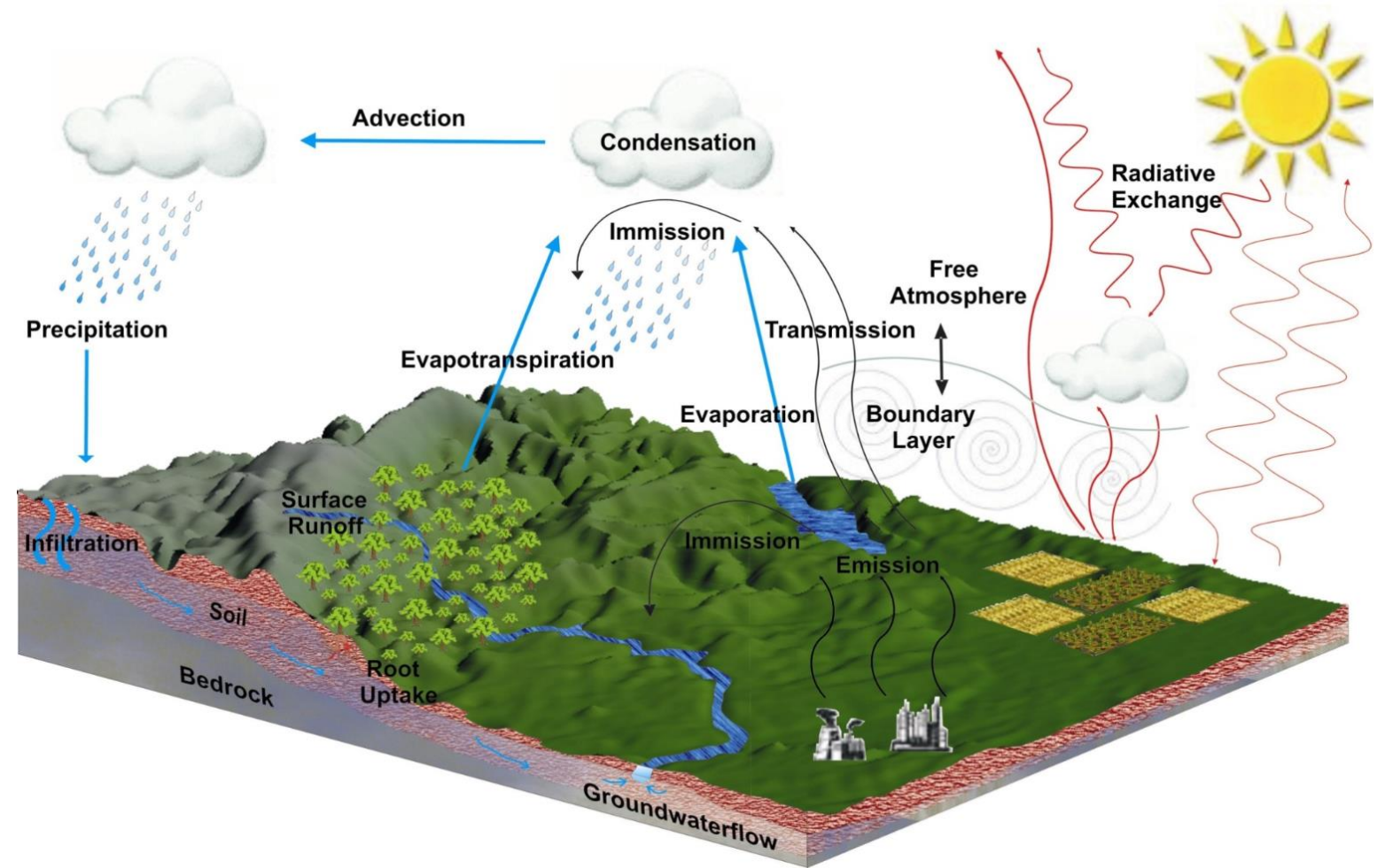# Joint SEA Projects Demo

Hans-Christian Hoppe, Philippe Couvée, GrégoirePichon
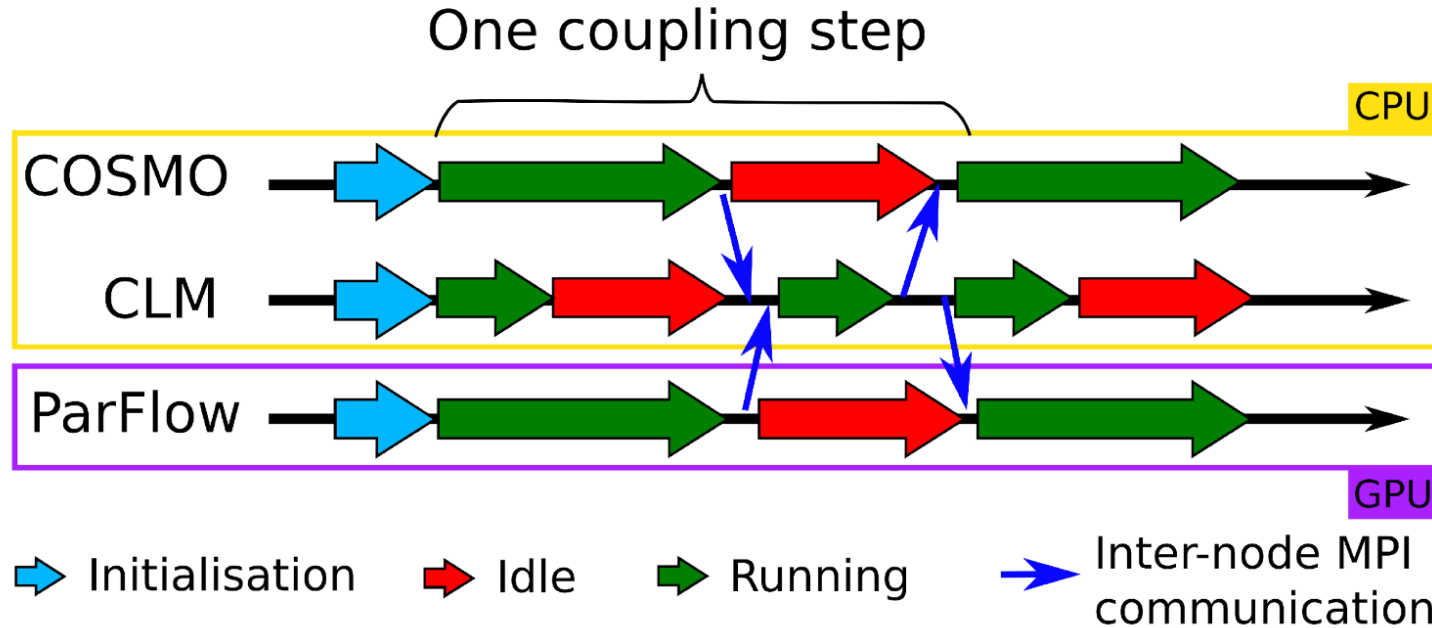
January 16, 2024

Terrestrial Systems Modelling Platform (TSMP) Problem

- Complex interactions and feedbacks between various sub-systems of the coupled geo-ecosystem, many drivers

- Linkages through energy, mass and momentum transfers

- Multiple spatio-temporal scales

- Anthropogenic physical system changes modify land surface and ecosystem processes and services with many socio-economic impacts
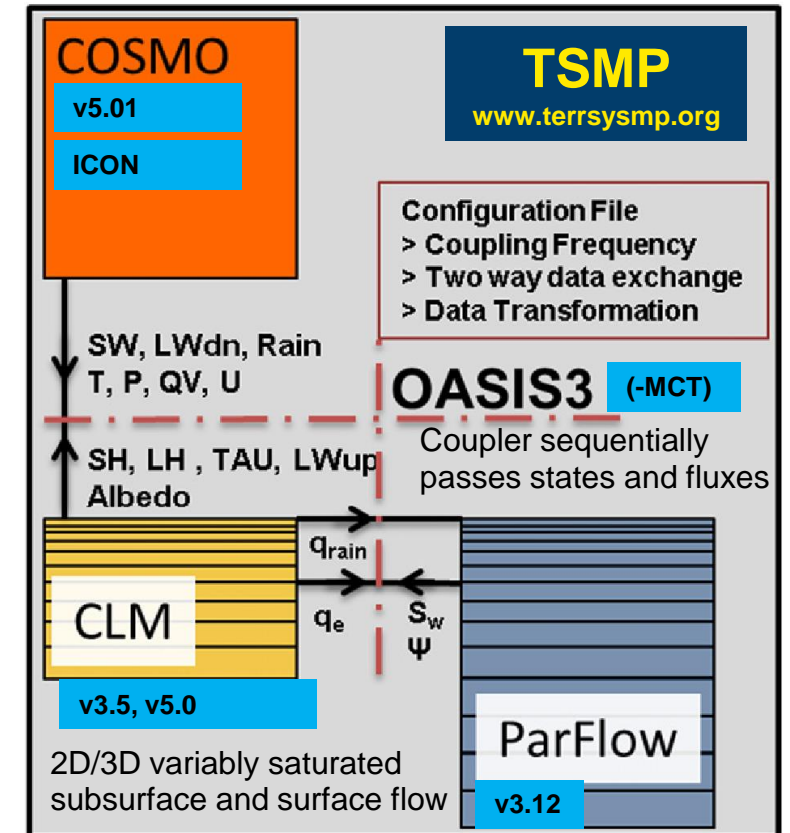
Terrestrial Systems Modelling Platform (TSMP) Application

One coupling step

COSMO · CLM · ParFlow

CPU
GPU

Initialisation · Idle · Running · Inter-node MPI communication

Large(r) problems with high(er) resolution will require heterogeneous and modular solutions, which come with new

– load balances
– scaling behaviours
– bottlenecks
– other unexpected things…

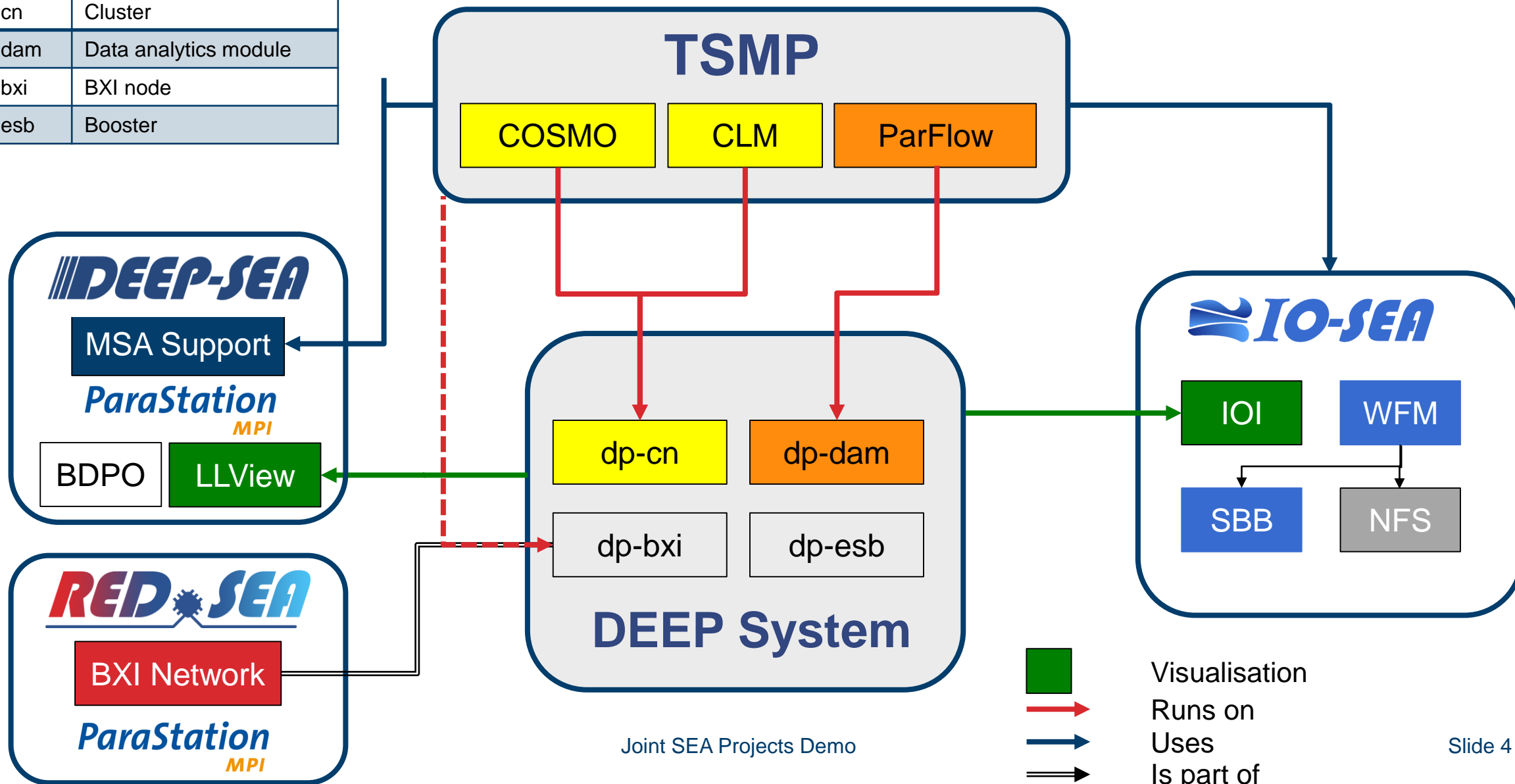**Multiple Program, Multiple Data & Multiple Hardware (MPMD&MH)**

COSMO
v5.01
ICON

TSMP
www.terrsysmp.org

Configuration File
> Coupling Frequency
> Two way data exchange
> Data Transformation

SW, LWdn, Rain
T, P, QV, U

OASIS3 (-MCT)

SH, LH , TAU, LWup
Albedo

Coupler sequentially passes states and fluxes

q_{rain}

CLM · q_e · S_w · Ψ
v3.5, v5.0

ParFlow
v3.12

2D/3D variably saturated subsurface and surface flow

Shrestha et al. (2014, Mon Weather Rev); Gasper et al. (2014, GMD); Kurtz et al. (2016, GMD); Burstedde et al. (2018, Comput Geosc)

TSMP in the SEA Projects: Running on the MSA

dp-cn	Cluster
dp-dam	Data analytics module
dp-bxi	BXI node
dp-esb	Booster

TSMP

COSMO | CLM | ParFlow

DEEP-SEA

MSA Support

ParaStation MPI

BDPO | LLView

RED SEA

BXI Network

ParaStation MPI

DEEP System

dp-cn | dp-dam

dp-bxi | dp-esb

IO-SEA

IOI | WFM

SBB | NFS

Visualisation

Runs on

Uses

Is part of

Joint SEA Projects Demo

Slide 4

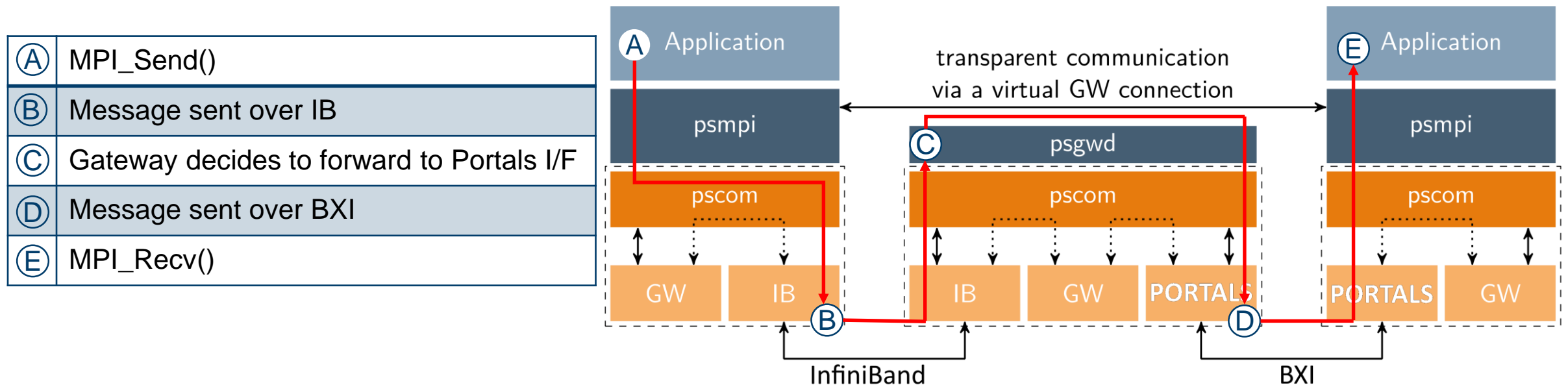# Multi-Module Execution Explained

Gateway processes/nodes bridge between different networks
- − Diagram shows integration with the pscom multi-network communication layer of ParaStation MPI
- − Similar approaches being integrated with MPC and OpenMPI

Totally transparent to the application

Applications are launched via mpirun/mpiexec or srun, with flags specifying mapping of processes to modules
- − Gateways are started and managed automatically

Ⓐ	MPI_Send()
Ⓑ	Message sent over IB
Ⓒ	Gateway decides to forward to Portals I/F
Ⓓ	Message sent over BXI
Ⓔ	MPI_Recv()

Acknowledgements