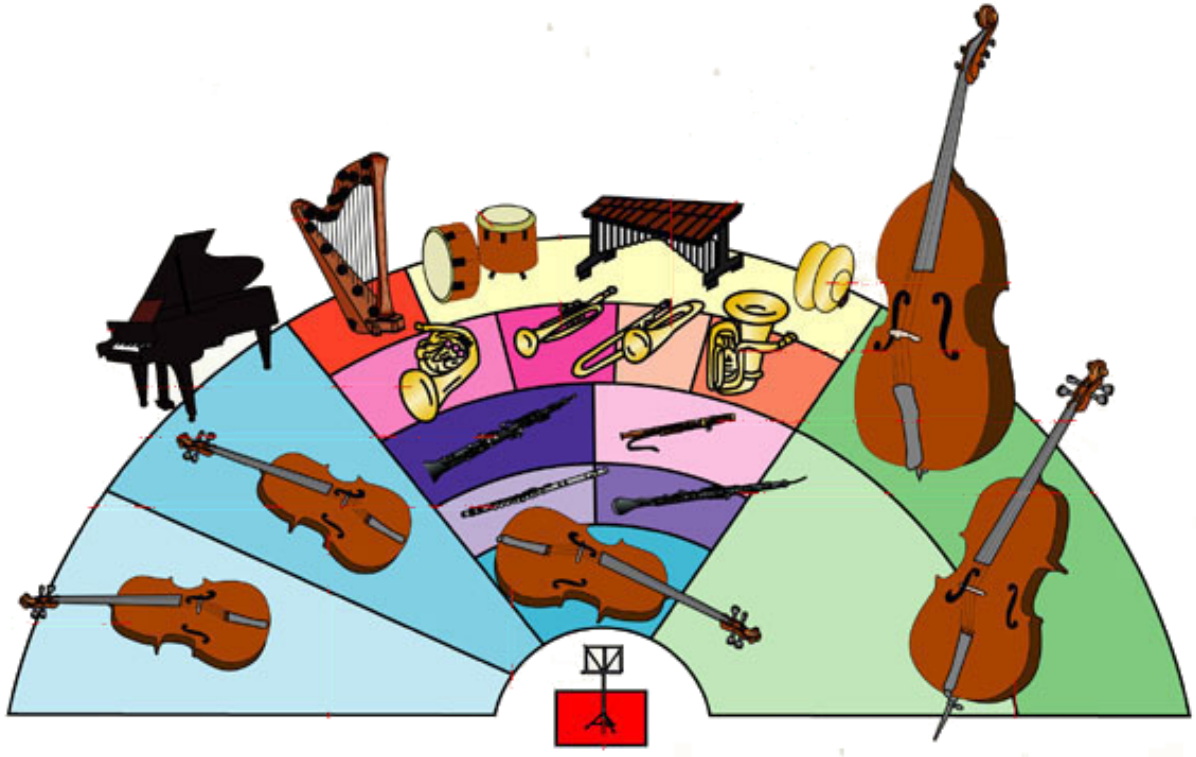

MUSIC

the Multi-Simulation Coordinator

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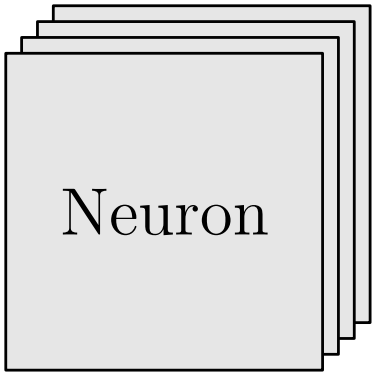
Introduction

The purpose of MUSIC

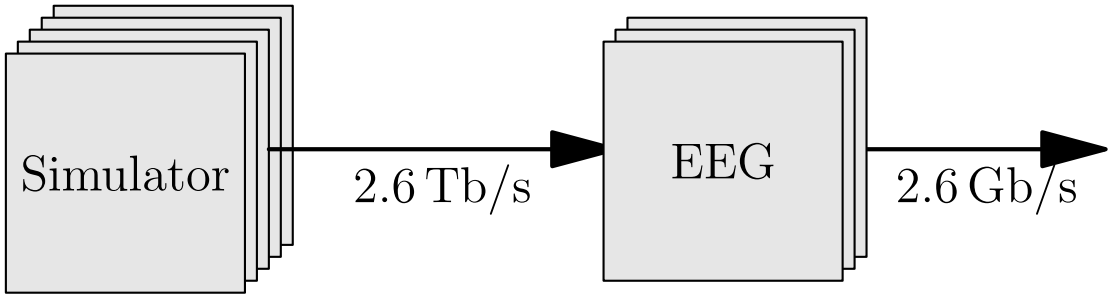
- On-line pre- or post-processing of huge amounts of data for a parallel simulator within the cluster
- Connect models developed for different parallel simulators
- Promote re-usability through modularity

Introduction

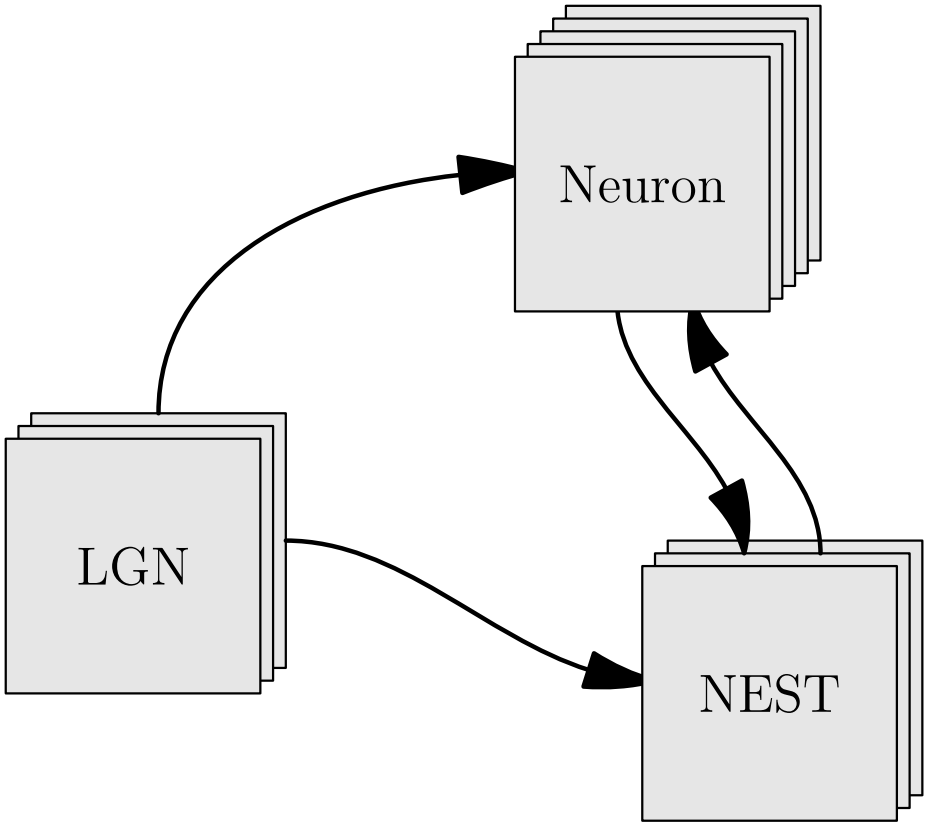



```
mpirun -np 4 nrniv my_simulation.hoc
```

Introduction



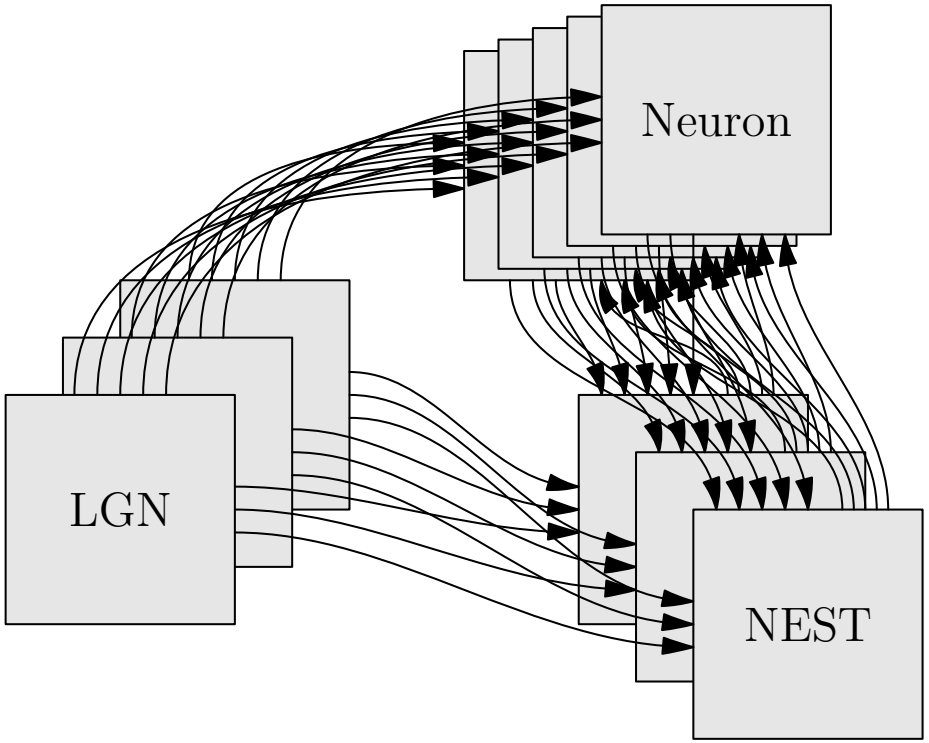
Introduction




```
mpirun -np 3 -hostfile h1 my_lgn_model
mpirun -np 5 -hostfile h2 nrniv my_simulation.hoc
mpirun -np 3 -hostfile h3 nest my_simulation.sli
```


Örjan Ekeberg and Mikael Djurfeldt

Introduction



Introduction

Recommendation from the report of the 1st INCF Workshop on Large-scale Modeling of the Nervous System:

> "**Implement an experimental framework for connecting software components.** *A feasibility study should be performed regarding the possibility of on-line communication between different software modules, for example two parallel simulators. INCF should allocate resources for implementing a software library with a communication interface.*"

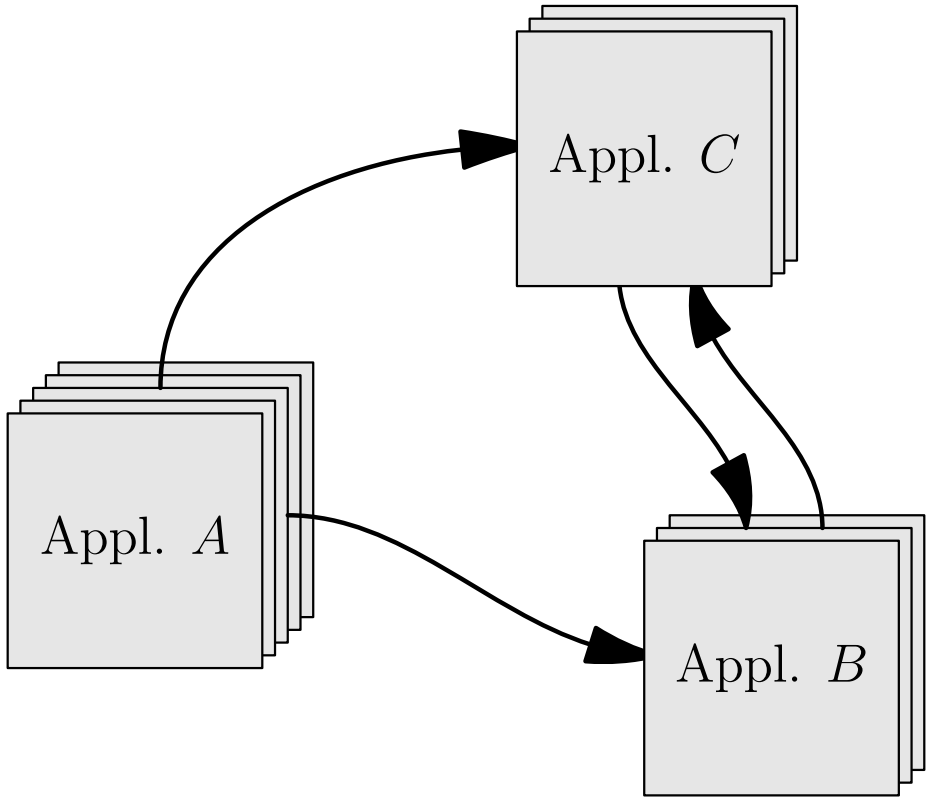
- MUSIC standard and software provided and supported by the International Neuroinformatics Coordinating Facility (INCF)
- Being developed by the CSC, KTH in a collaborative partnership with the INCF
- Released publicly under the GPL license through the INCF Software Center in early 2009

Introduction

Design Goals

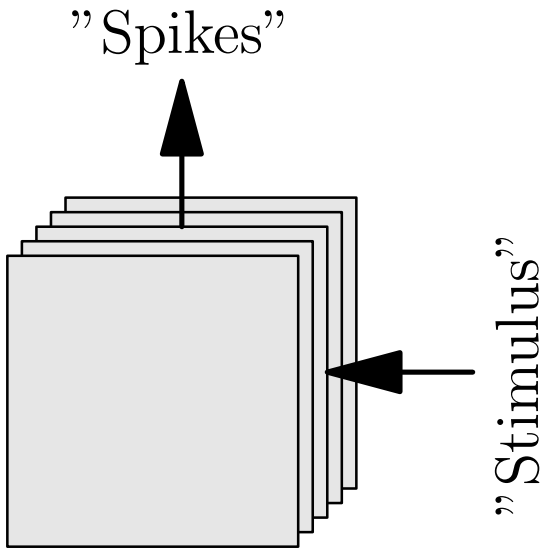
- **Portability**
  Based on C++ and MPI
- **Simplicity**
  Minimal impact on existing simulators
- **Independence**
  Encourage independent tool development
- **Performance**
  High bandwidth, low latency through use of MPI
- **Extensibility**
  Some classes in API can be subclassed

Users View of MUSIC



A multi-simulation where several parallel applications exchange runtime data

Users View of MUSIC



- MUSIC-adapted applications present Ports
- Ports have names
- User connects ports via a *configuration file*

Users View of MUSIC

Typical configuration file `my_simulation.music`:

```
stoptime=1.0
[model]
  binary=nrniv
  args=my_simulation.hoc
  np=40
[EEG]
  binary=eegsynthesizer
  args=geometry.dat 50e-6 10
  np=12
  model.eneurons -> input[1600]
```

```
mpirun -np 52 music my_simulation.music
```

Programmers View of MUSIC

Execution goes through three phases

- Launch phase
  Outside the control of the application
- Setup phase
  Declaration and mapping of ports
- Runtime phase
  Simulation and transfer of data

Programmers View of MUSIC

Each application is responsible for:

1. Initializing MUSIC
2. Creating Ports
3. Mapping Ports
4. Initiating the Runtime Phase
5. Advancing Simulation Time

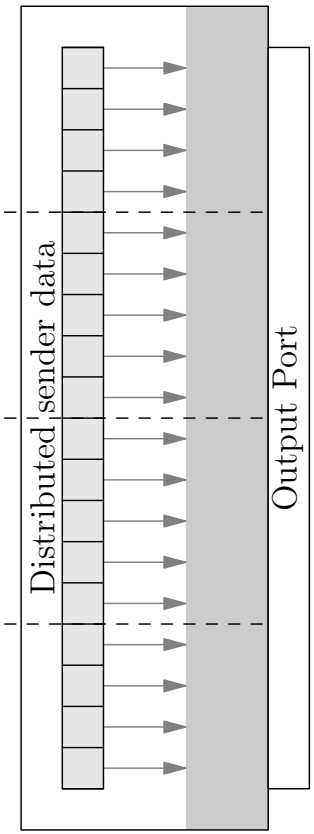
Programmers View of MUSIC

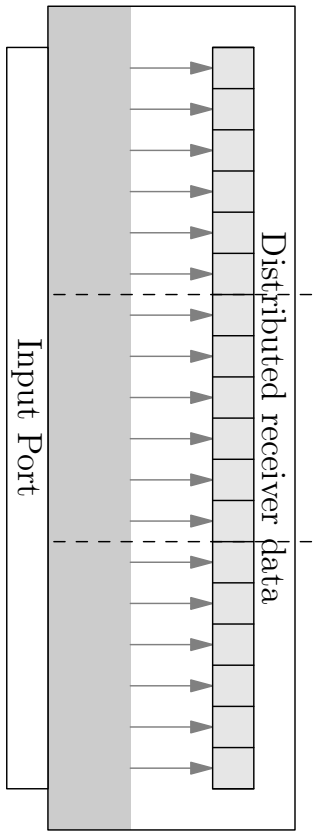
Initializing MUSIC

```
int main (int argc, char *argv[])
{
  setup = MUSIC::setup (argc, argv);
  comm = setup->communicator ();
  ...
}
```

Programmers View of MUSIC

Programs announce willingness to send or receive data via ports





Programmers View of MUSIC

Creating and mapping a port

```
p = setup->publish_cont_output ("out");

array_data m (state_vars, MPI::DOUBLE,
              mybase, mysize);
p -> map (&m);
```

Programmers View of MUSIC

Supported Data Types

- Continuous — Time varying values
  - Sender: Reading from user data structures
  - Receiver: Writing into user data structures
- Events — Spikes
  - Sender: User calls an insertion function
  - Receiver: MUSIC calls user-supplied handler
- Messages — Arbitrary strings of bytes
  - Sender: User calls an insertion function
  - Receiver: MUSIC calls user-supplied handler

Programmers View of MUSIC

Initiating the runtime phase

```
...
runtime = new MUSIC::runtime (setup, 0.0001);

while (runtime->time () < stoptime)
  {
    ...
    runtime->tick ();
    ...
  }
```

Implementers View of MUSIC

What goes on behind the scene?

- Spatial Aliasing

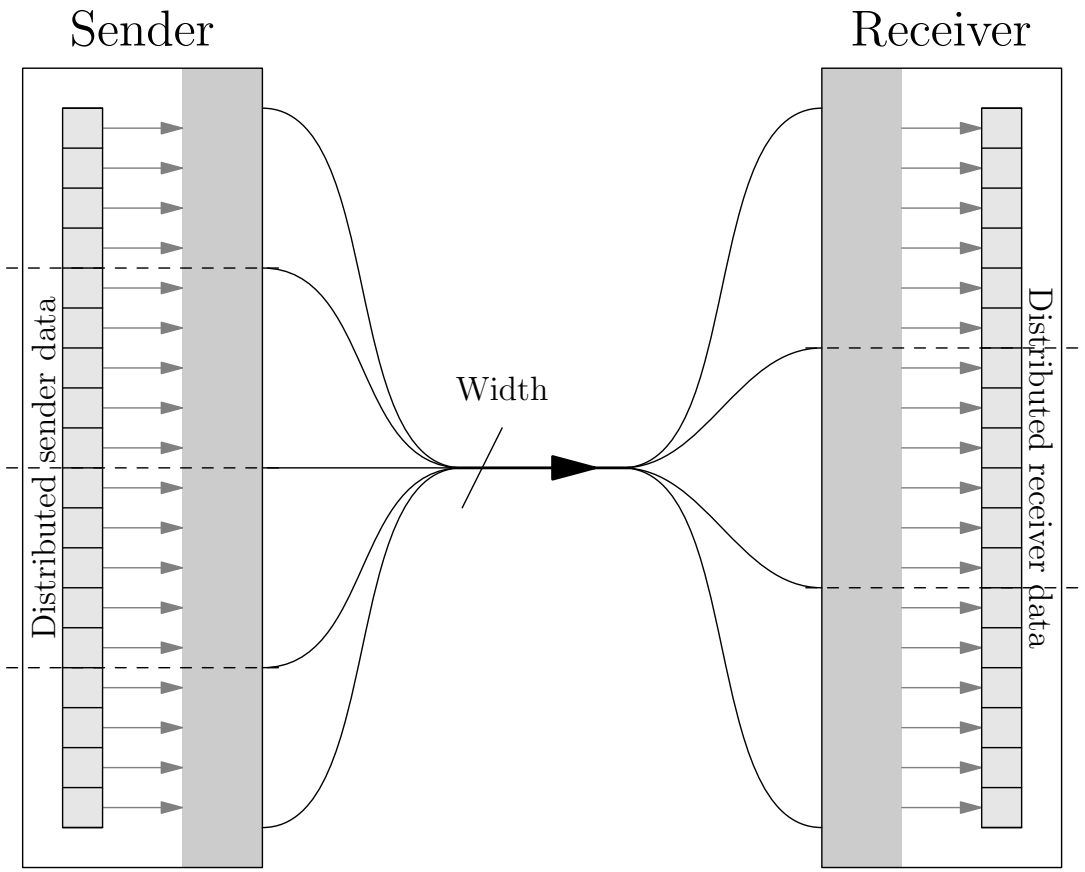
  Data resides on different processors

- Temporal Aliasing

  Different applications may use different time steps

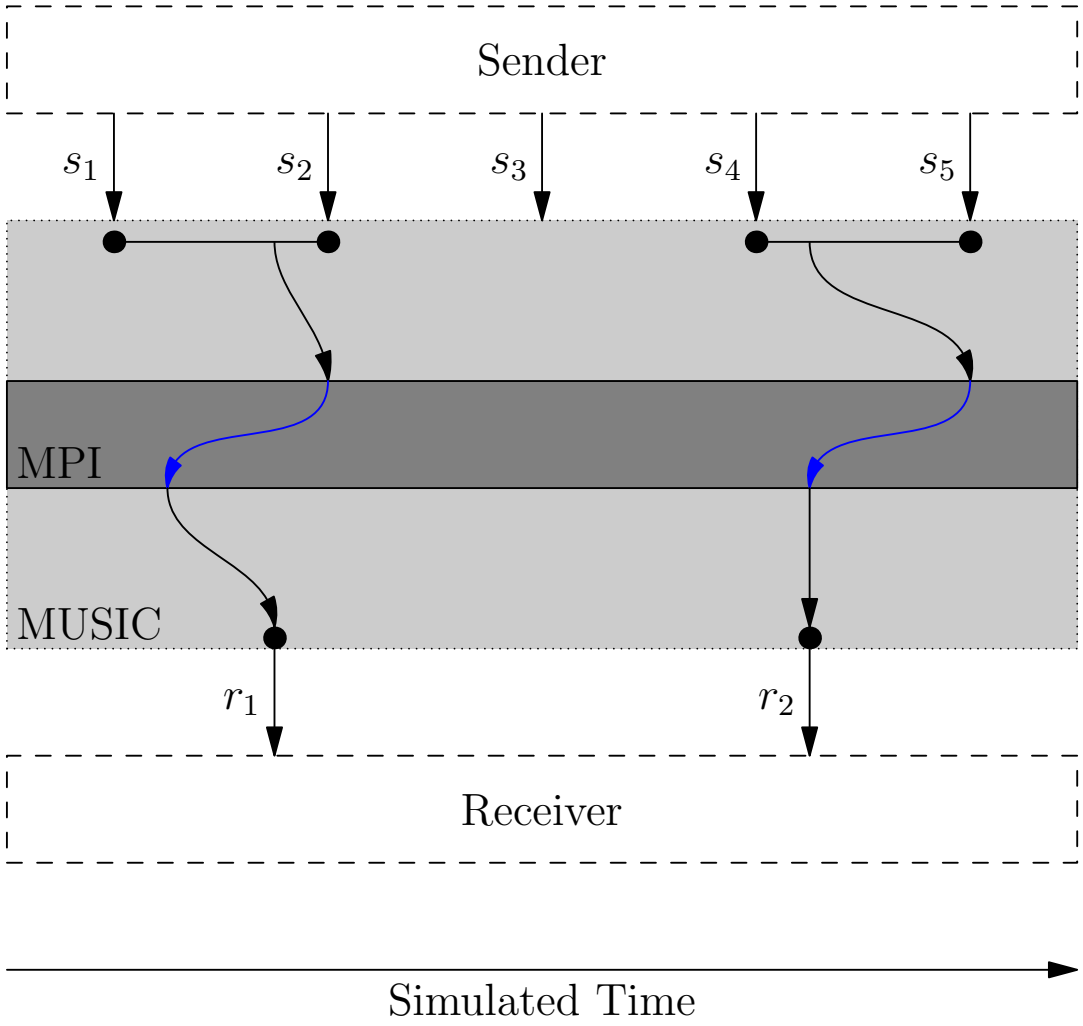
Implementers View of MUSIC

Spatial Aliasing



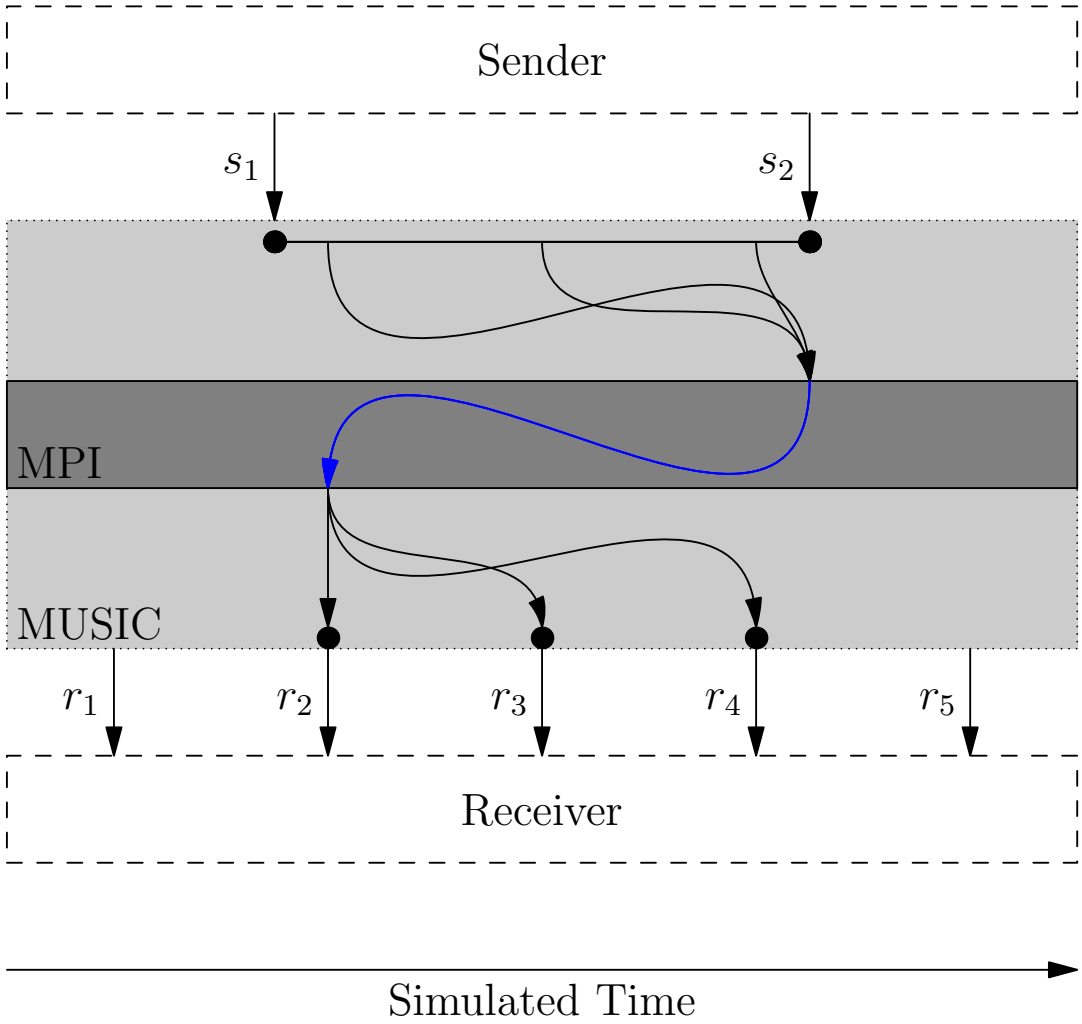
Implementers View of MUSIC

Temporal Aliasing



Implementers View of MUSIC

Temporal Aliasing



Request For Comments

- MUSIC project page

  http://www.incf.org/programs/modeling/music-multi-simulation-coordinator

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