

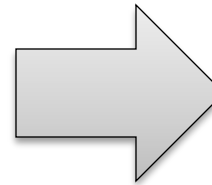
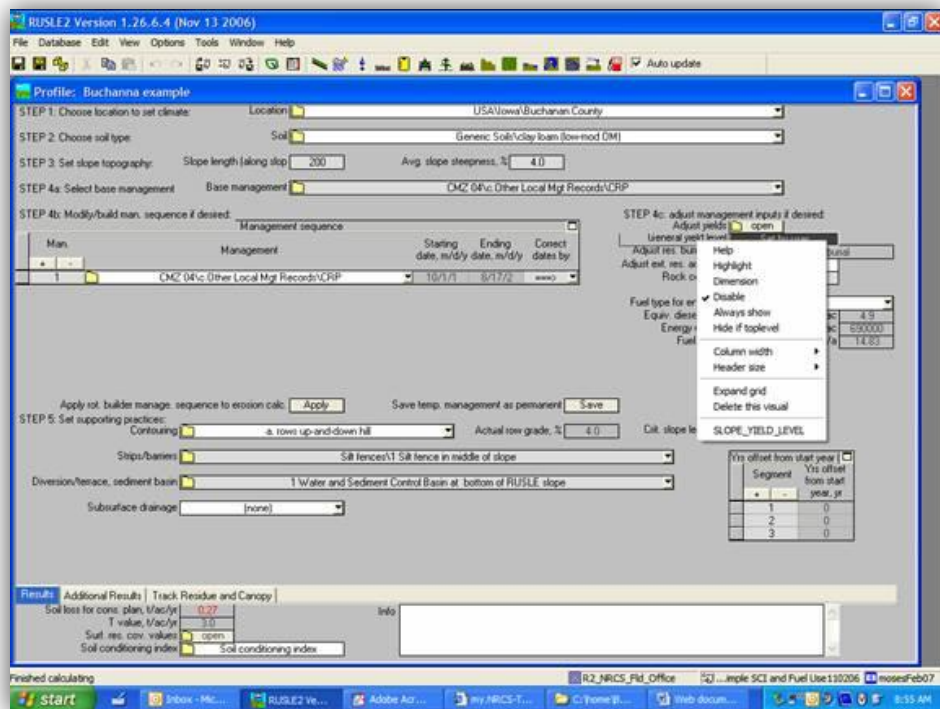
Modular Modeling in OMS 3

Application: CSIP

O David, Colorado State University, ARS/NRCS, Fort Collins, CO

(J Lyon, W Lloyd, K Rojas, F Geter, L Ahuja, J Ascough, J Carlson, M Arabi, L Garcia)

Technology Shift



Cloud First policy



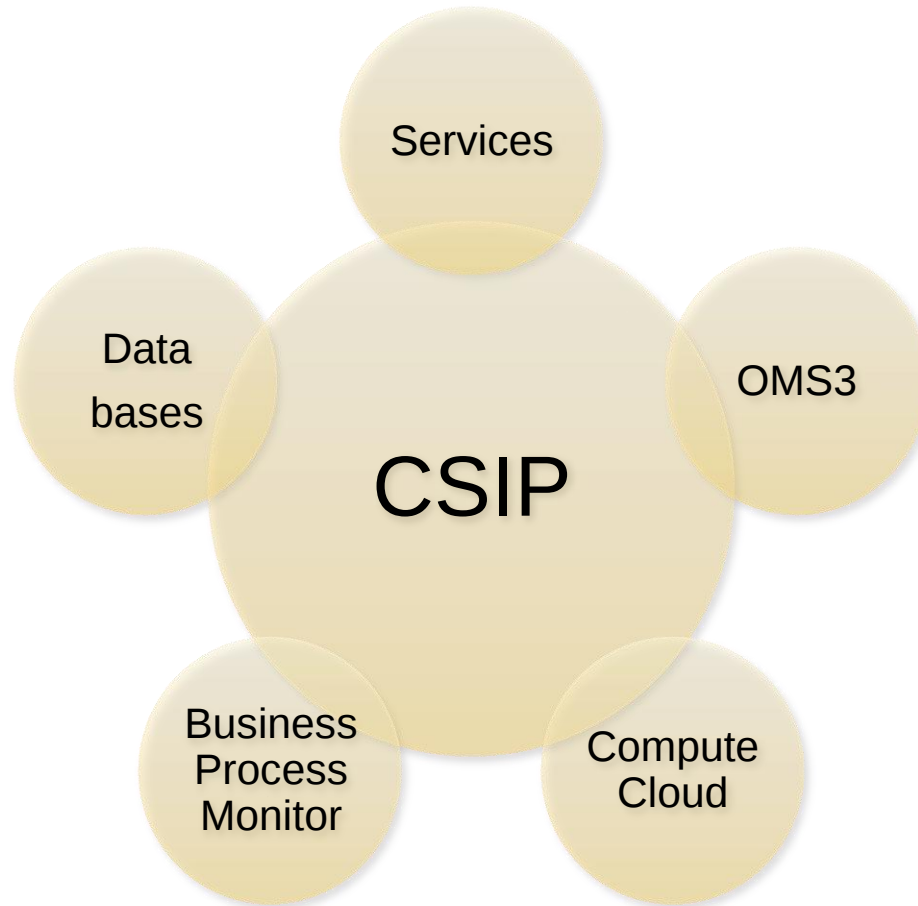
25 POINT IMPLEMENTATION PLAN TO REFORM FEDERAL INFORMATION TECHNOLOGY MANAGEMENT

Vivek Kundra
U.S. Chief Information Officer

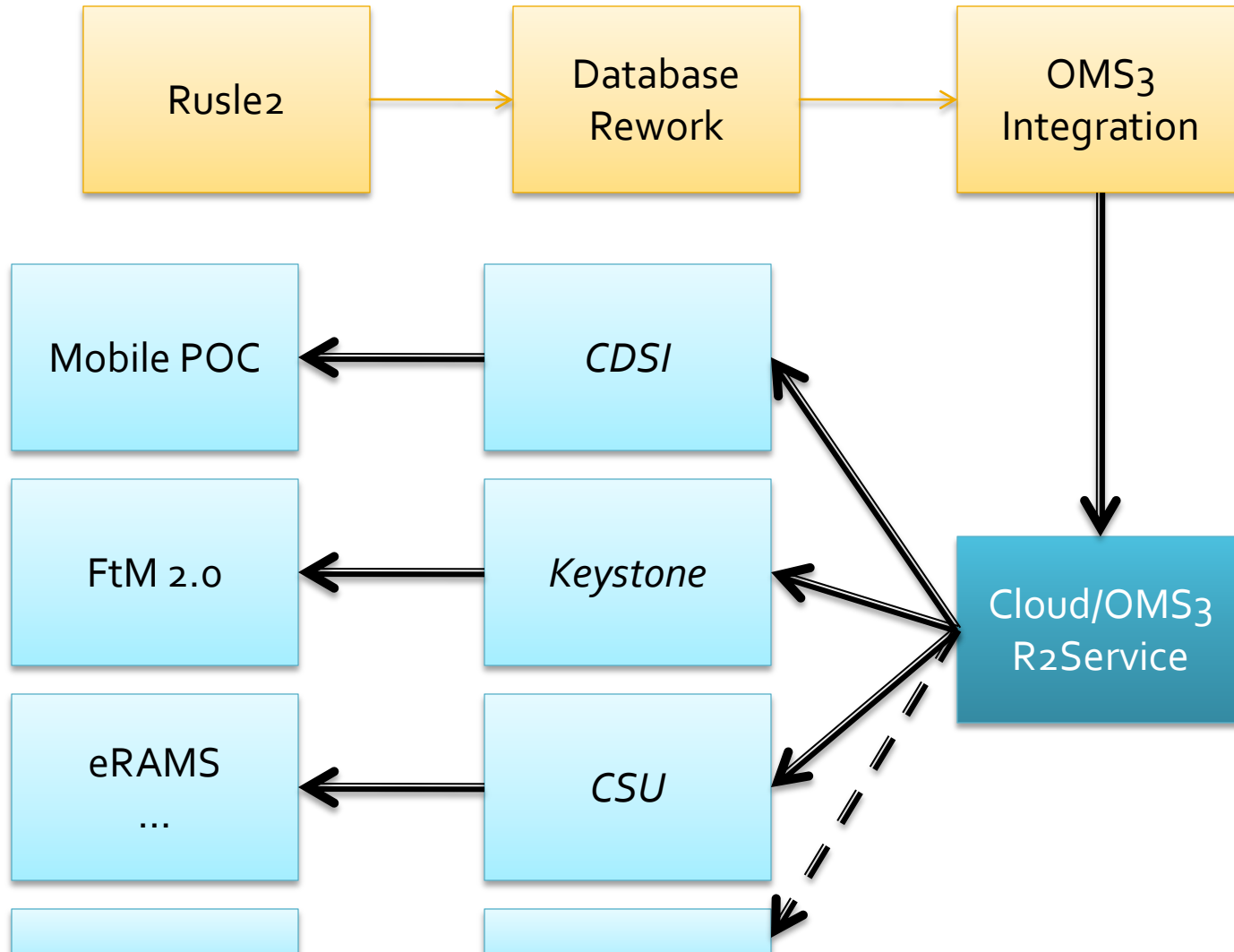
DECEMBER 9, 2010

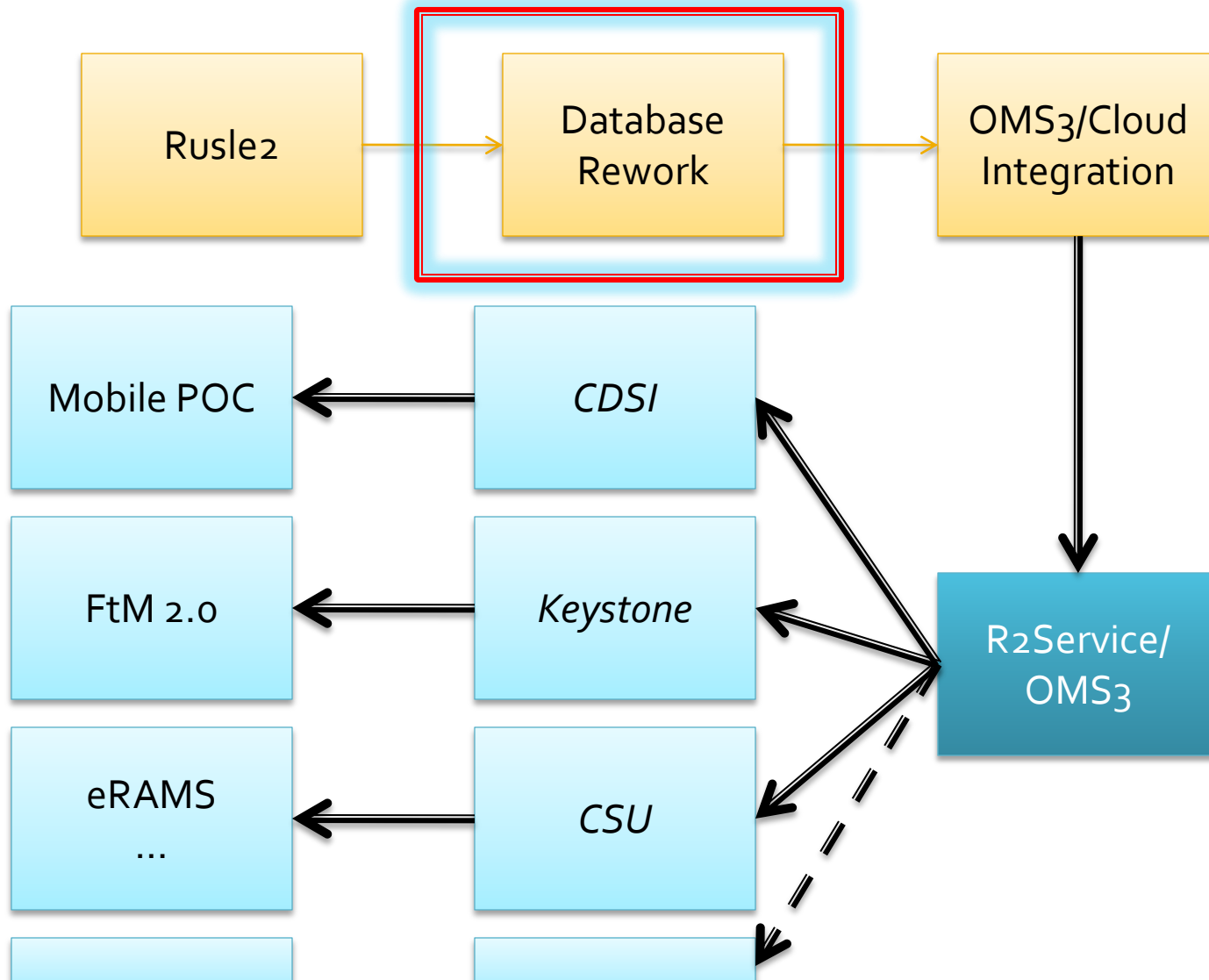


Cloud Services Innovation Platform



Example : Rusle2 CSIP



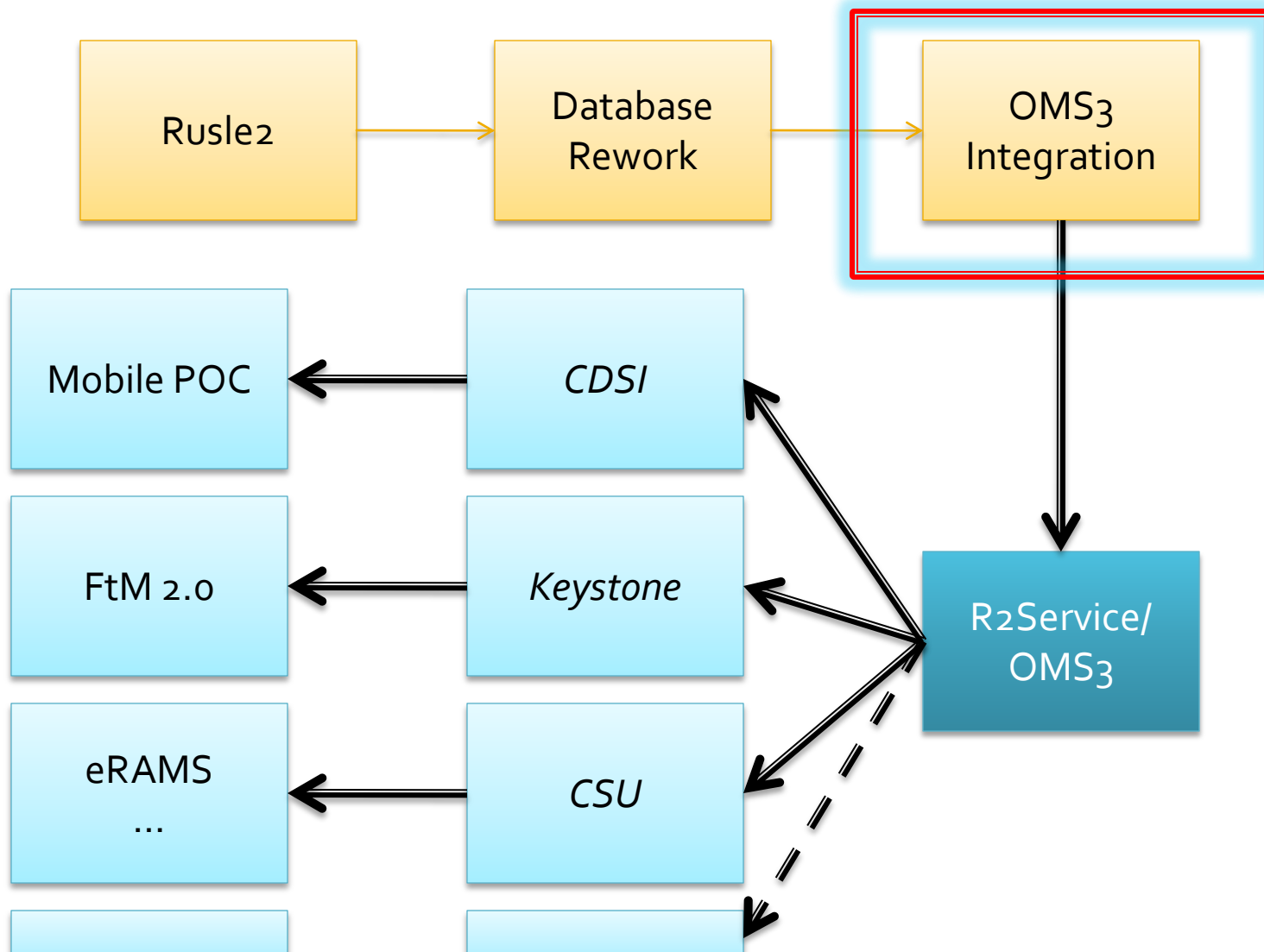


Legacy GDB Data Stores

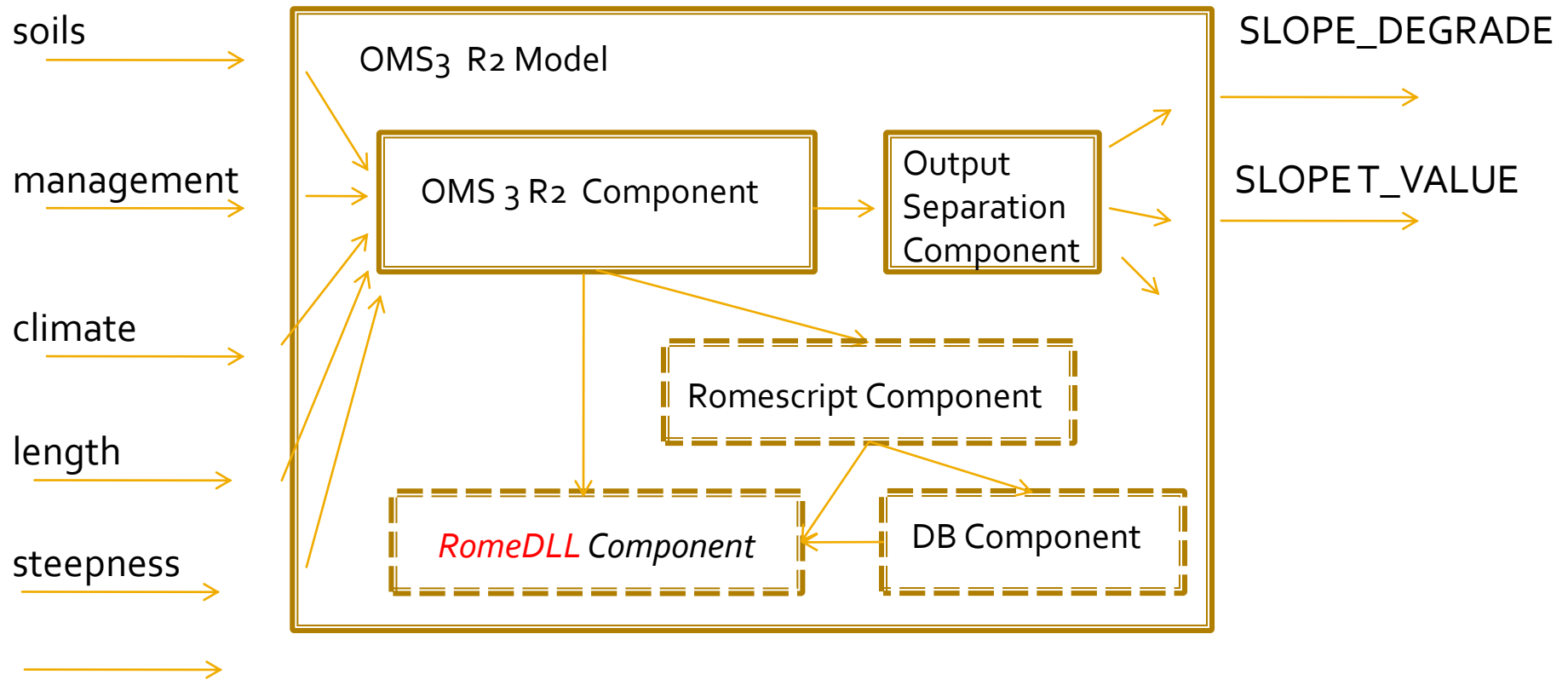
- Embedded XML in SQLite DB
- Multiple copies of data
- Need to update every computer
- Sharing over network
- Versioning
- Ad hoc solution
- Administration & Security
- Foreign data formats

CSIP Rusle2 Data Storage

- Data stored on central server(s)
- Access over internet / network with Multiple protocols
 - file:/ http:/ ftp:/ https/ ...
- Minor changes to model I/O
- Versioned database
- DB Access Module



Rusle2 OMS₃ Modules



Rusle2 / OMS₃

- Based on modified legacy Rusle2 DLL
- Embedded OMS₃ Model
 - Annotation-based bindings in OMS₃.1
 - Rusle2 database access Module
- Central data store, document oriented
- Rusle2/OMS₃ bundled as model application,
... later virtual machine

Modeling Framework

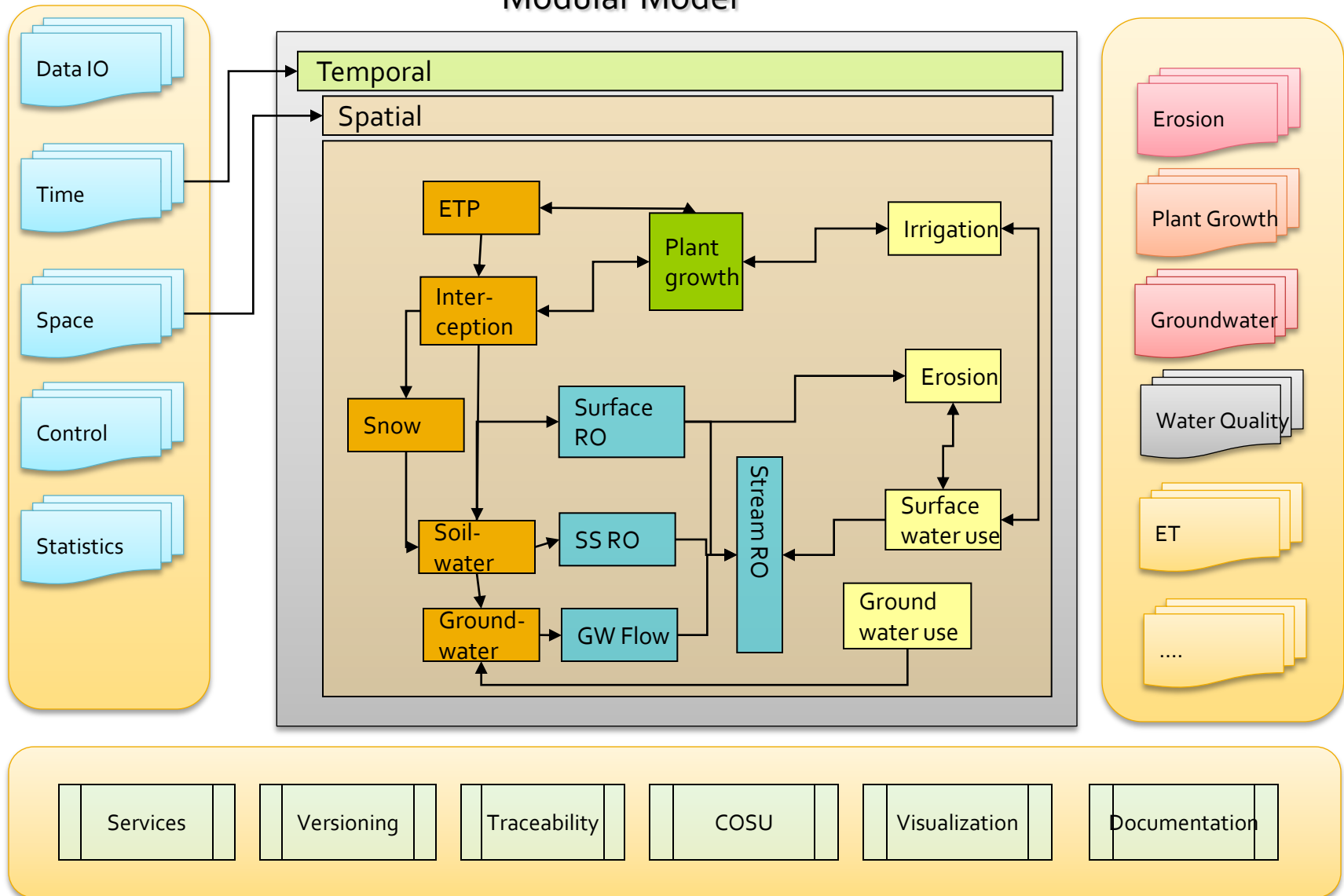
- “Separation of concerns” [Dijkstra 1974]
- Reusability of services such as I/O procedures, science processes, presentation utilities, and integration approaches
- Separation of a modeling solution in separate units (module or component)

System Components

OMS₃ Principal Architecture

Science Components

Modular Model



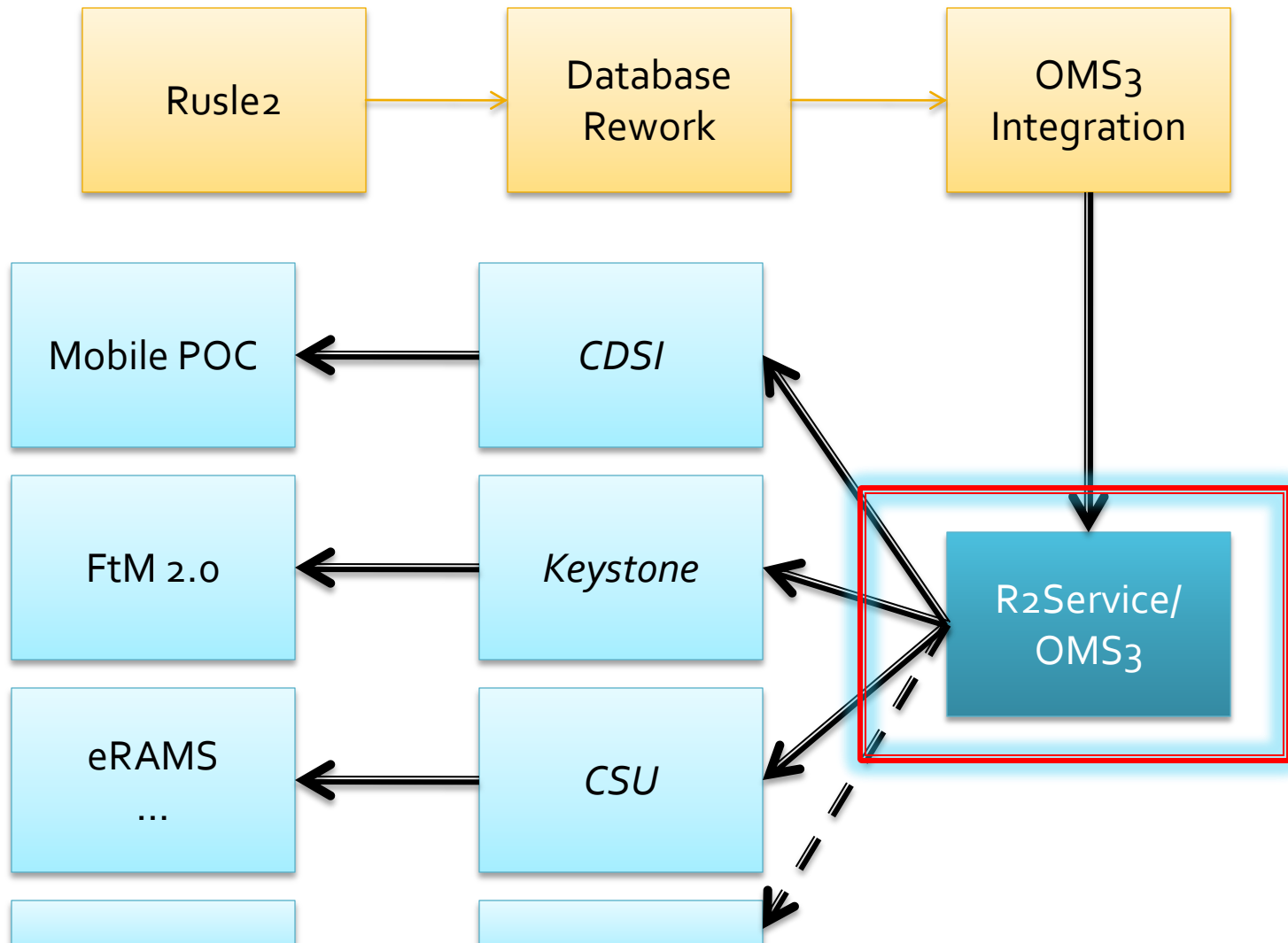
Object Modeling System

- Software Framework and System for Environmental Modeling
 - Used for Development, Application, and Deployment of models
 - Based on 'state of the art' software engineering methods
 - Models are based on "Science building blocks"
= software components
- Models:
PRMS/AgES/RUSLE2/McCabe/Geotop/IAEA(ISO) ...

OMS₃ increases efficiency

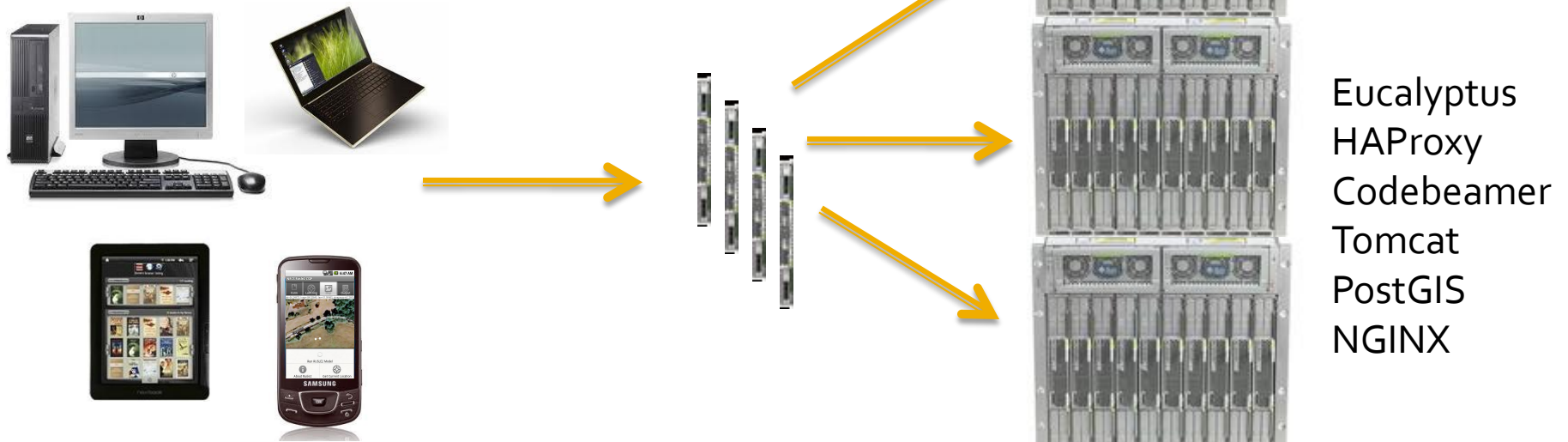
- 1) OMS₃ Invasiveness Study (Lloyd 2010)
 - Cross Language/Modular Framework Model implementation and Model Metrics Analysis
 - Size & complexity reduction ~10 - 15%
- 2) Detailed COCOMO (Boehm 1981)

40% - 50% reduction in model development/deployment costs using OMS₃ vs. traditional approaches



CSIP Cloud

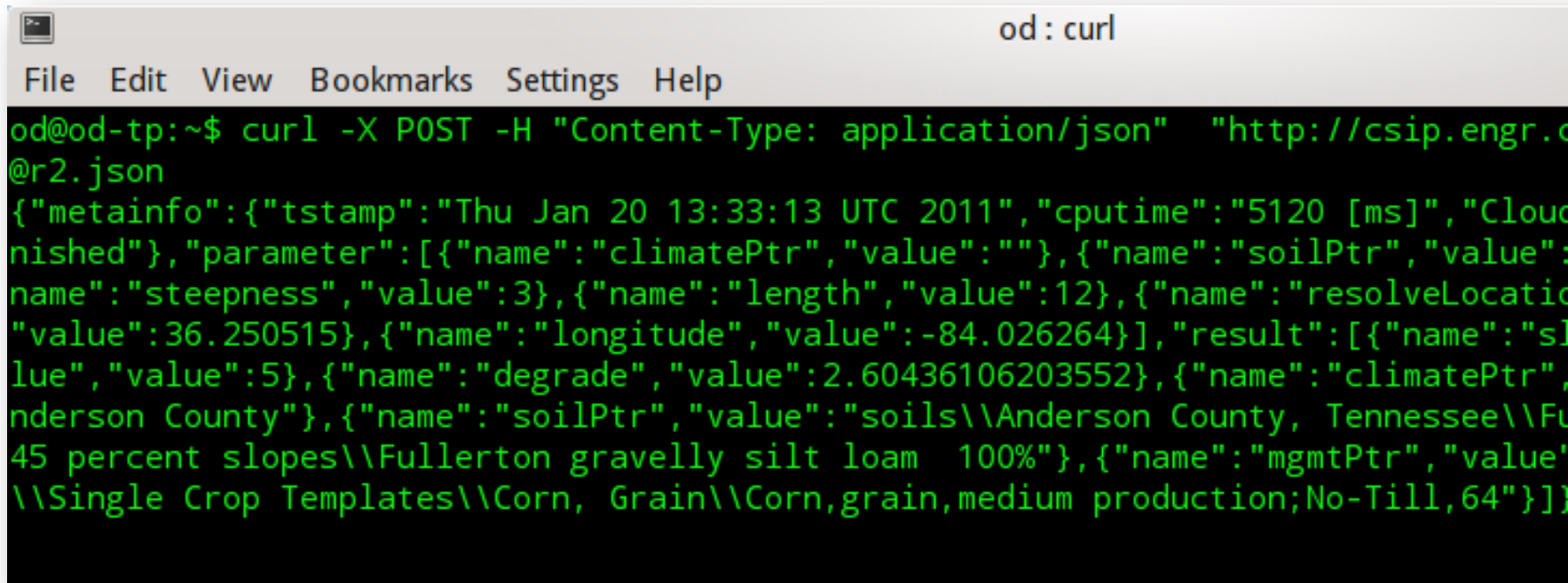
- ☐ CSU / NRCS / ARS Collaboration
- ☐ Innovative model technology deployment
- ☐ Hybrid Cloud
- ☐ OMS₃ Models as service
- ☐ High scalability of modeling resources
- ☐ Ensemble Runs / scenario management
- ☐ Database partitioning / scaling
- ☐ Model independent implementation



CSIP ModelServices

- OMS₃ Model services
 - Rusle2
 - EFH₂
 - **Energy**
 - (AgES-W)
- Data services
 - management lat/long lookup (R2 keys)
 - soils lat/long lookup
 - climate lat/long lookup
 - full R2 database

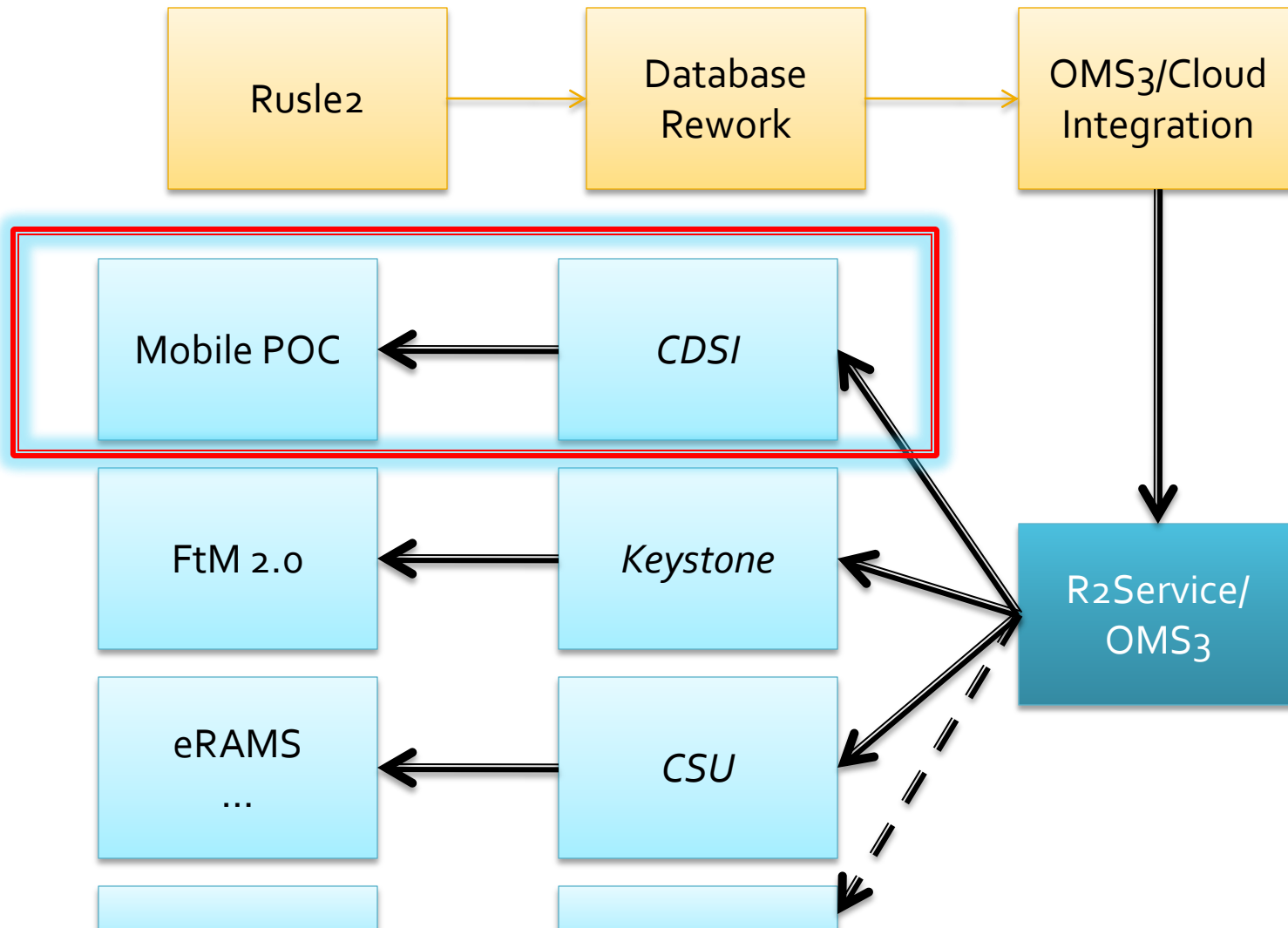
RUSLE2 ModelServices



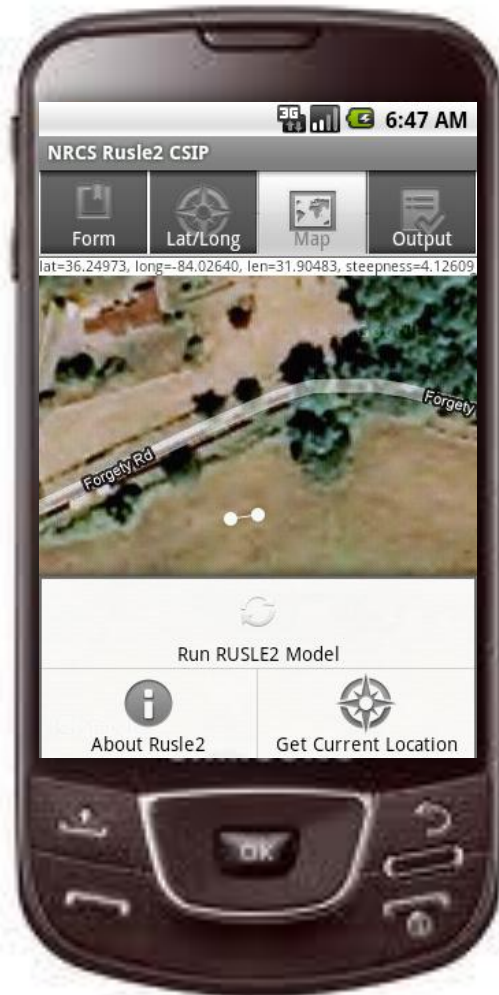
```
od : curl
File Edit View Bookmarks Settings Help
od@od-tp:~$ curl -X POST -H "Content-Type: application/json" "http://csip.engr.colostate.edu:8081/rest/m/rusle2" -d @r2.json
{"metainfo":{"tstamp":"Thu Jan 20 13:33:13 UTC 2011","cputime":"5120 [ms]","CloudCompleted":true,"parameter":[{"name":"climatePtr","value":"","description":"Climate pointer to a file containing climate data"}, {"name":"soilPtr","value":"","description":"Soil pointer to a file containing soil data"}, {"name":"steepness","value":3,"description":"Steepness of the slope (0 to 100%)"}, {"name":"length","value":12,"description":"Length of the slope (0 to 1000 feet)"}, {"name":"resolveLocation","value":36.250515,"description":"Latitude of the location"}, {"name":"longitude","value":-84.026264,"description":"Longitude of the location"}, {"name":"result":[{"name":"slope","value":5,"description":"Slope of the slope (0 to 100%)"}, {"name":"degrade","value":2.60436106203552,"description":"Degradation rate (0 to 100%)"}, {"name":"climatePtr","value":"","description":"Climate pointer to a file containing climate data"}, {"name":"soilPtr","value":"","description":"Soil pointer to a file containing soil data"}, {"name":"mgmtPtr","value":"","description":"Management pointer to a file containing management data"}]}]}
```

REST/JSON Protocol, e.g.:

```
curl -X POST -H "Content-Type: application/json"
"http://csip.engr.colostate.edu:8081/rest/m/rusle2" -d @r2.json
```

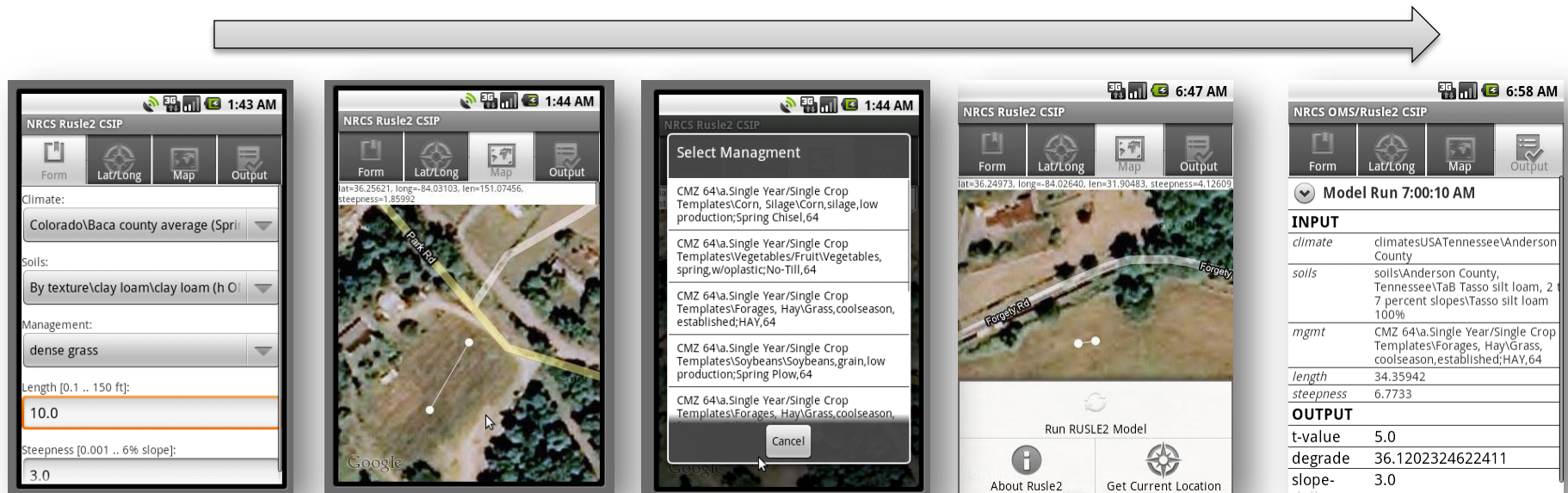


Mobile POC



- Android Application
- USGS Elevation service
- GPS enabled
- CSIP R2 execution
 - data service
 - model service

Rusle2 Mobile POC



Manual
Parameter
Selection

Transect
Definition

USGS
Elevation
Service

Location based
Management
Selection

Remote Model
Execution
of Rusle2 in
CSIP/OMS3

Model
Results

Keystone Alliance

Field to Market Calculator 2.0 Design

Soil Conservation Metric Screen

Fieldprint Calculator

Start

Land Use

Soil Conservation

Soil Carbon

Irrigation Water Use

Energy Use

Greenhouse Gas Emissions

Summary

To go back to previous tabs, please use the tabs rather than your browser's Back button.

Soil Conservation

2010 Corn grain

Tillage System

corn grain;NT,anhyd<

Interceptor

☐ Yes ☒ No

Drainage

☐ Yes ☒ No

Fieldprint	You	State	Diff
Scenario 1			
Soil Water Erosion	0.41 T/Ac/yr	1.4 T/Ac/yr	-1.09 T/Ac/yr
Soil Wind Erosion	2.1 T/Ac/yr	1.9 T/Ac/yr	1.2 T/Ac/yr
Soil Conservation	2.51 T/Ac/yr	3 T/Ac/yr	-0.49 T/Ac/yr

Prev

Calculate

Next

2010 Corn grain

You

State Average

High ← Resource Efficiency → Low
More Efficient ↔ Less Efficient

Land Use

0 20 40 60 80 100

Soil Loss

0 20 40 60 80 100

Water Use

0 20 40 60 80 100

Energy Use

0 20 40 60 80 100

Climate Impact

0 20 40 60 80 100

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Conclusion

- CSIP prototypes NRCS model deployment for enhanced decision making.
- Emphasizes on modular science components supporting conservation planning for CDSI
- OMS₃/CSIP offers a technology path streamlining legacy model integration and research model advancement
- OMS₃ increases efficiency in model development; thus ensures rapid deployment