SIRIUS-DV : CNES NEW FLIGHT DYNAMICS ALGORITHMS

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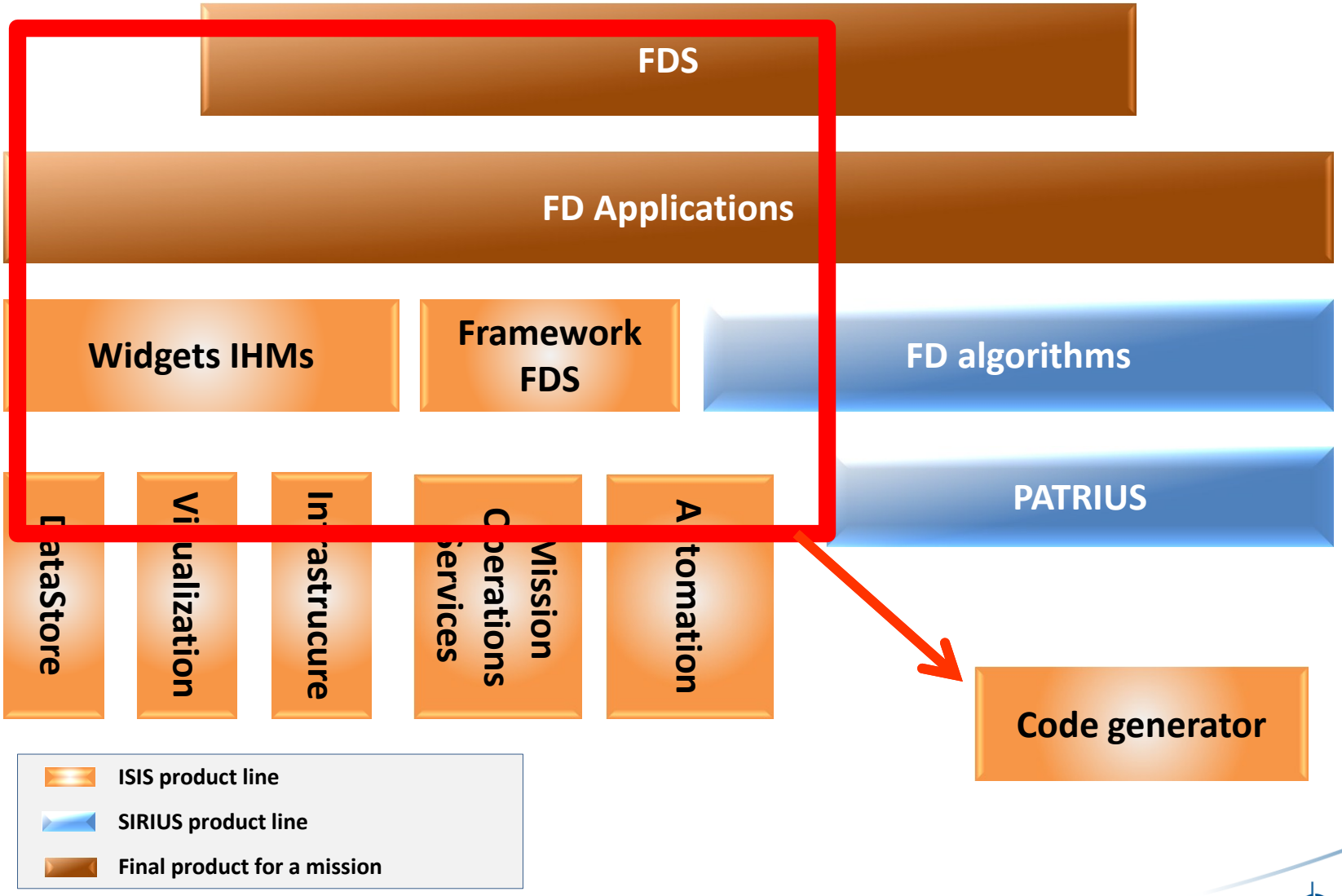
SUMMARY

- INTRODUCTION
- THE SCENARIO
- SCENARIO PROCESSINGS
- PRODUCTIVE PROPAGATOR
- DEVELOPMENT PROCESS

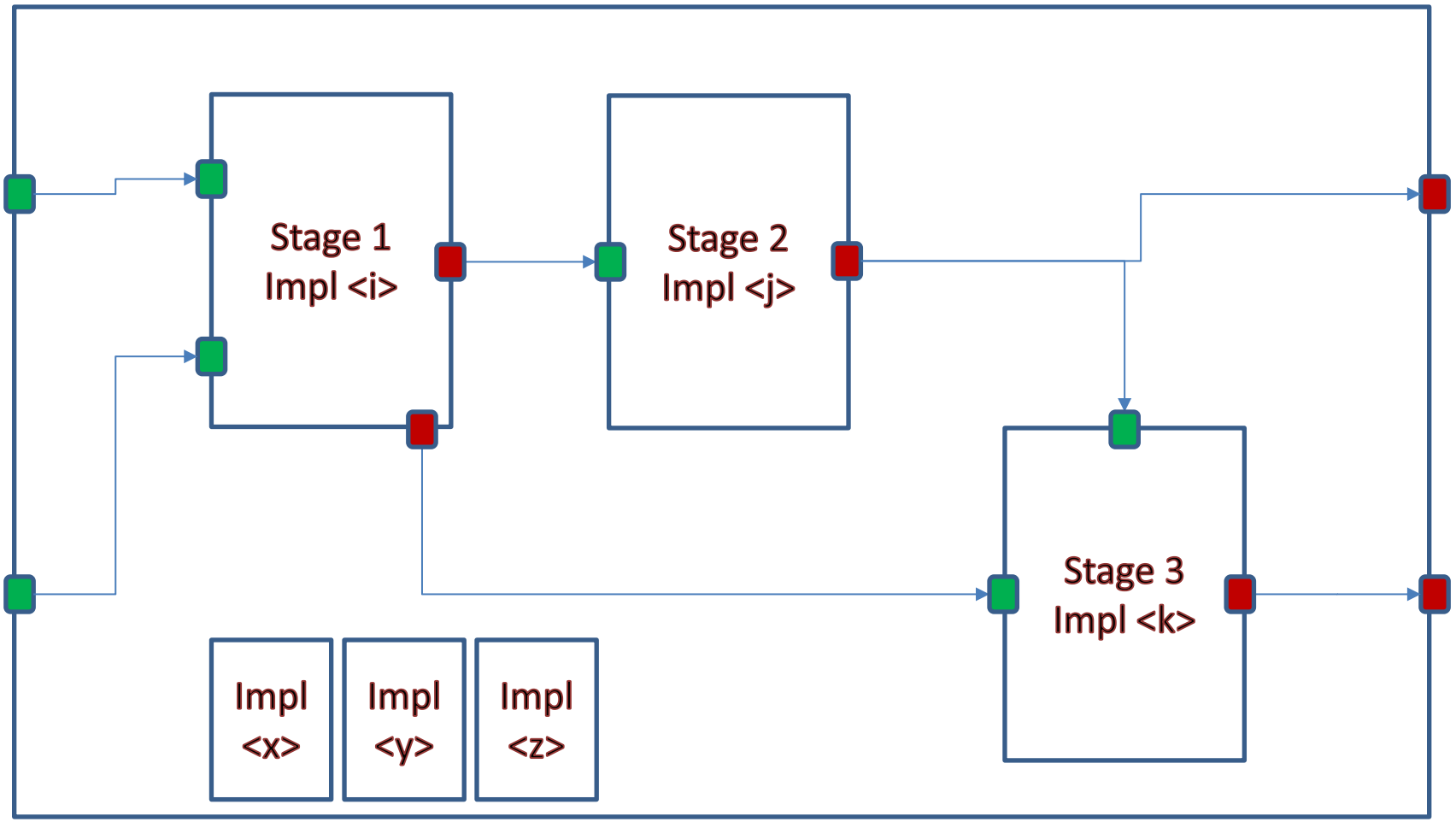
INTRODUCTION (I) : MAIN GUIDELINES

- New approach in the development of a FDS
  - Clear division between computation layer and FD supporting services
  - 2 different contracts
- Development driven by CNES
  - Architecture definition
  - Decomposition and reuse of functions
- FD services
  - A service can invoke other sub-services, and it only knows their interfaces
  - Stateless
  - Simple interface : Inputs (common arguments + specific parameter) + Response
- Why?
  - Flexibility
  - Easy to evolve
  - Limited coupling between computation layer and CC solutions

INTRODUCTION (II) : BUILDING A FDS



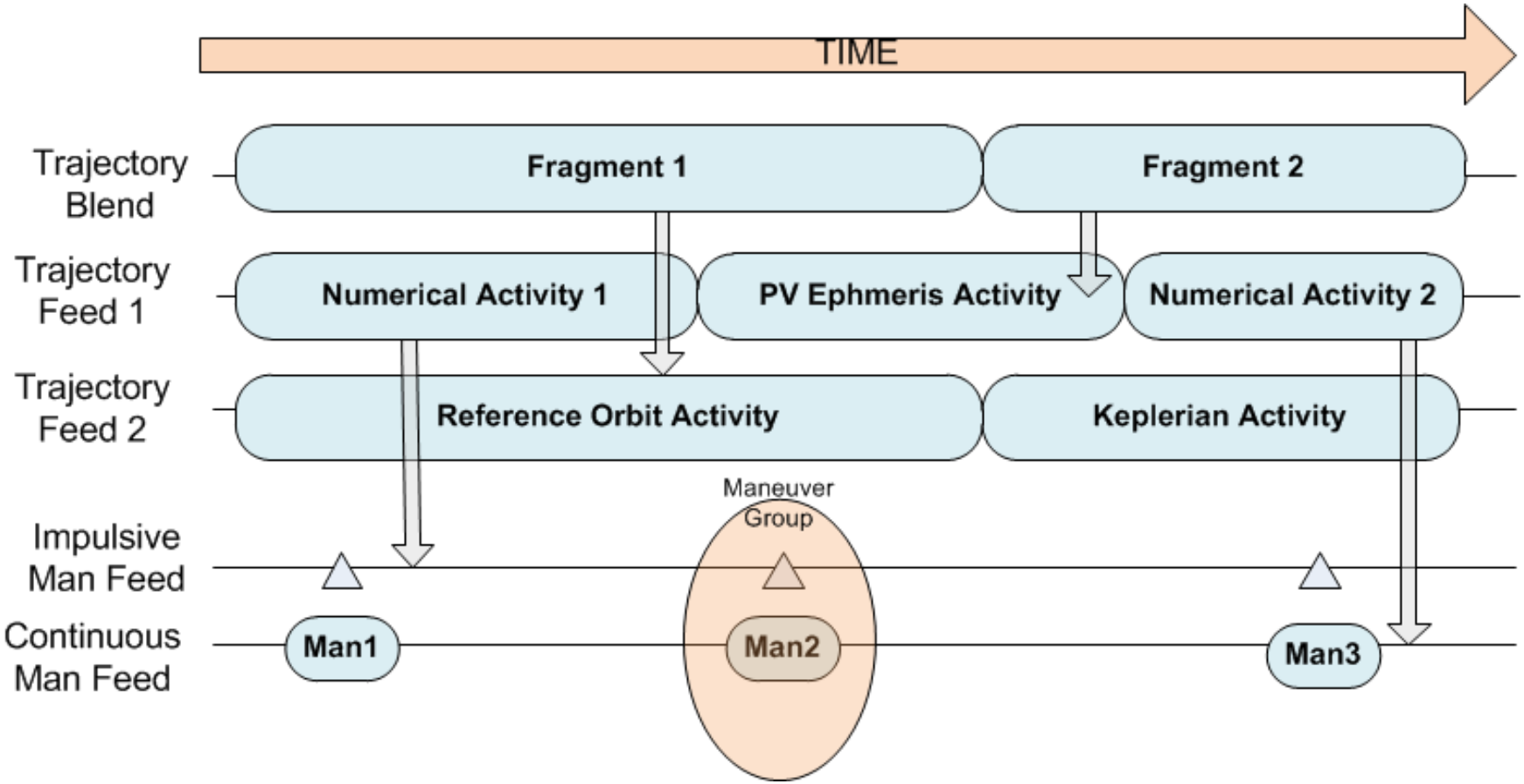
INTRODUCTION (III) : ASSEMBLING A FD SERVICE



SCENARIO (I) : THE CORE DATA

- Complex and structure data, without associated operations
- Describes the state and the evolution model of **one** satellite, over the whole lifetime
- Evolution in parallel (not independent) of the defined domains:
  - Trajectory
  - Attitude
  - Mass, inertias
  - …
- Composed by :
  - Activities : lowest level, per domain (trajectory, attitude)
  - Feeds : Temporal axis, per domain
  - Blends : Synthesis of the feeds, best global vision
- Its structure is adapted/defined for every mission

SCENARIO (II) : EXAMPLE



SCENARIO PROCESSINGS (I) : GENERAL CONCEPTS

- Simulation of the states of the scenario
- Several levels :
  - Blend processing
    - By fragments
    - By priority
    - By user selection
  - Feed processing
  - Activity processing
- Divided by the domains of the scenario
  - Trajectory, attitude, MCI, maneuvers, tanks, thrusters and solar arrays

SCENARIO PROCESSINGS (II) : TYPES

- Trajectory processing: Position/velocity at T
  - Blend : Searches the fragment and invokes the feed processing
  - Feed : Searches the activity (error if not found) and invokes the activity processing
  - Activity : Depends on type (numerical, keplerian, ephemeris,…)
- Attitude processing: Attitude (and derivatives) at T
  - Blend : Searches the feed by priority
  - Rest as trajectory, but no error in feed processing
- Maneuver processing : Force/delta-V produced by the maneuver at T
  - Blend : Searches the maneuver by user choice.
  - Feed : Searches the activity (no error) and invokes the activity processing
- MCI processing : Mass, center of gravity and inertia at T
- Tank processing : Tank state (propellant mass, Pressure, Temp) at T
- Thruster processing : Flow rate, force, throughput of thruster at T
  - Similar logic as for trajectory

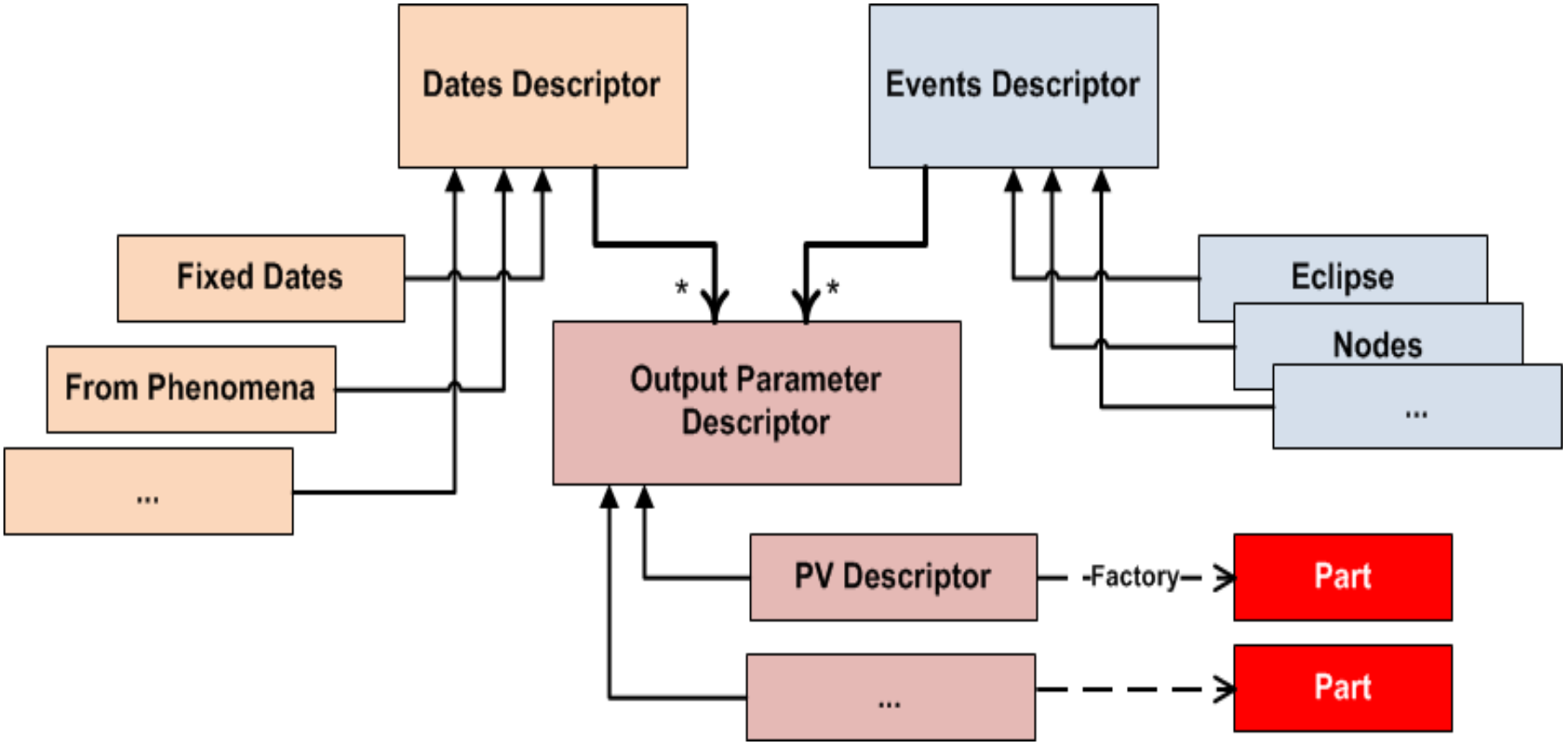
PRODUCTIVE PROPAGATOR (I)

- In charge of producing output ephemeris (list of time-stamped data) :
  - At dates, as defined by the input list of DateDescriptor
    - Fixed dates
    - Given interval
    - Interval of a phenomenon
  - At events, as defined by the input list of EventDescriptor

- The output data are defined by OutputParametersDescriptor
  - Reference to scenario descriptors (blend/feed) needed in the computation
  - Dedicated « part » in charge of filling the data

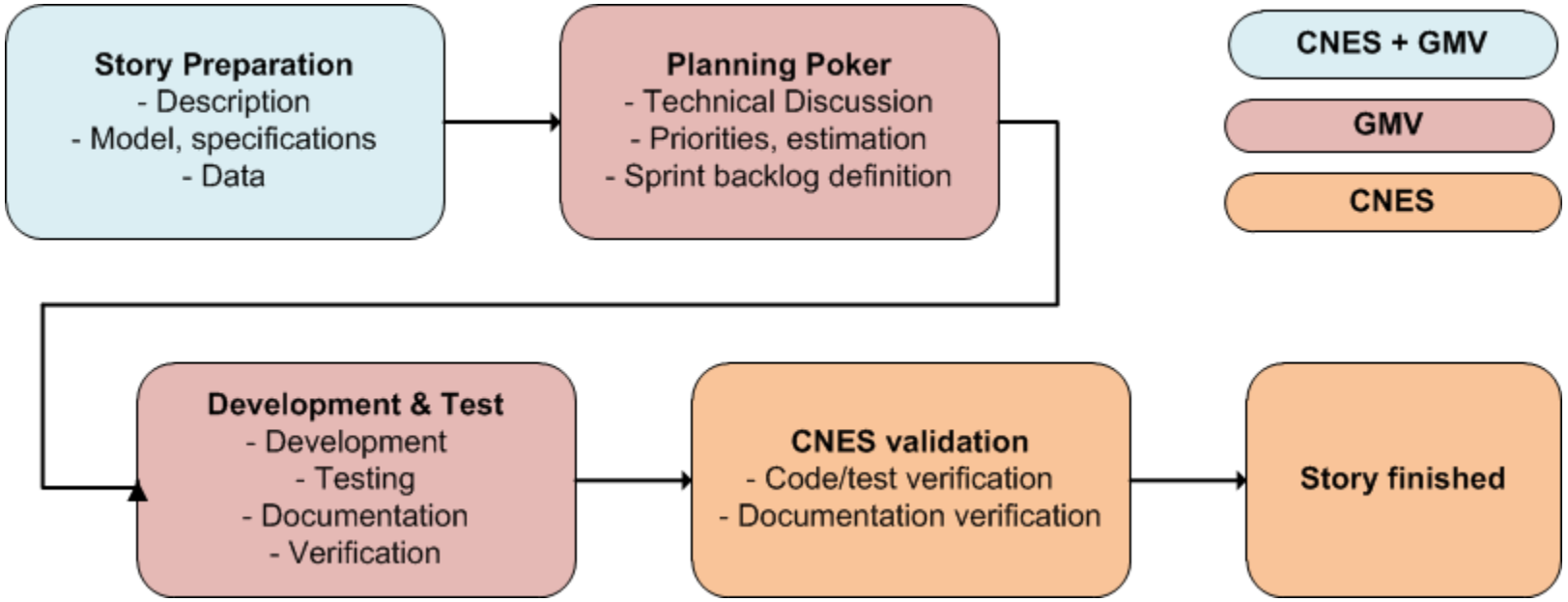
- Algorithm:
  - The output parameters define the data from scenario that are needed.
  - The scenario processings are in charge of simulating (propagation) the scenario state with the required descriptors (feed/blend) at desired date.
  - The part is invoked with this scenario state to compute and fill the output parameter

PRODUCTIVE PROPAGATOR (II)



DEVELOPMENT PROCESS

- Agile/SCRUM with 4-weeks sprints
- CNES builds the model (data, interfaces, requirements).
- The templates of the code are generated (using a code-generator).
- The code is implemented, tested and documented by GMV.
- CNES checks if everything is OK and closes the story.



Thank you for your attention ☺

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