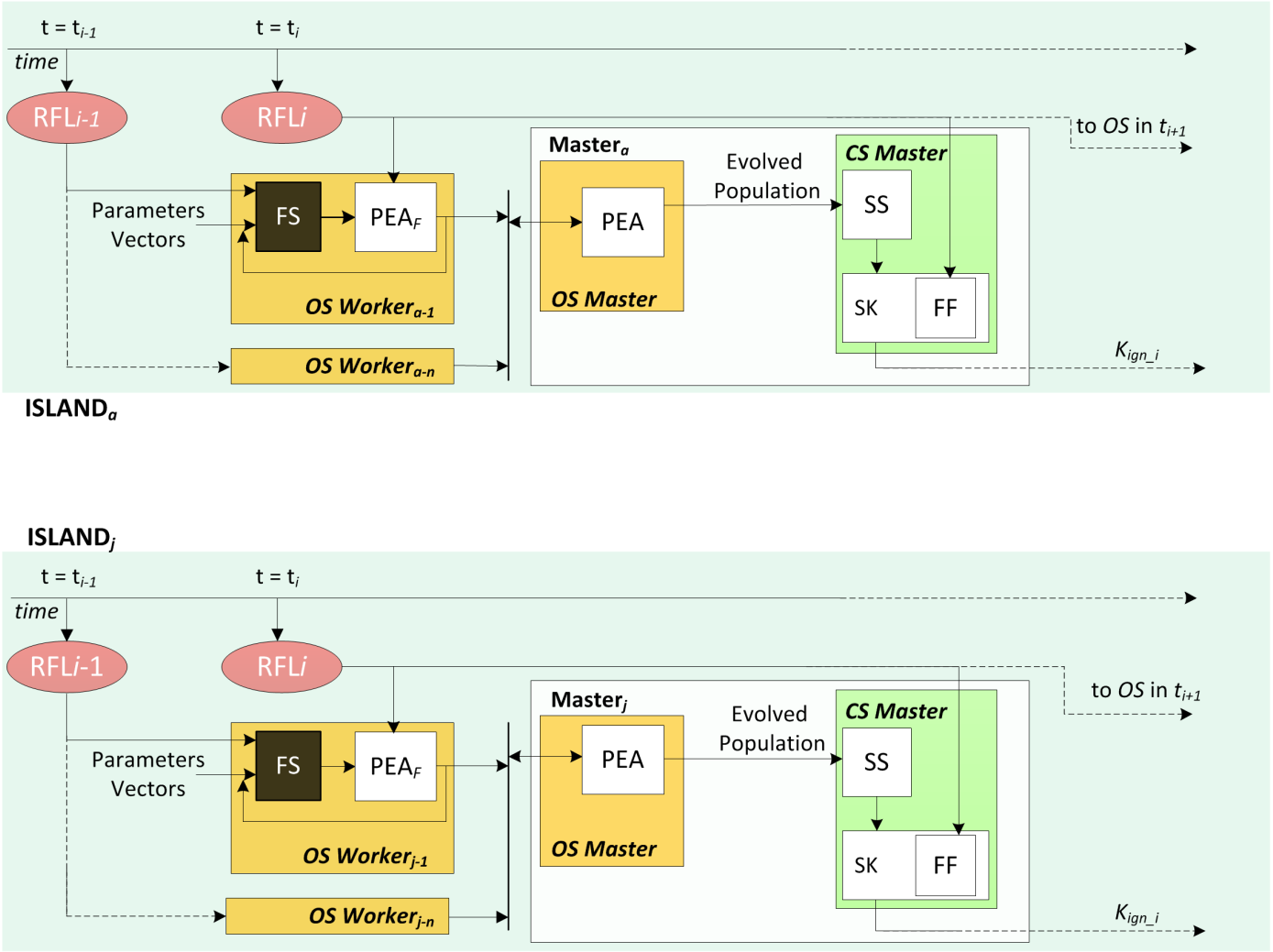


ESS-IM communication and population treatment

ESS-IM in detail



ESS-IM: a detailed schema

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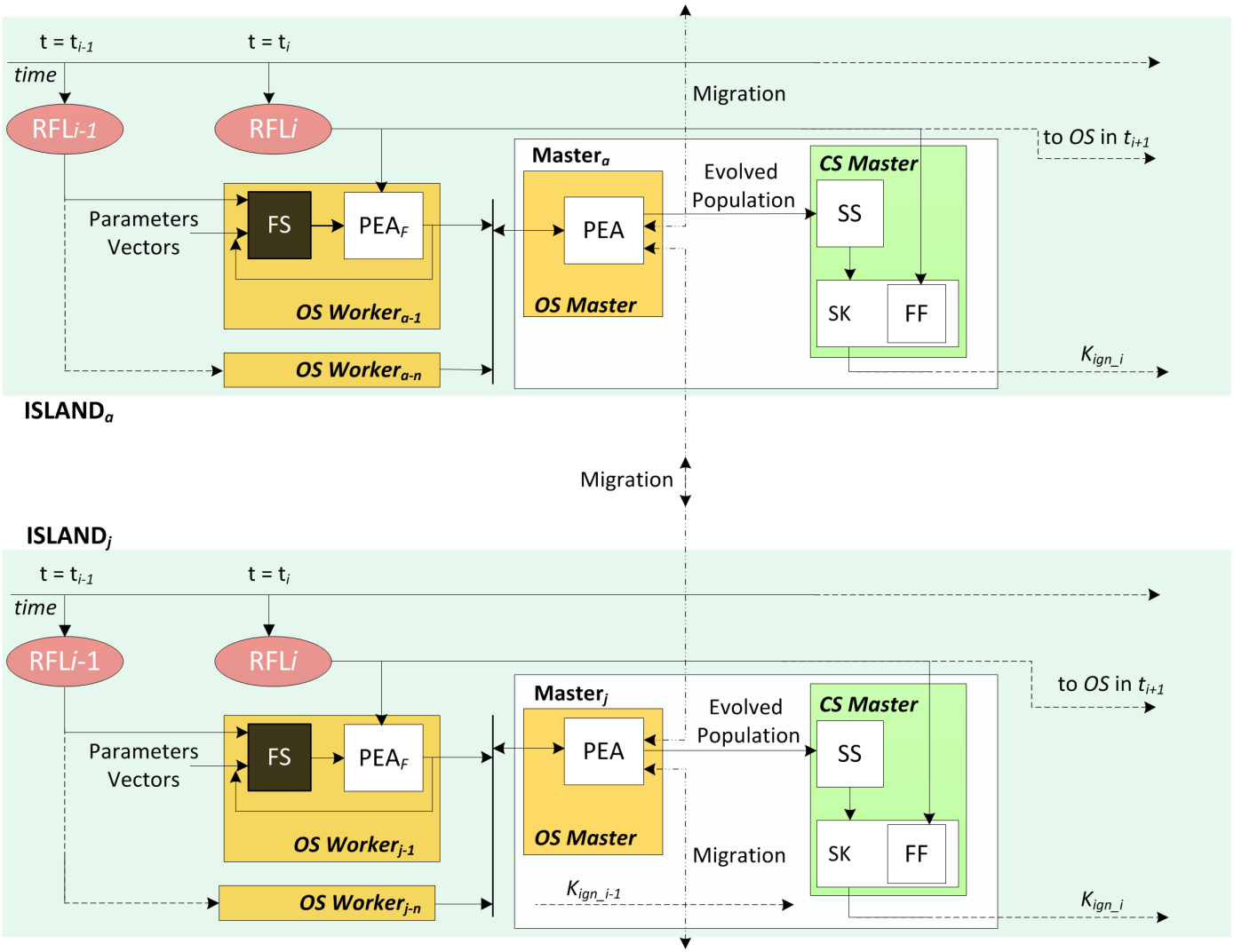

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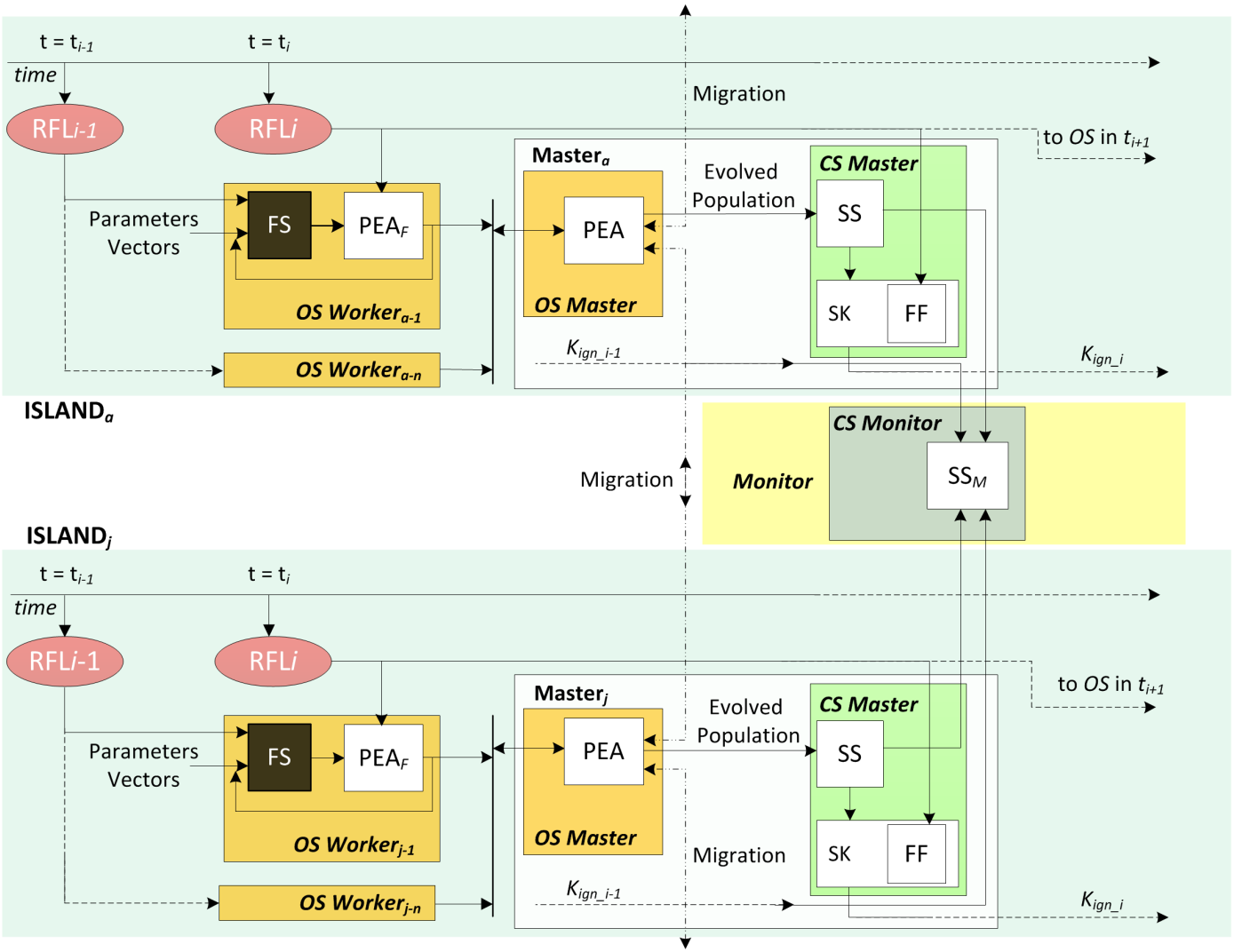

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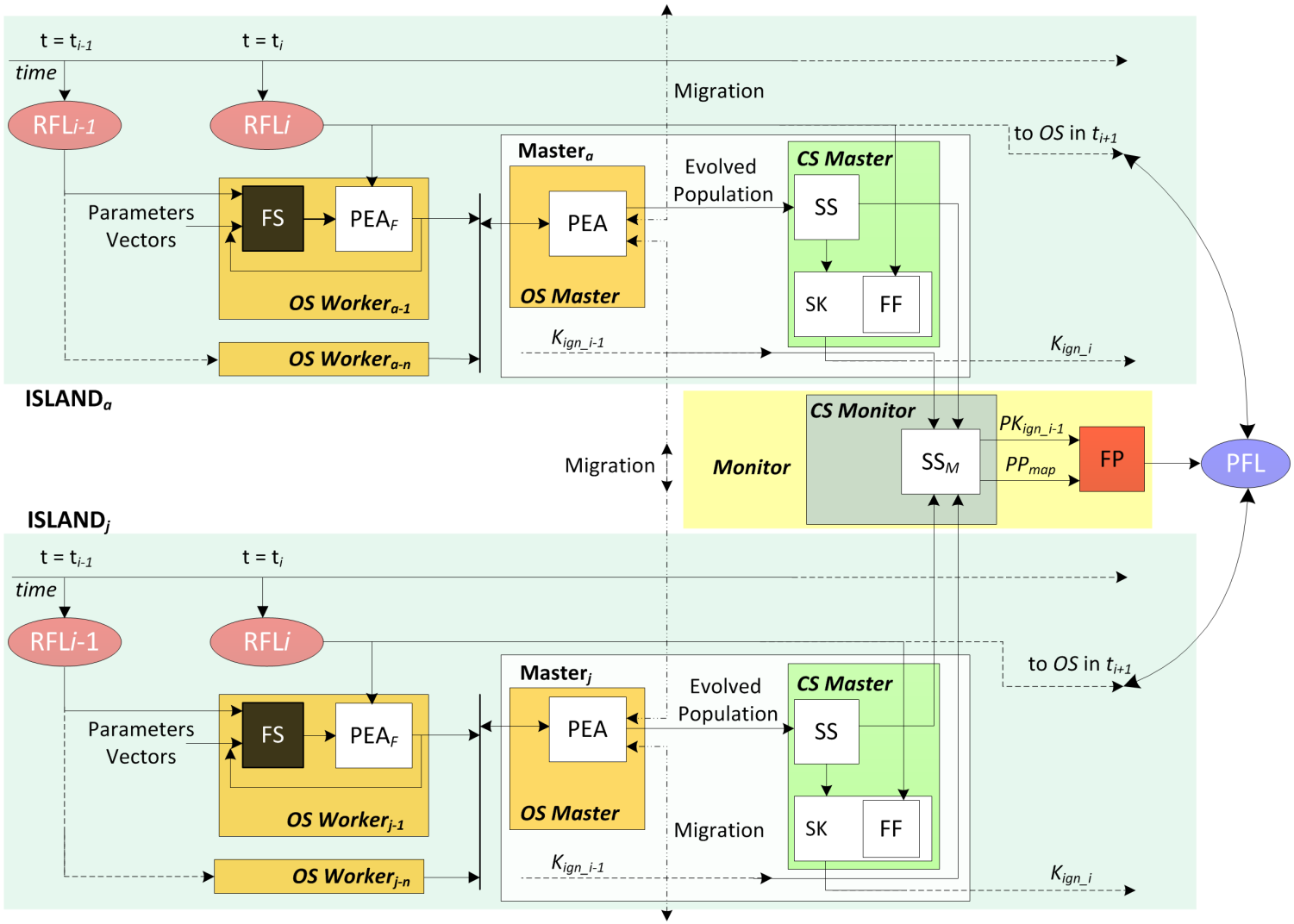
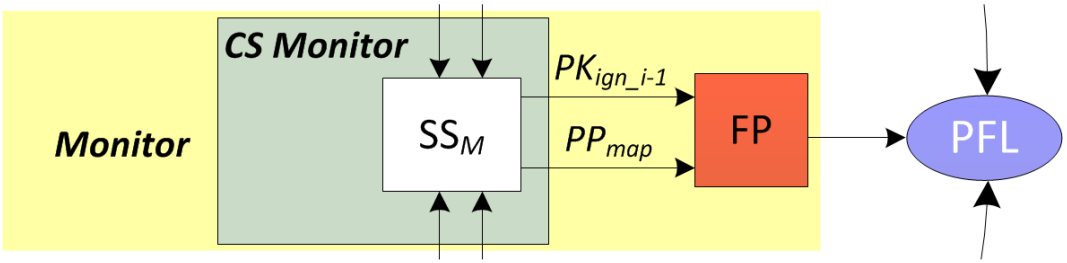


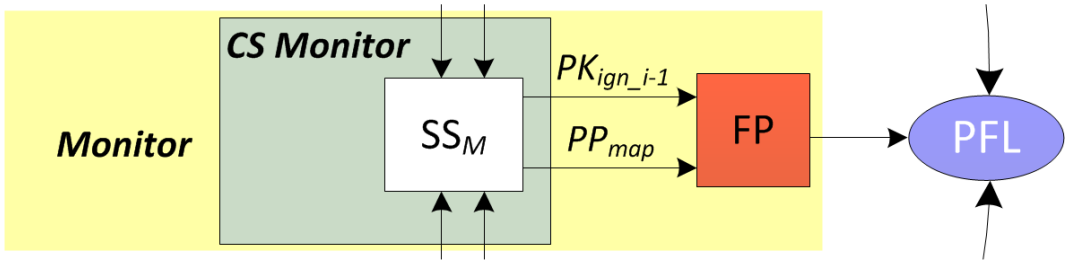
ESS-IM: a detailed schema

CS-Monitor, different criteria



CS-Monitor: Calibration Stage in Monitor Node

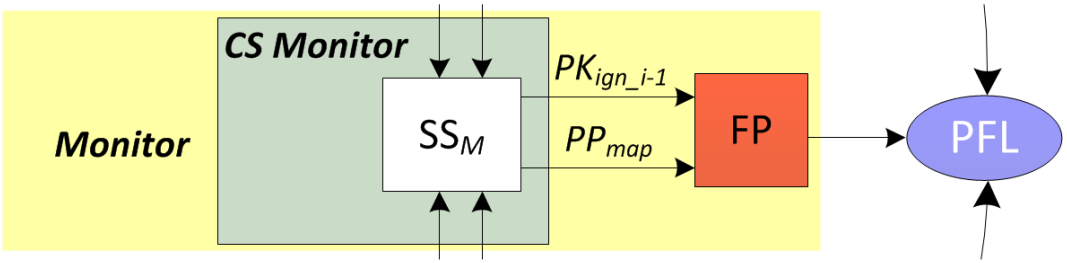
CS-Monitor, different criteria



CS-Monitor: Calibration Stage in Monitor Node

1 The best K_{ign} of all islands.

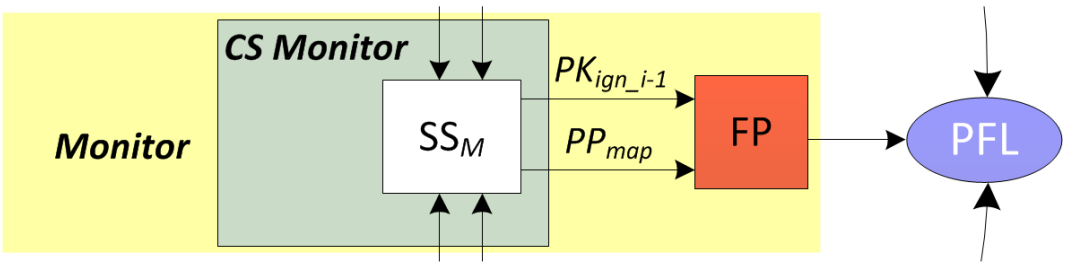
CS-Monitor, different criteria



CS-Monitor: Calibration Stage in Monitor Node

1. The best K_{ign} of all islands.
2. To calculate just one K_{ign} based on statistical map that aggregates the statistical maps of each population.

CS-Monitor, different criteria



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1. The best K_{ign} of all islands.
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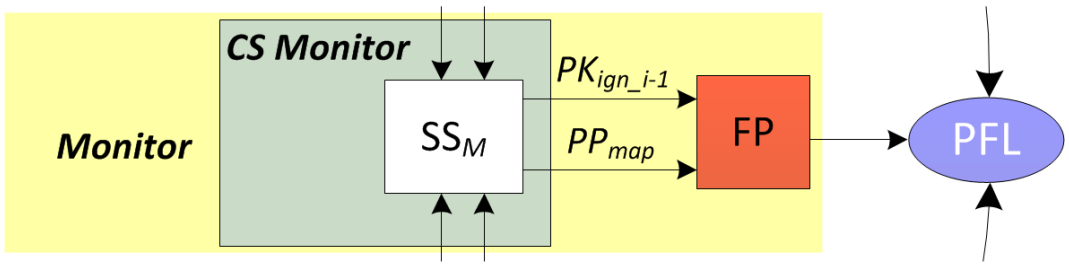
3. The K_{ign} that is firstly found could be considered.

CS-Monitor, different criteria



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1. The best K_{ign} of all islands.
2. To calculate just one K_{ign} based on statistical map that aggregates the statistical maps of each population.
3. The K_{ign} that is firstly found could be considered.

Due to the existence of the different mentioned alternatives:

We will conduct a detailed comparison of these options.

Conclusions and future work

There are many issues to be considered:

- The different ways to implement the statistical method.
- The different alternatives for implementing the Fire Prediction stage.
- The influence of different migration strategies.
- The possibilities of communication topologies.

Future Work:

Further study should focus on the analysis and tuning of the method to obtain the best possible results and compare it with other existing methods.

Thanks for your attention!