Homogeneous Resource Configuration and Access for an Autonomous Robotic Vehicle

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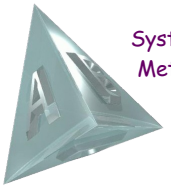


System Design
Methods Lab

ERT

Embedded & Real-Time Systems Lab

Background

- Participation in DGC entry development
  - 13-month consortium effort [Indy Robotics]
  - individuals, groups, small companies, university groups
- Lessons:
  - reasonable infrastructure (Pub/Sub
  - system integration problems (recalibration, asynchronus)
  - distance collaboration is difficult
  - high general interest at IU---cognitive robotics, computer learning, networking, etc.
- Local *experimental platform* needed

ERTS Embedded & Real-Time Systems Lab

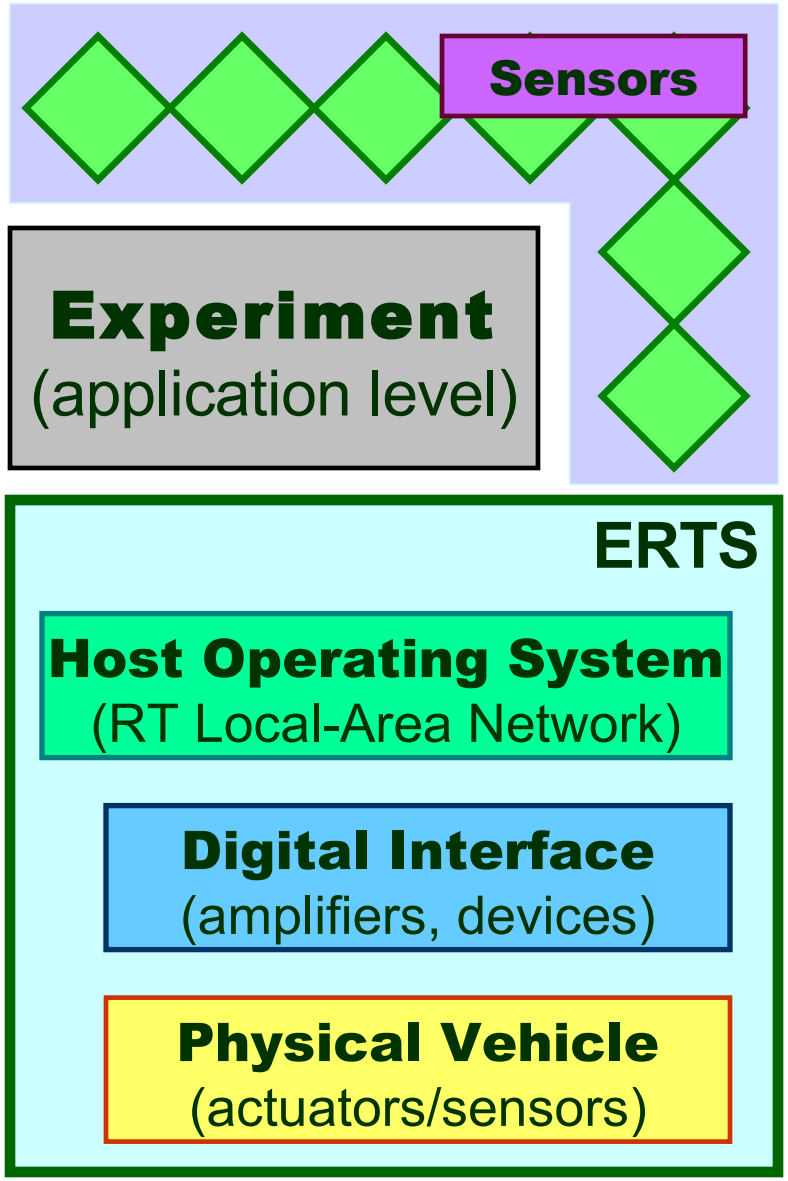
Functional goal: *autonomous* real-world navigation

Mission: *collaborative* research and instruction

Needs: horizontal and vertical *configurability*

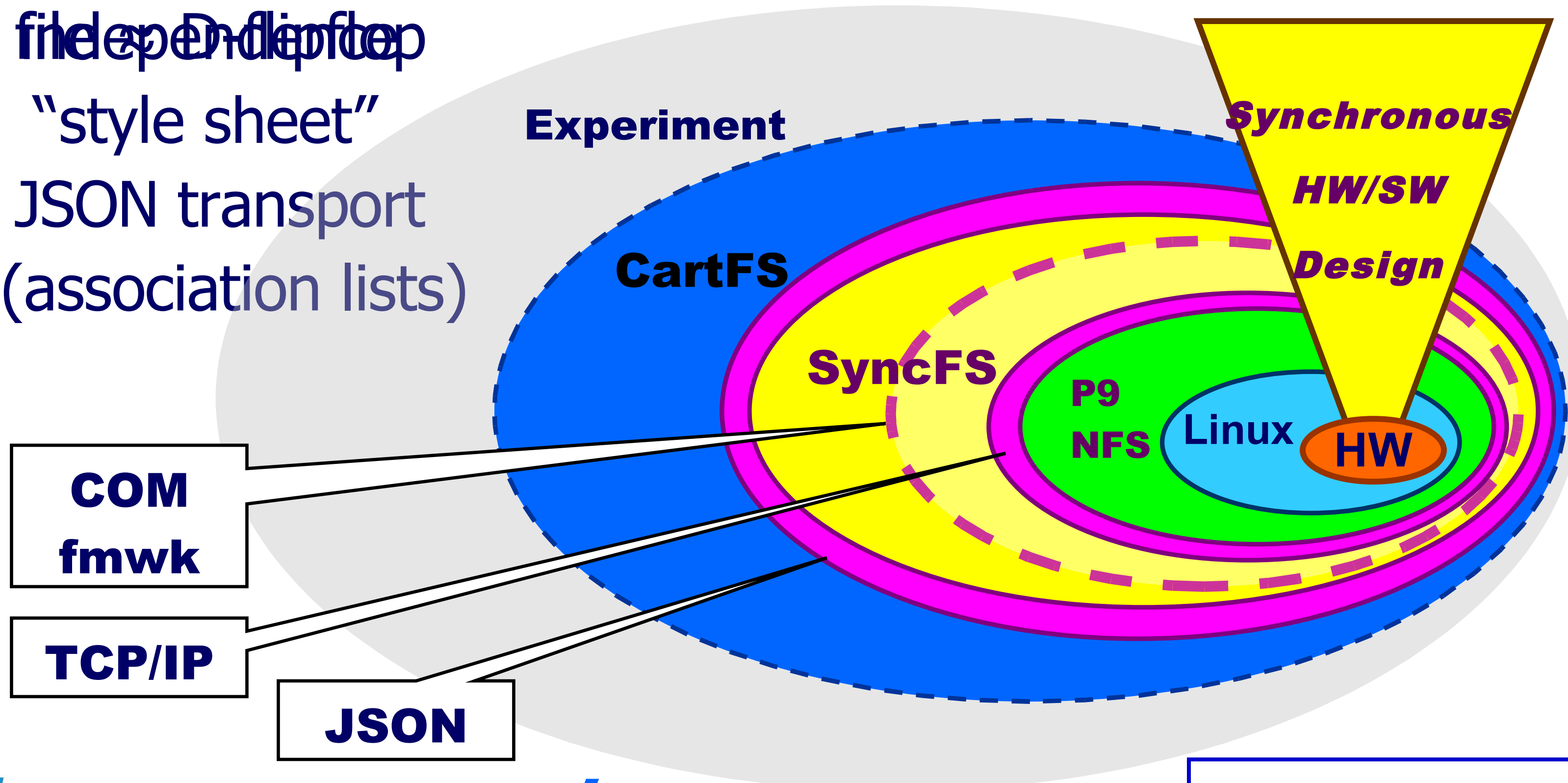
ERTS Architecture

- CS Systems Research
  - deep penetration
- AI, Vision, CogSci
  - flexible capabilities
  - rapid integration
- Education
  - early (ugrad.) exposure
  - physical testing
  - diverse backgrounds
  - *rapid* prototyping



ERTS/SyncFS Prototyping Environment

- CartFS Implementation Model
- SyncFS Design Support
  - modified version of P9
  - component based
  - { *read* ; *process* ; *write* }*
  - implicit CLOCK
  - language
  - synchronization, "time triggered"
  - file => D-flipflop
  - independence
  - "style sheet"
  - JSON transport (association lists)



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SyncFS Synchronized File System

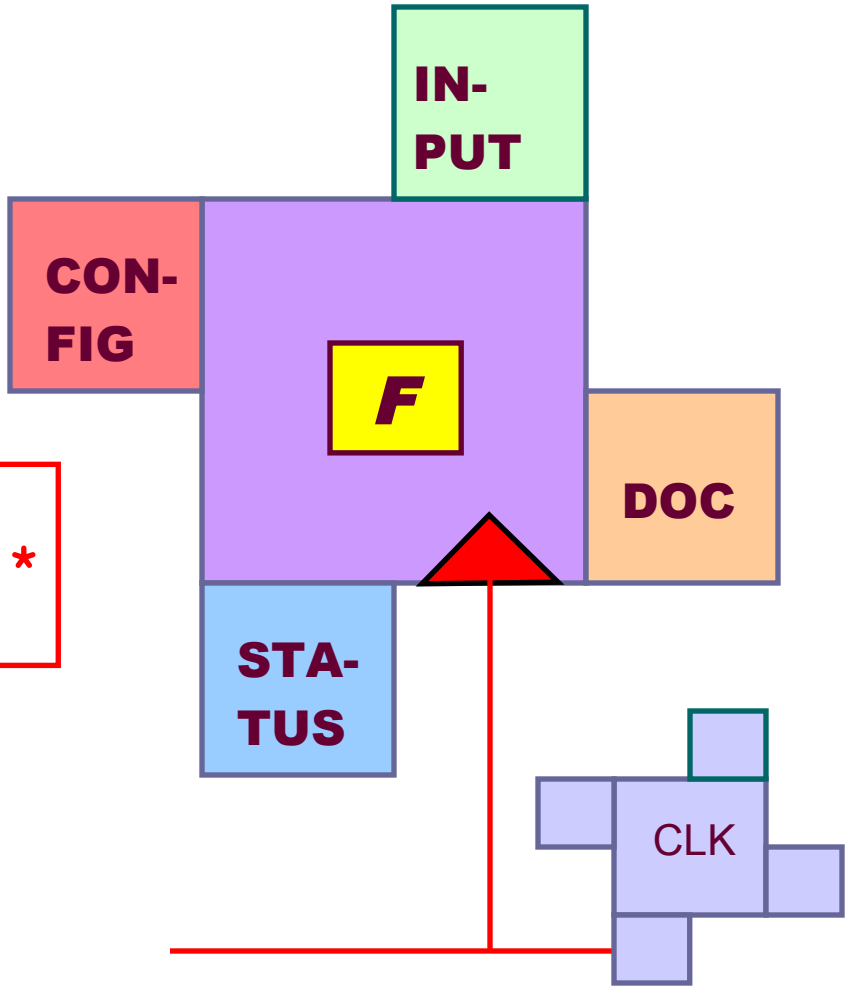
- Modified version of P9 NFS from [Plan 9] inspired by [Brown & Pisupati, 2006]
  - small, open source, ships with Linux
- Basic FS I/F to shared data (asynchronous)
  - interal files
  - **mount -t 9p** *ip dir* **-o rw,port=p,access=any**
- Synchronous support
  - ***CLK*** component
  - ***write***, ***stat*** deferred to CLK "edge"

CartFS Component Model

- MRSW file system
- Component
  - synchronizes with CLK
  - writes only its STATUS

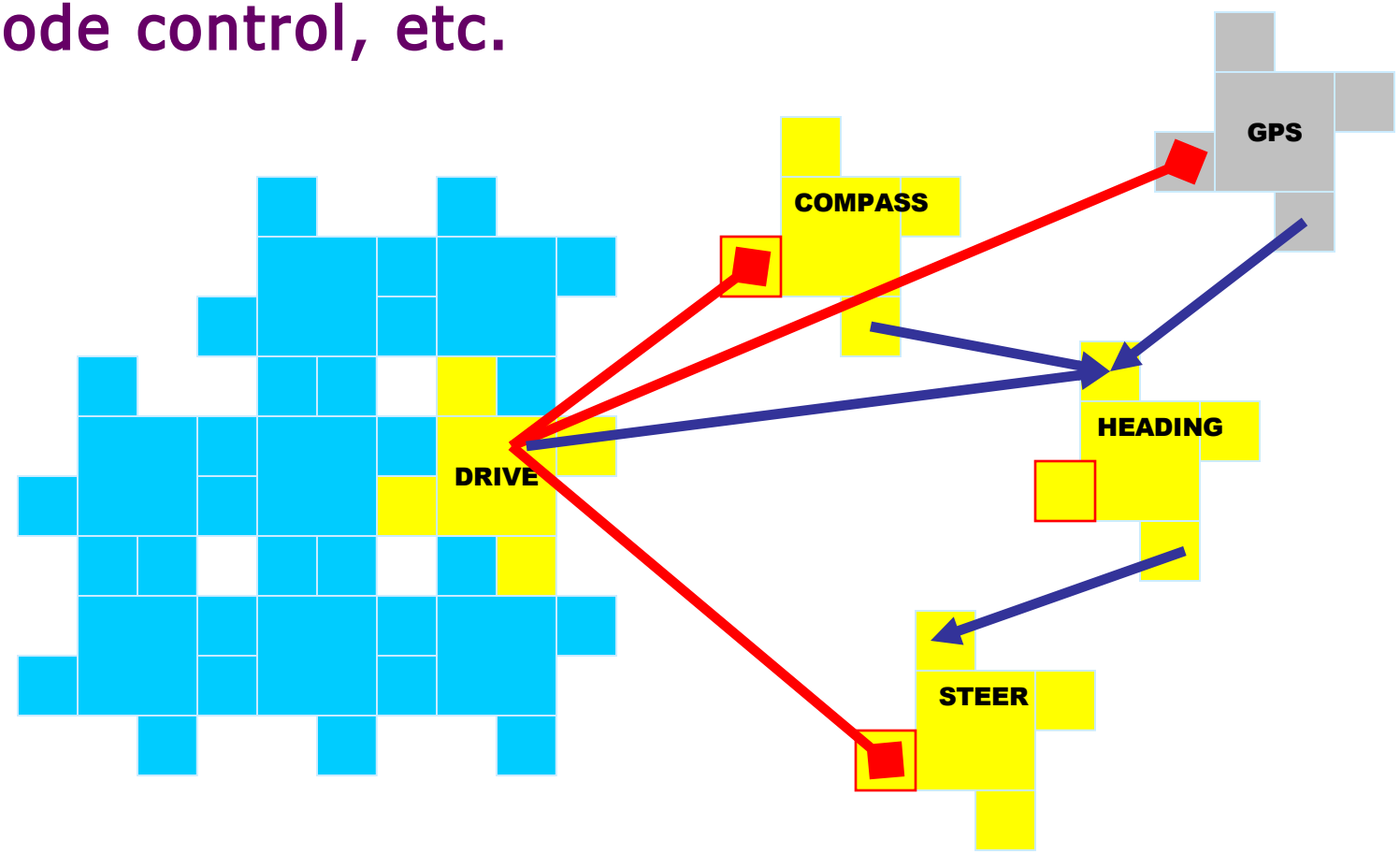
```
init;
{read ; process ; write; }*
exit;
```

  - file ≈ association list

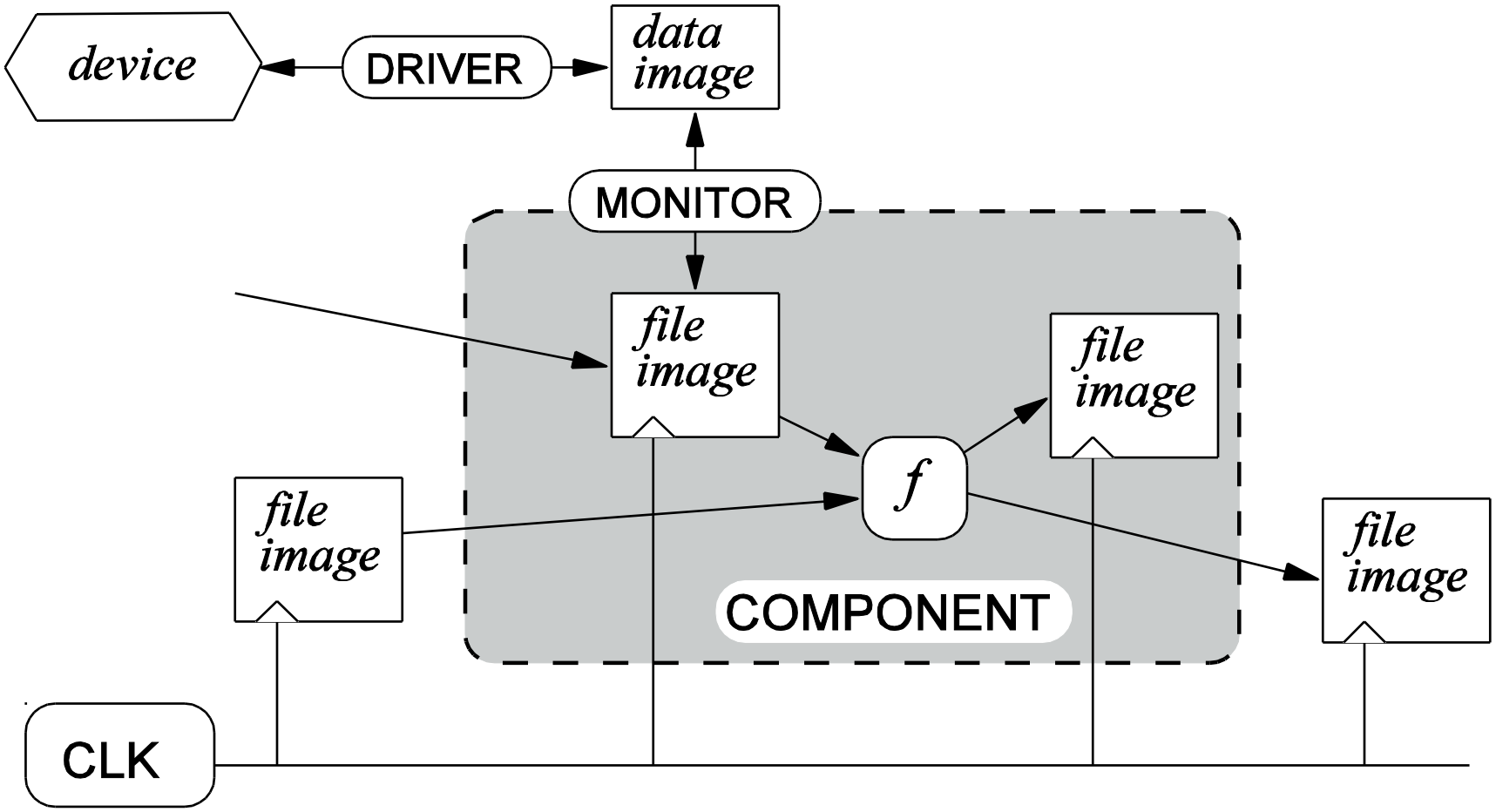


Dynamic configuration

- Call by reference (file name) via CONFIG file
- Mode control, etc.

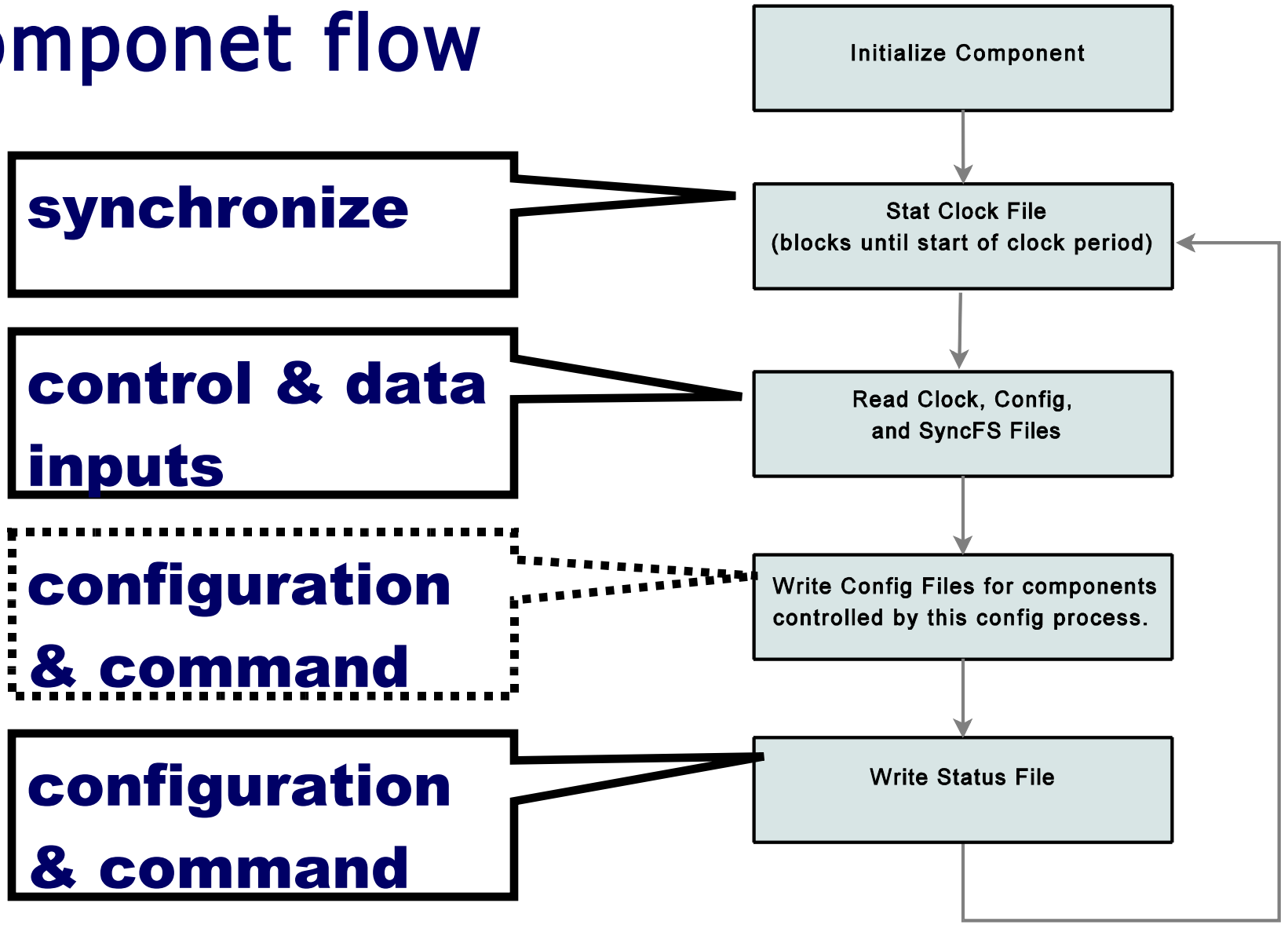


CartFS compontent

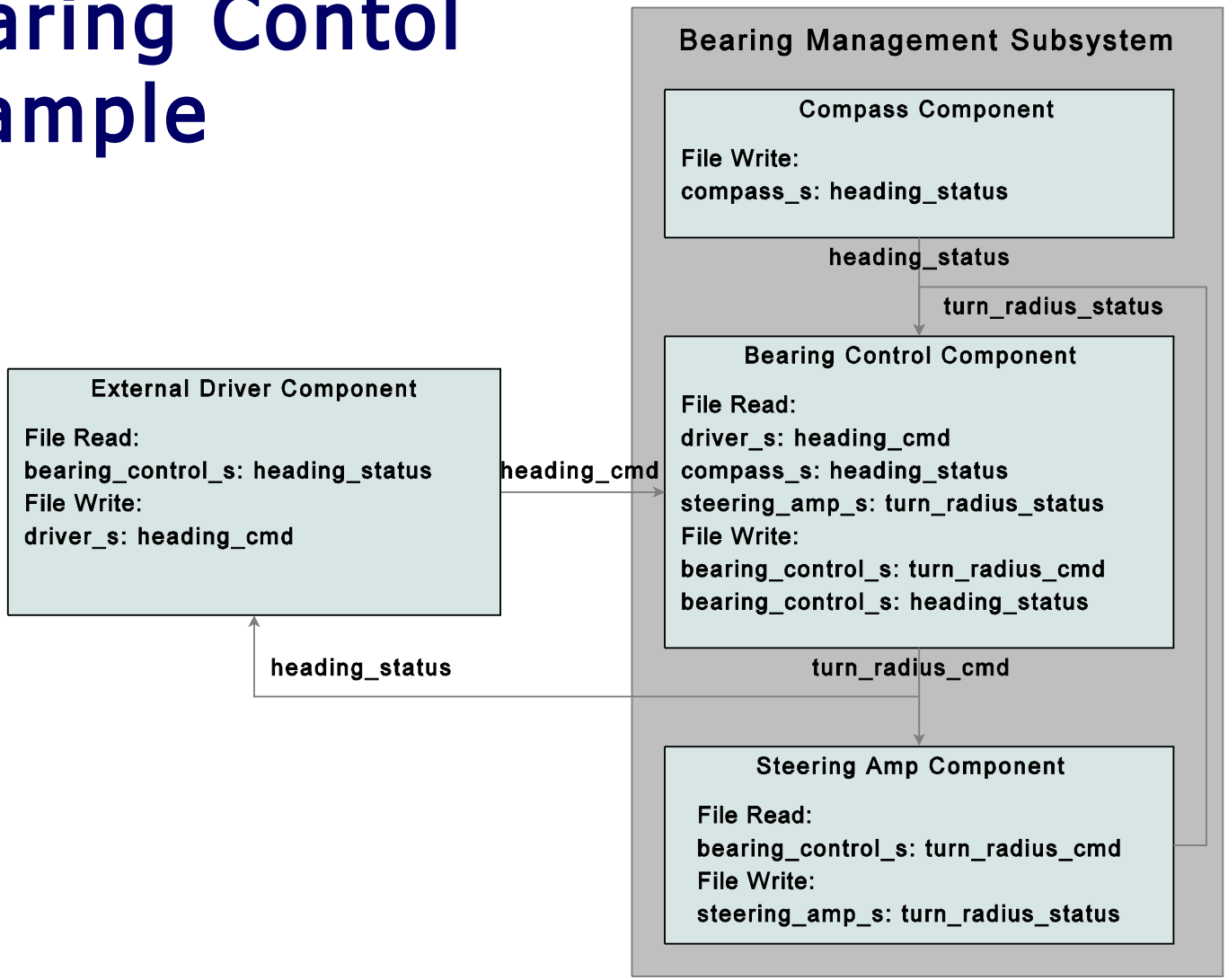


Conclusions, directions

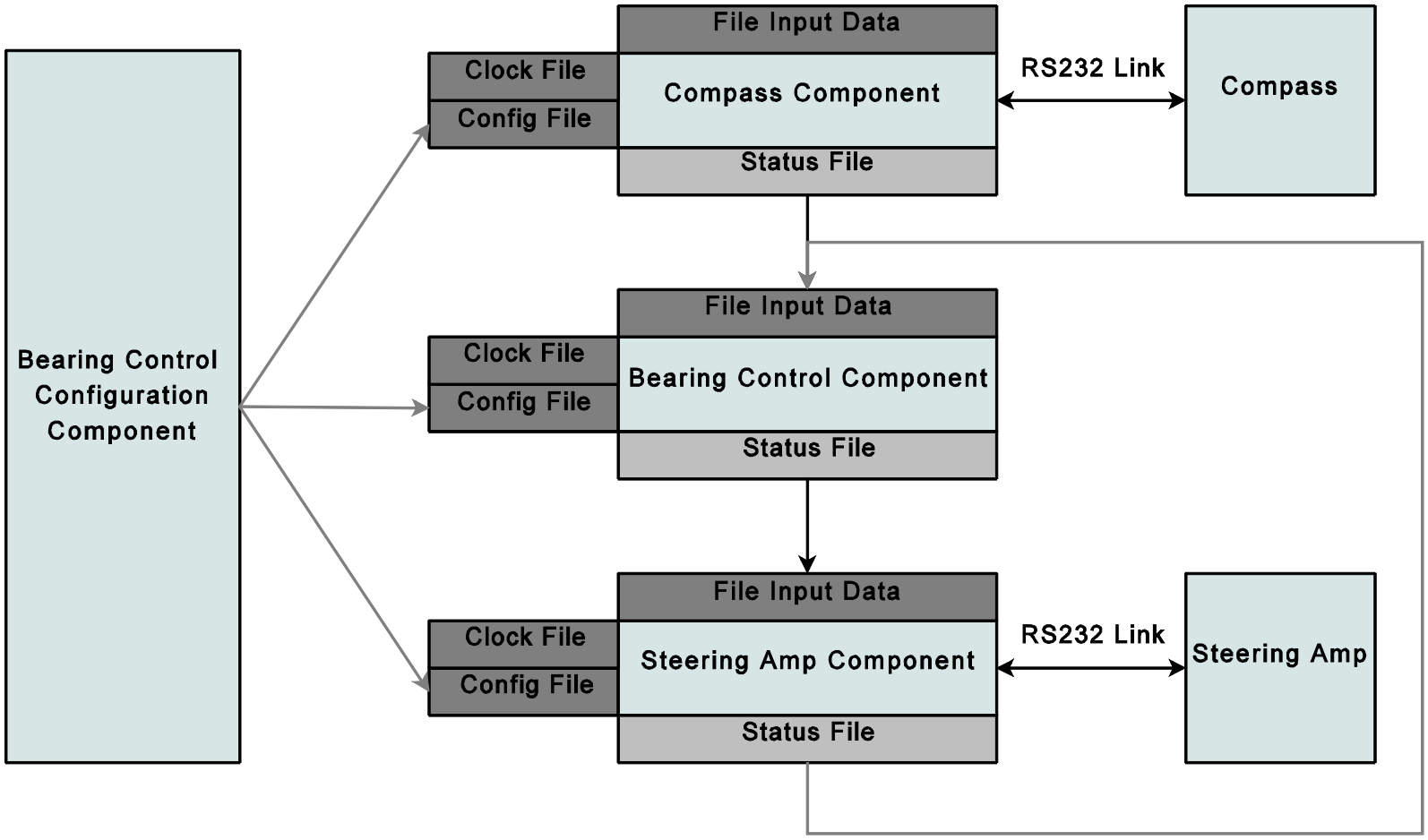
Componet flow



Bearing Contol Example



Bearing Control configuration



```
#!/usr/bin/env python

from cartfs import Sensor
class options:
  root = '/tmp/cartfs'
  clock = 'clock'
  port = '/dev/cartfs_compass'

class CompassHandler():
  def get_heading(self):

class CompassSensor(Sensor):
  def process(self):
    if self.compass_c['enable'] == 'True':
       self.compass_s['heading'] = self.compass.get_heading()
    else:
       self.compass_s['heading'] = "Disabled"
       self.compass_s['enable'] = self.compass_c['enable']
```

Driver.py

```
#!/usr/bin/env python

from cartfs import Sensor
class options:
root = '/tmp/cartfs'
    clock = 'clock'
    config = './driver/driver_c'
    status = './driver/driver_s'

class DriverSensor(Sensor):

    driver_c = {'enable':True}
    driver_s = {'clock':0,'enable':True,'desired_heading':0}

    def process(self):
        self.driver_s['desired_heading'] = self.desired_heading
```

headingcontroller.py

```
#!/usr/bin/env python
from cartfs import CartFSLoggingHandler, Sensor

class HeadingcontrollerSensor(Sensor):
  headingcontroller_c =
   {'compass_heading':
      ['/tmp/cartfs/compass/compass_s','heading',-1],
    'desired_heading':
      ['/tmp/cartfs/driver/driver_s','desired_heading',-1]}


  def process(self):
    self.headingcontroller_s['inv_turn_radius'] =
       self.get_inv_turn_radius(
           self.headingcontroller_c['compass_heading'],

           self.headingcontroller_c['desired_heading'])
```

cartfs.py

```
from copy import copy
# import demjson
import cjson
import logging
import os

__all__ = ['CartFSFile', 'CartFSLoggingHandler', 'Sensor']

# json = demjson.JSON(compactly=False)

class CartFSFile(object):
    def __init__(self, file, mode='r', create=False):
        """
        Initialize the `CartFSFile` object. Open a file for
   reading or writing
        and possibly create the file.

        Parameters:
        - `file`: a string, the name of the file to open.
        - `mode`: a string, one of:
            - 'r': open the file for reading.
            - 'w': open the file for writing.
```