

Automotive Underhood Thermal Systems Design - A Federated Approach

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Introduction

Automotive Underhood Thermal Systems Design - A Federated Approach

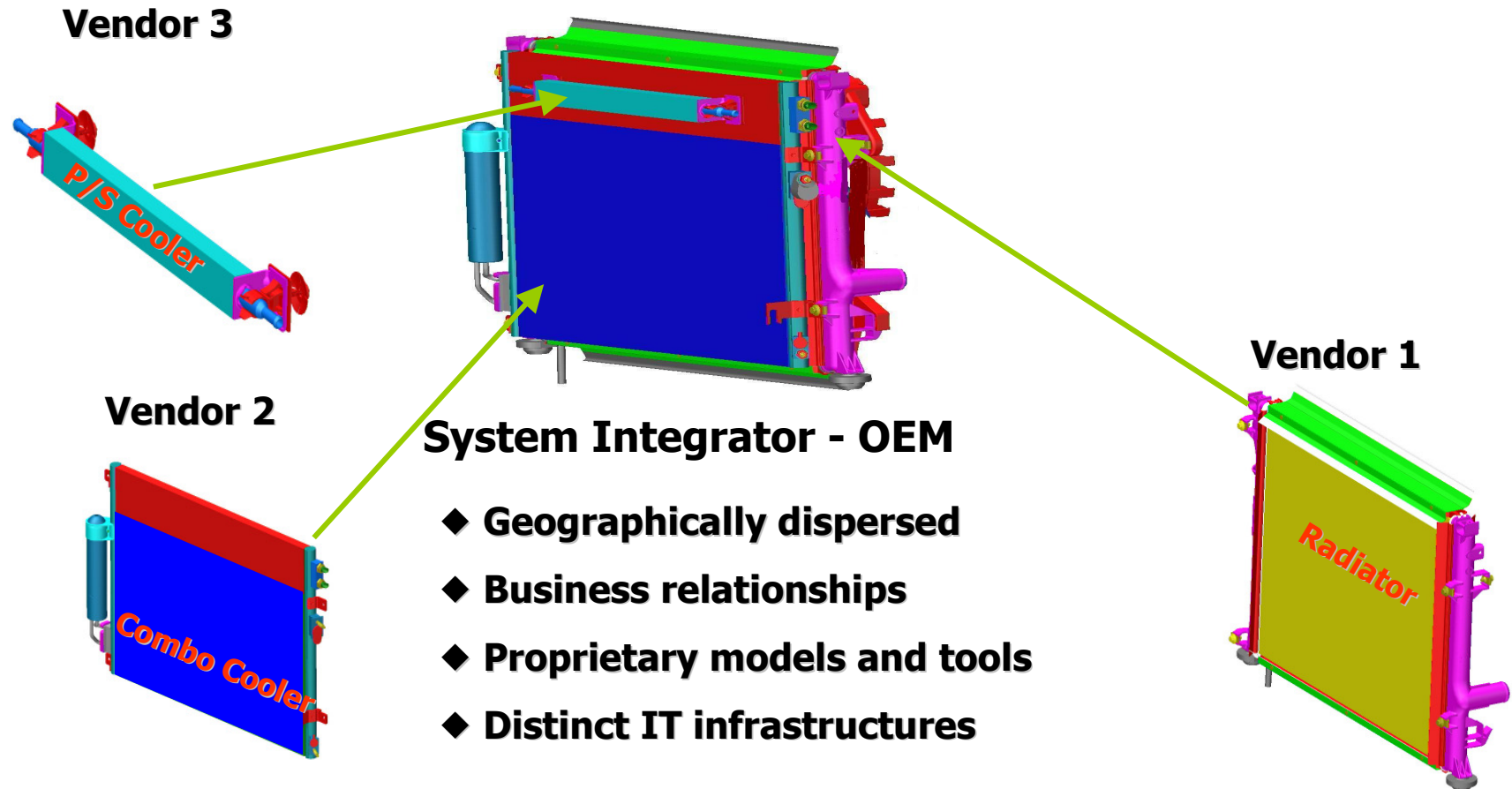
- Supplier uses OEM simulation models and work via internet
- Protect intellectual property among suppliers while working with the same OEM
- Supplier runs simulation for multiple design points
- Reliability and robust design of thermal system

Federated Intelligent Product Environment - FIPER

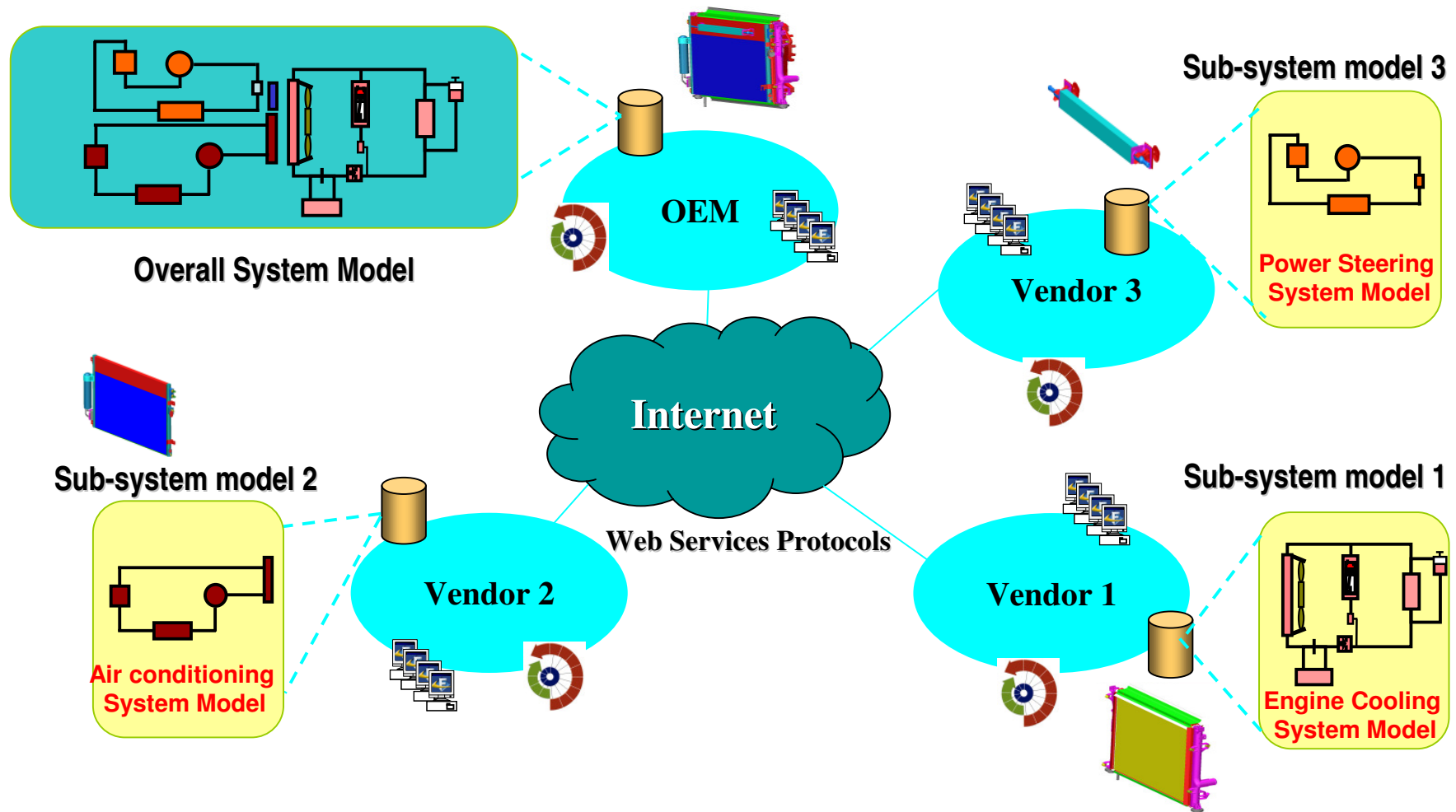
- Suppliers remotely run computer model at OEM site using FIPER B2B Feature
- An environment that allows engineers to capture and manage CAE simulation tools and processes.
- Design exploration tools to automatically improve performance and quality.
 - Design of Experiments, Optimization, Reliability Analysis and Transfer Function generation.
- A distributed and parallel infrastructure to execute user-submitted CAE jobs to maximize resources and reduce cycle time.

Federated Design Process

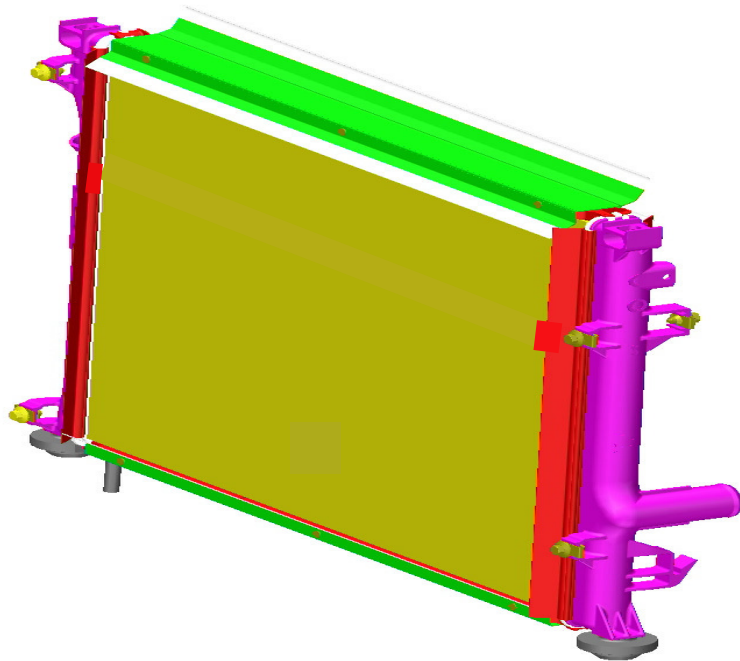
Cooling Module Design



Federated Integration Model



Radiator Selection – An Example

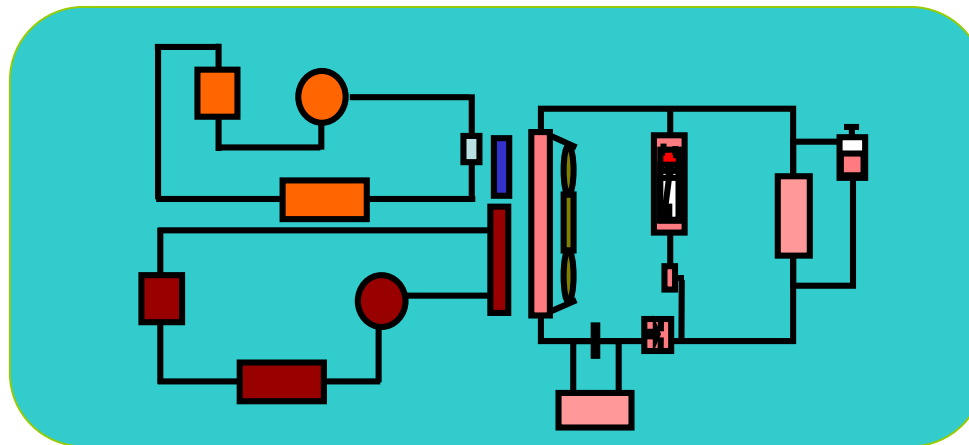


- Design Parameters
 - Height
 - Width
 - Thickness
 - Fin Pitch
- Supplier Response
 - Coolant Temperature
 - Cost

Objective

- OEM develops under-hood thermal systems for one of its vehicles
- OEM wants all its radiator suppliers to make reports on their radiator performance within this cooling system

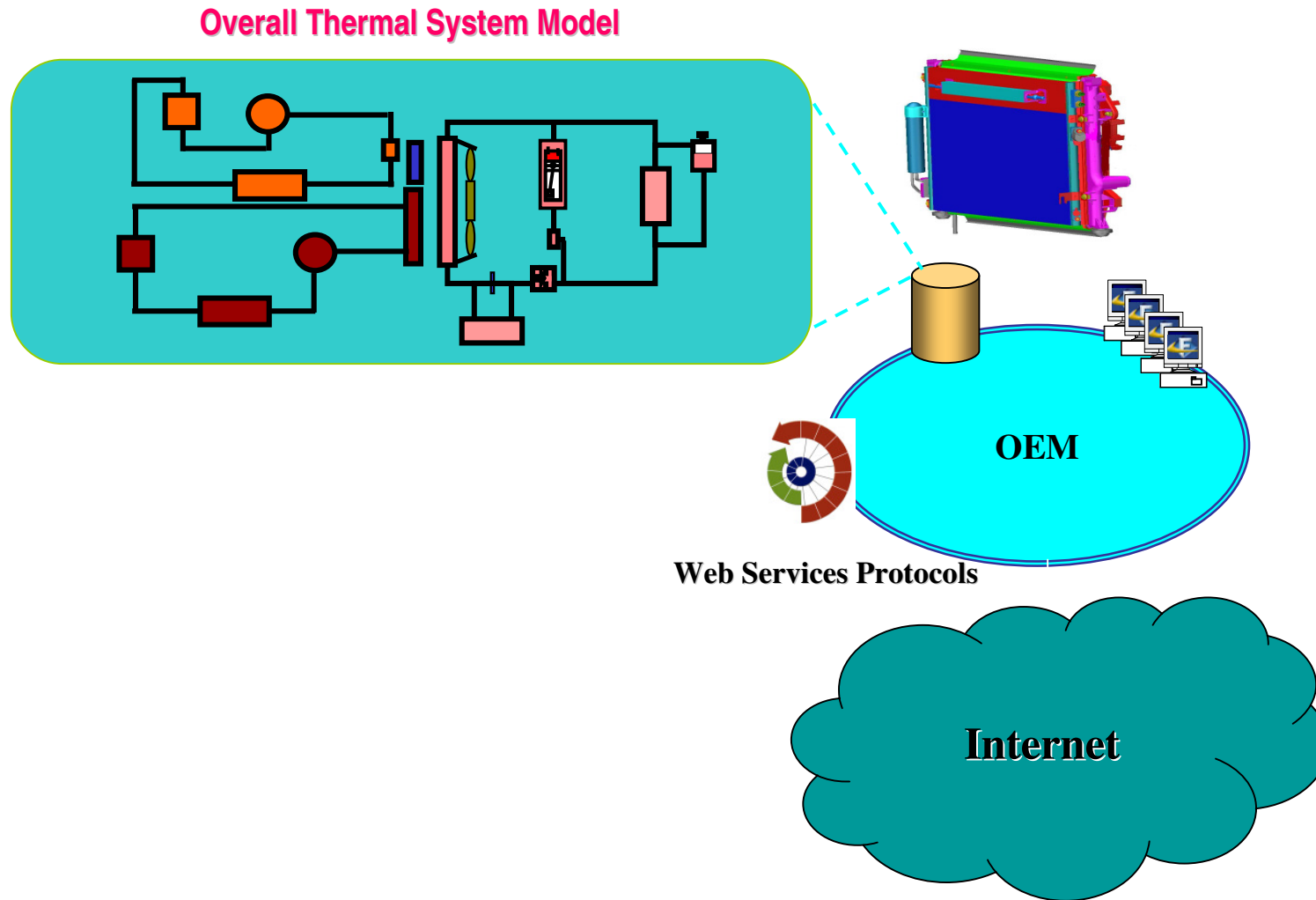
OEM Overall Thermal System Model



Project Architecture

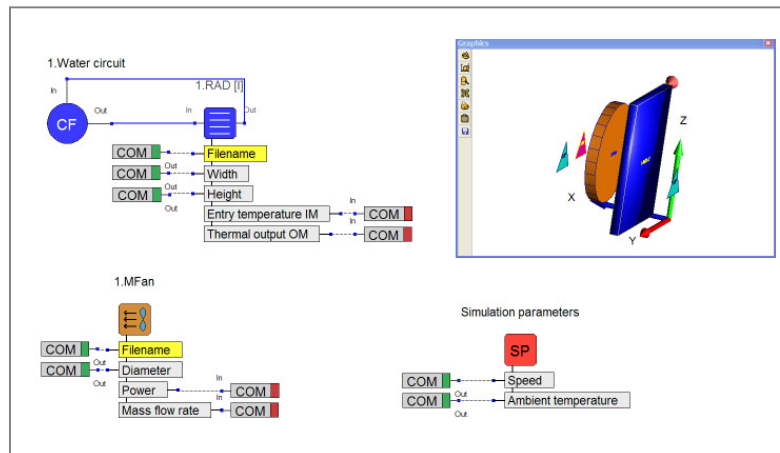
- OEM Action
 - Makes a FIPER-based cooling system model using KULI
 - Publishes it in the FIPER library
 - OEM makes the model available for Suppliers via Internet
- Supplier Action
 - Makes a FIPER model that remotely plugs into OEM's system model
 - Executes the FIPER model by plugging KULI radiator component model into OEM system model
 - Collects system output (top tank temperature)
 - Supplier sends e-mail to the OEM, together with additional radiator information such as cost and dimensions

OEM Site – FIPER Model

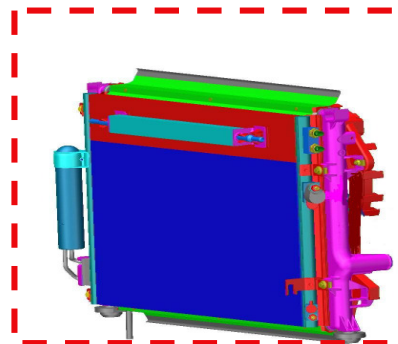
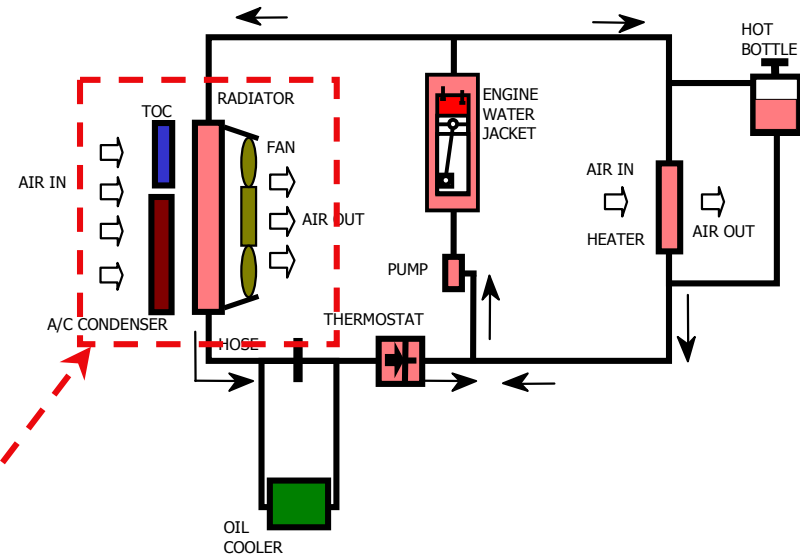


KULI Cooling System Model

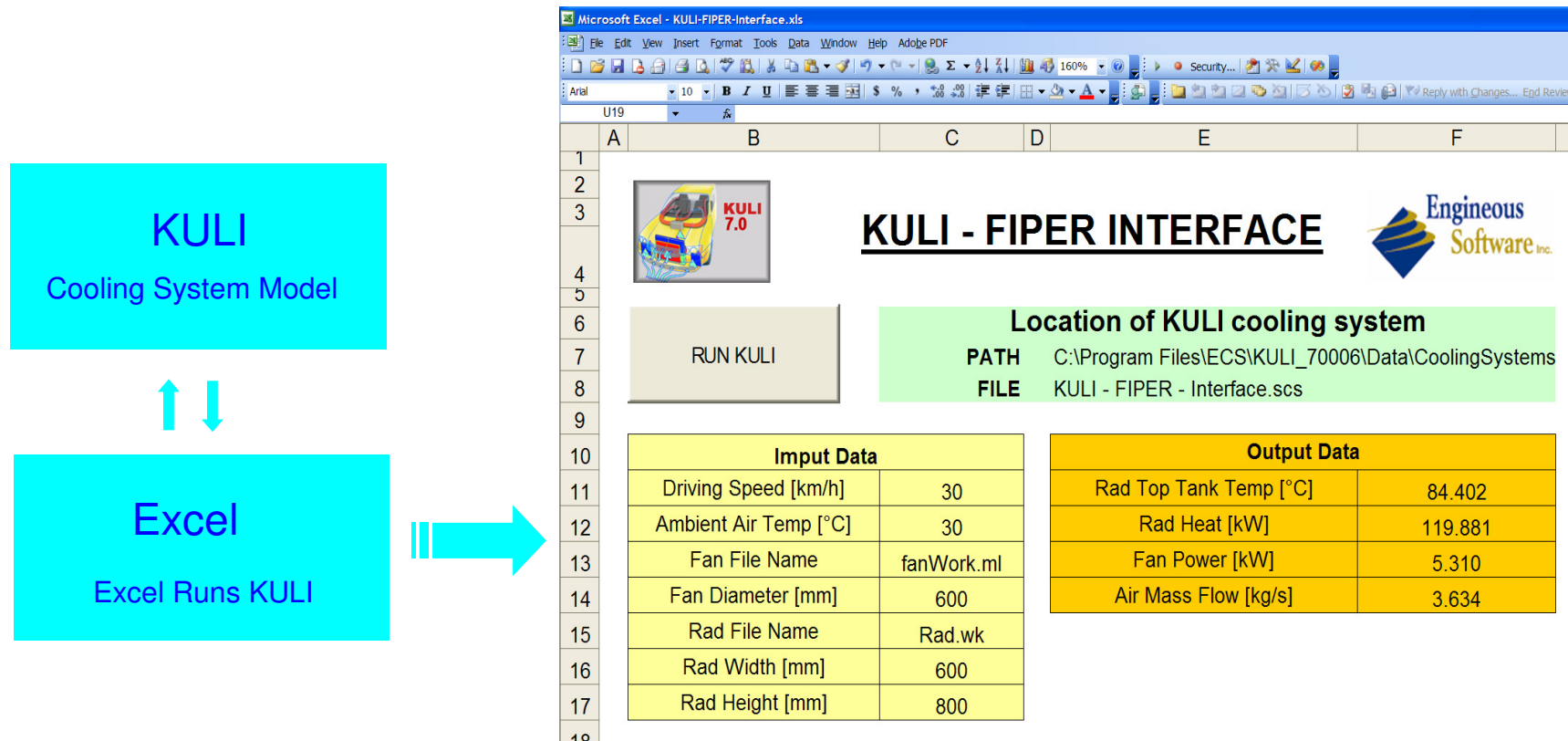
KULI Network



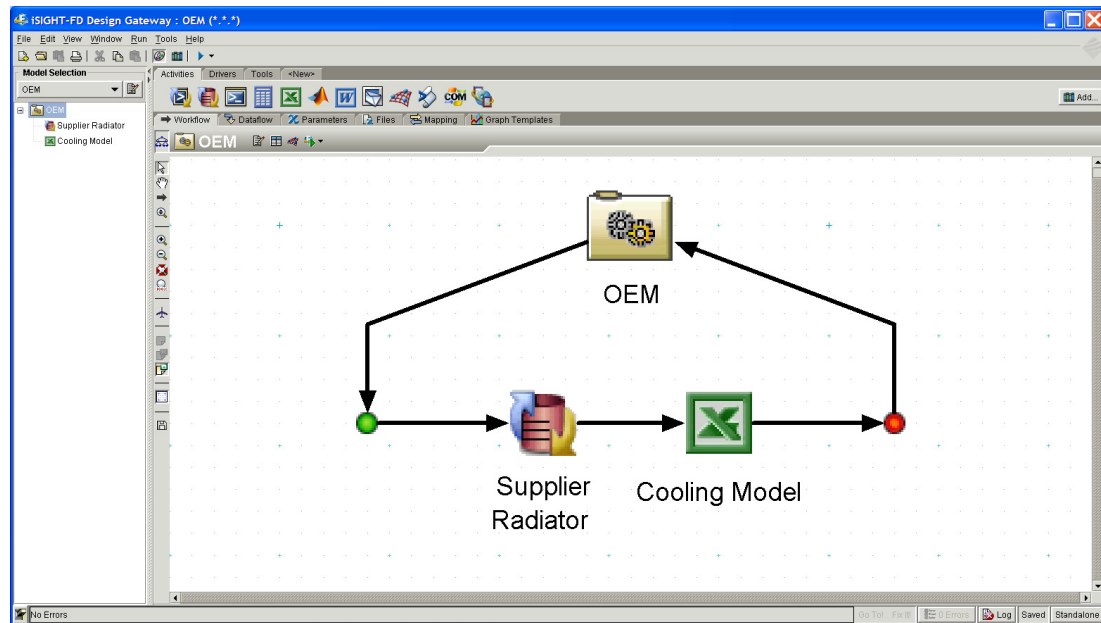
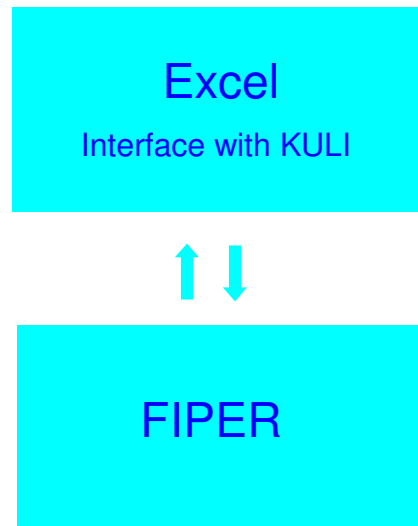
Schematic Network



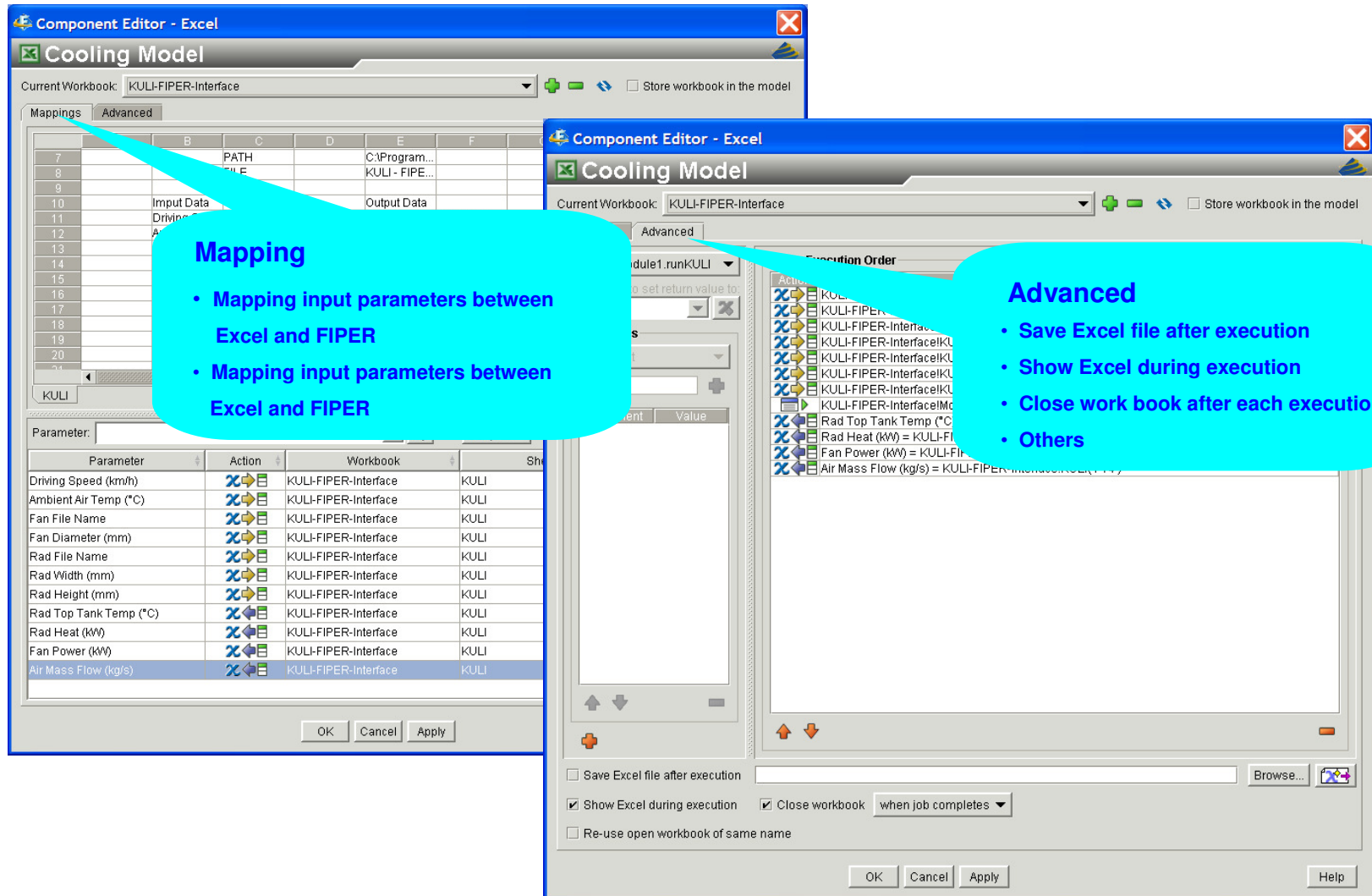
Excel Interface to the KULI Cooling System Model



FIPER model at OEM



Excel Block



Publishing the Model

Making the Model Available via Internet

Publish

Name: OEM_Cooling_Model Publish As...

Type: Model

Description: This is a component subtree of model "iSIGHT_Cooling".

☒ Share this model with other FIPER environments

☒ Use environments from latest published version (if a...)

ACS Name	User(s)
192.168.245.230	fiperacs

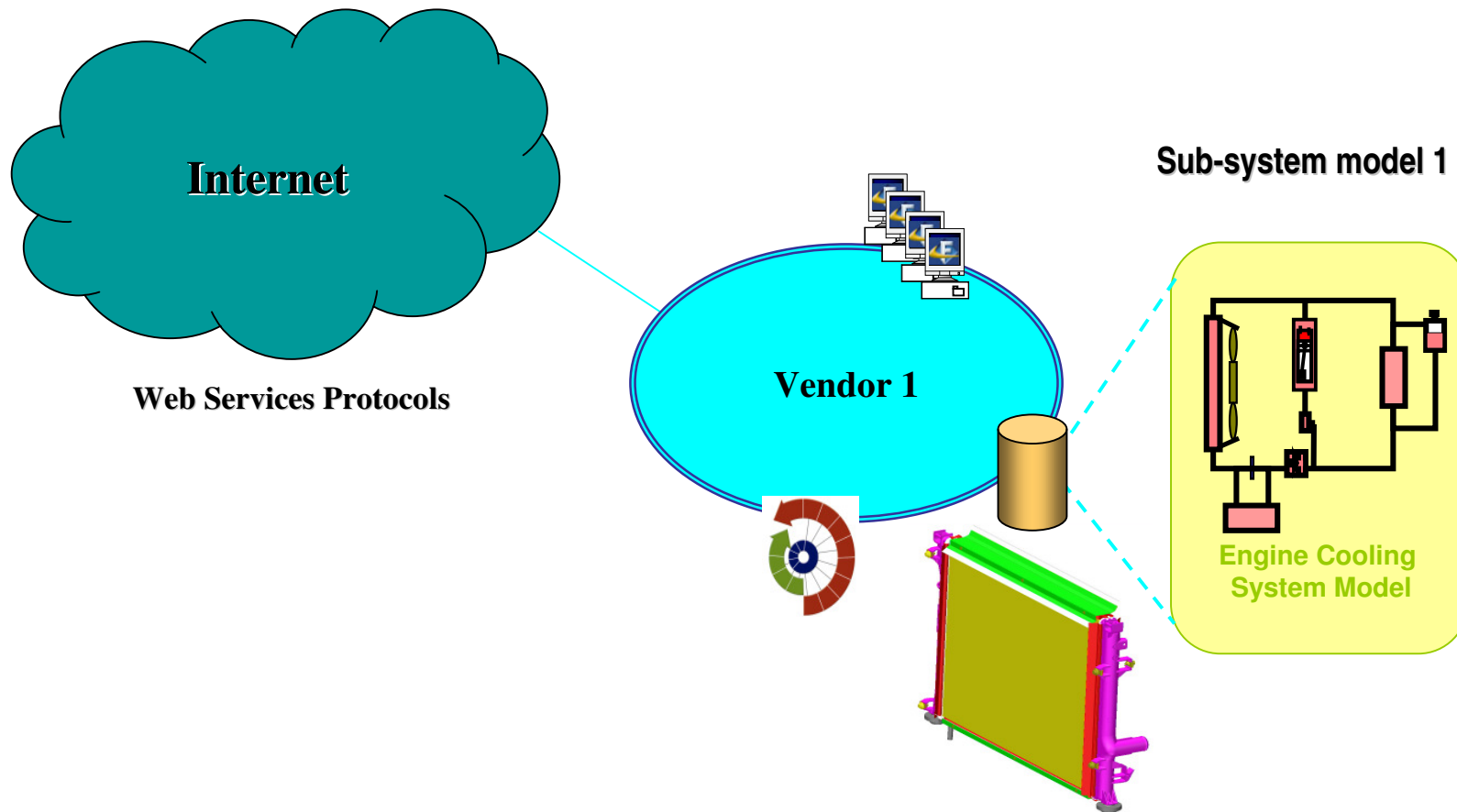
Attributes

Name	Value

Publish Cancel

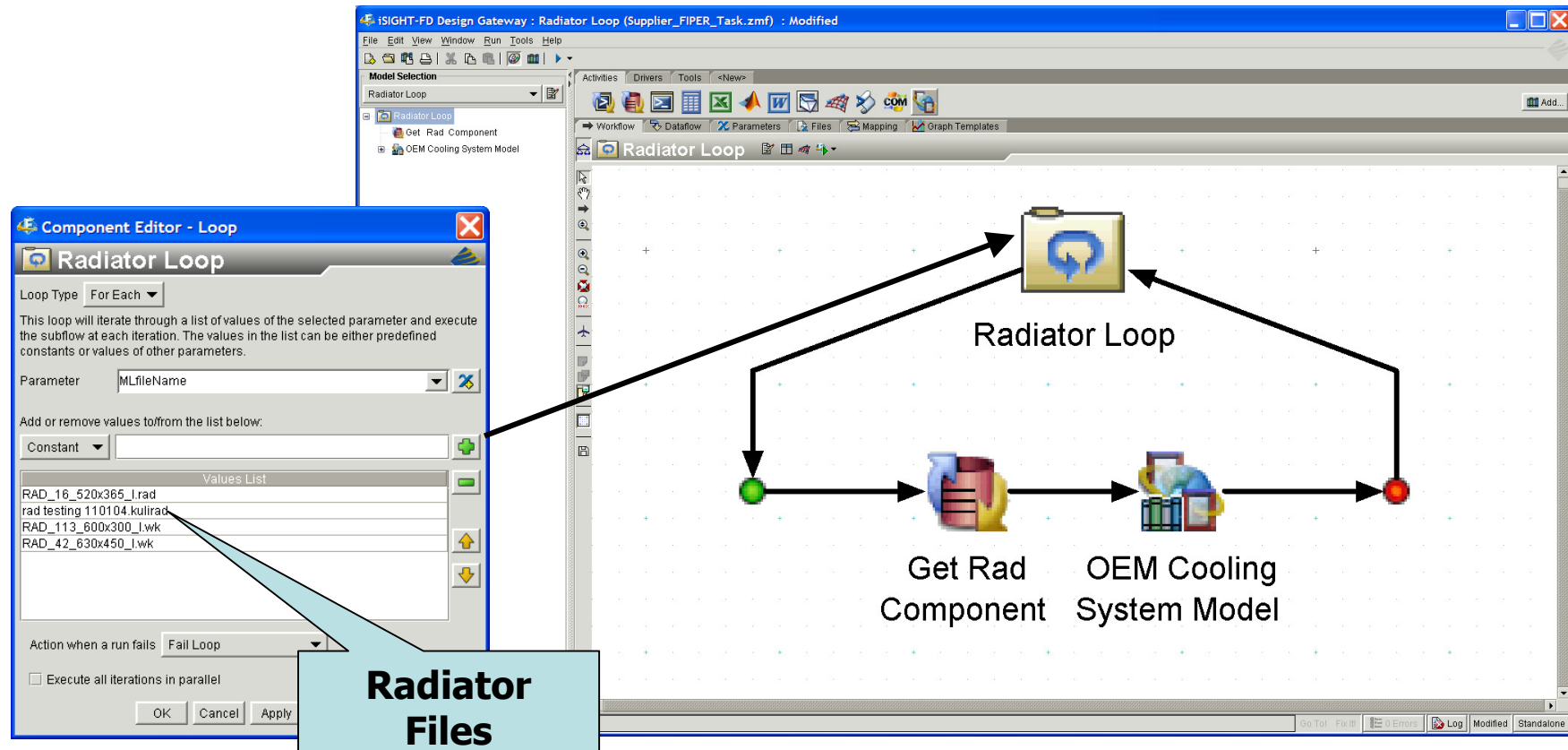
Supplier's ACS Number

Supplier Site - FIPER Model

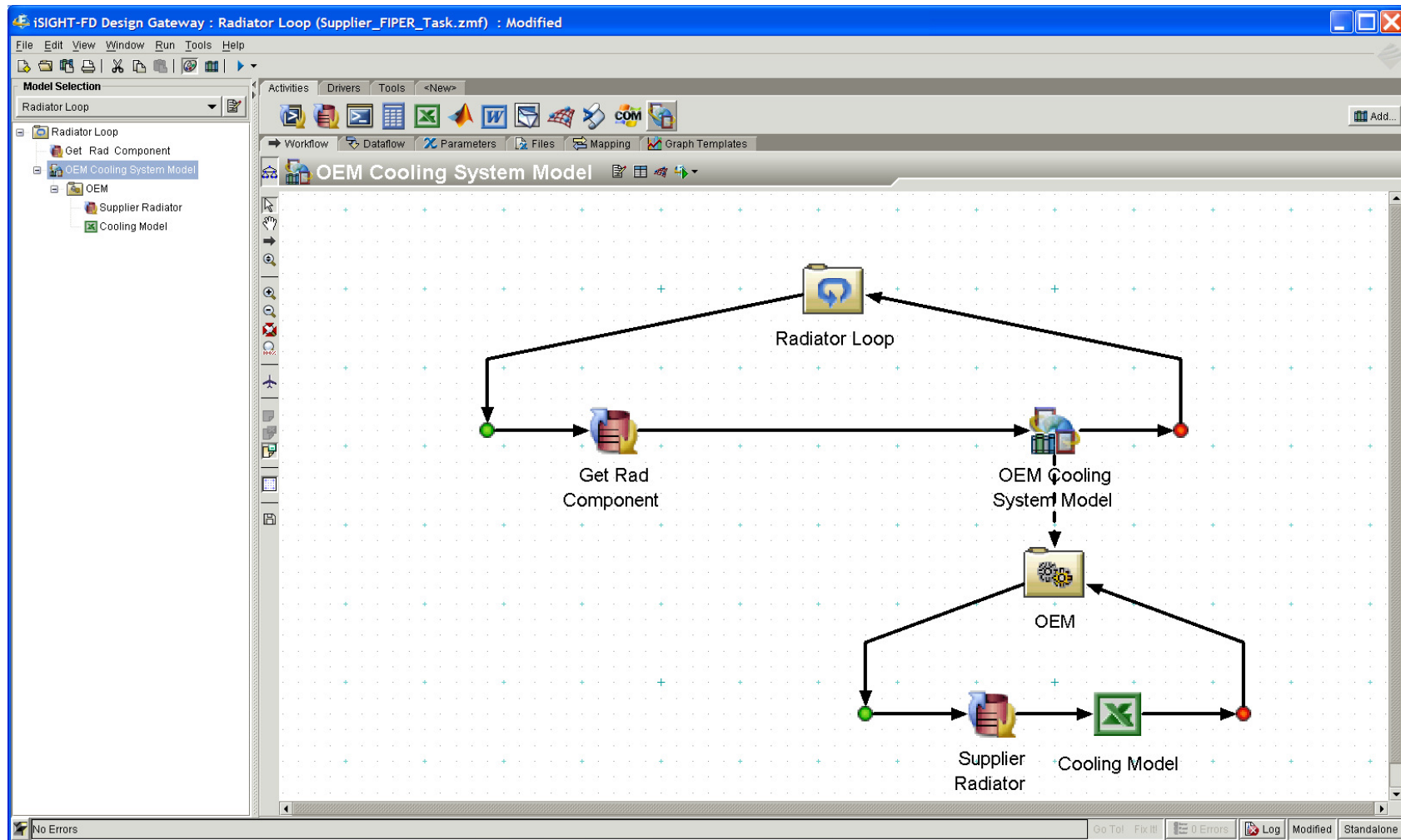


FIPER model at Supplier

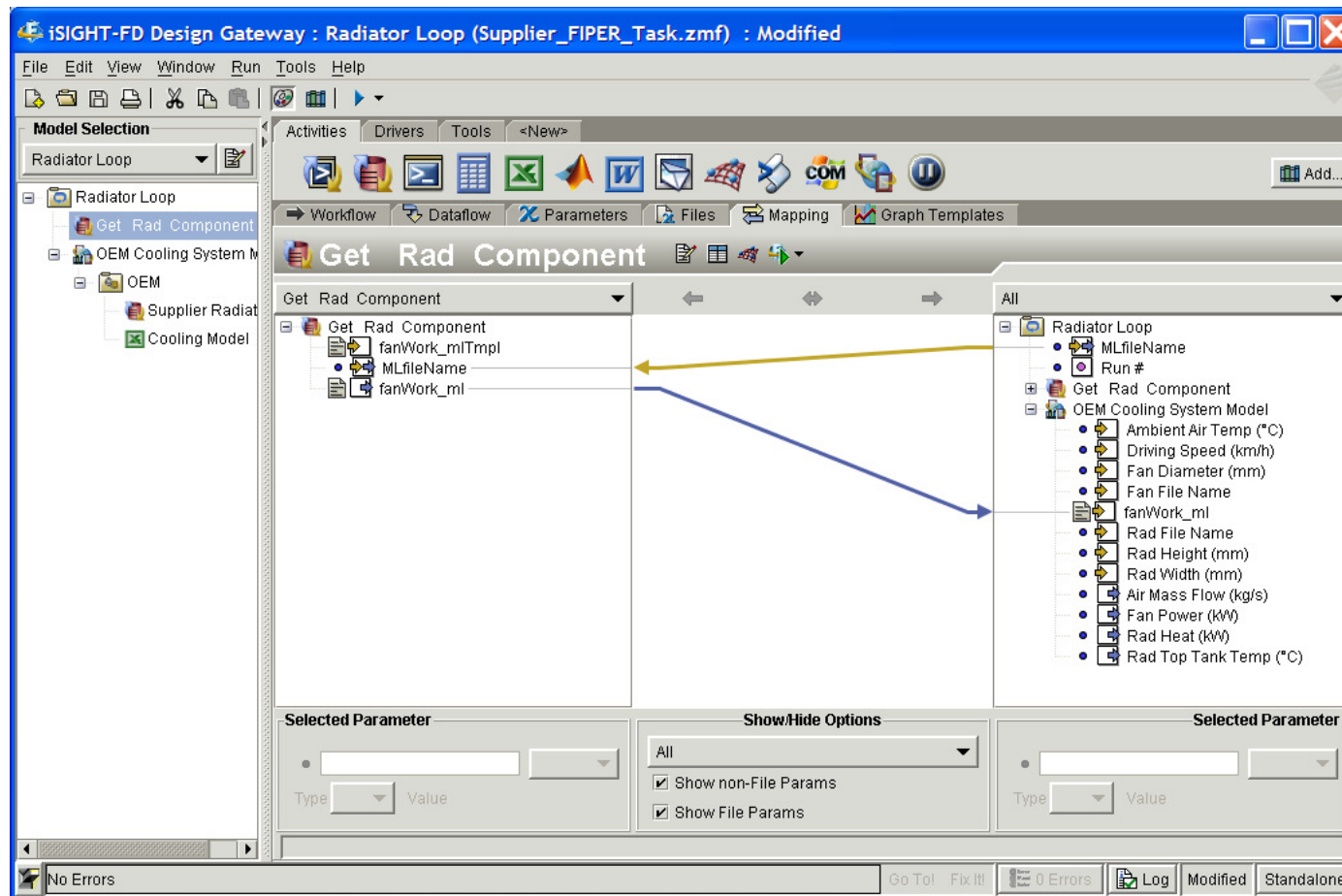
FIPER Model at Supplier Site plugged into OEM's Cooling System Model



Combined Supplier and OEM Task Details



File swap via Loop and DatEx components



Component Editor – Remote Model

Remote OEM Cooling System Model used at the Supplier Site

Component Editor - Remote Model

Remote Model

Remote model name:

Version:

Location:

Inputs	
Name	Value
[-] Effectiveness	
+ [] 0	
+ [] 1	
+ [] 2	
[-] IM Pressure Drop	
+ [] 0	
+ [] 1	
[-] OM Pressure Drop	
+ [] 0	
+ [] 1	

Outputs	
Name	Value
..... • Top Tank Temper	275.13841674805

FIPER Interface to the Report File

Results produced by the OEM model for 4 different radiators from the Supplier

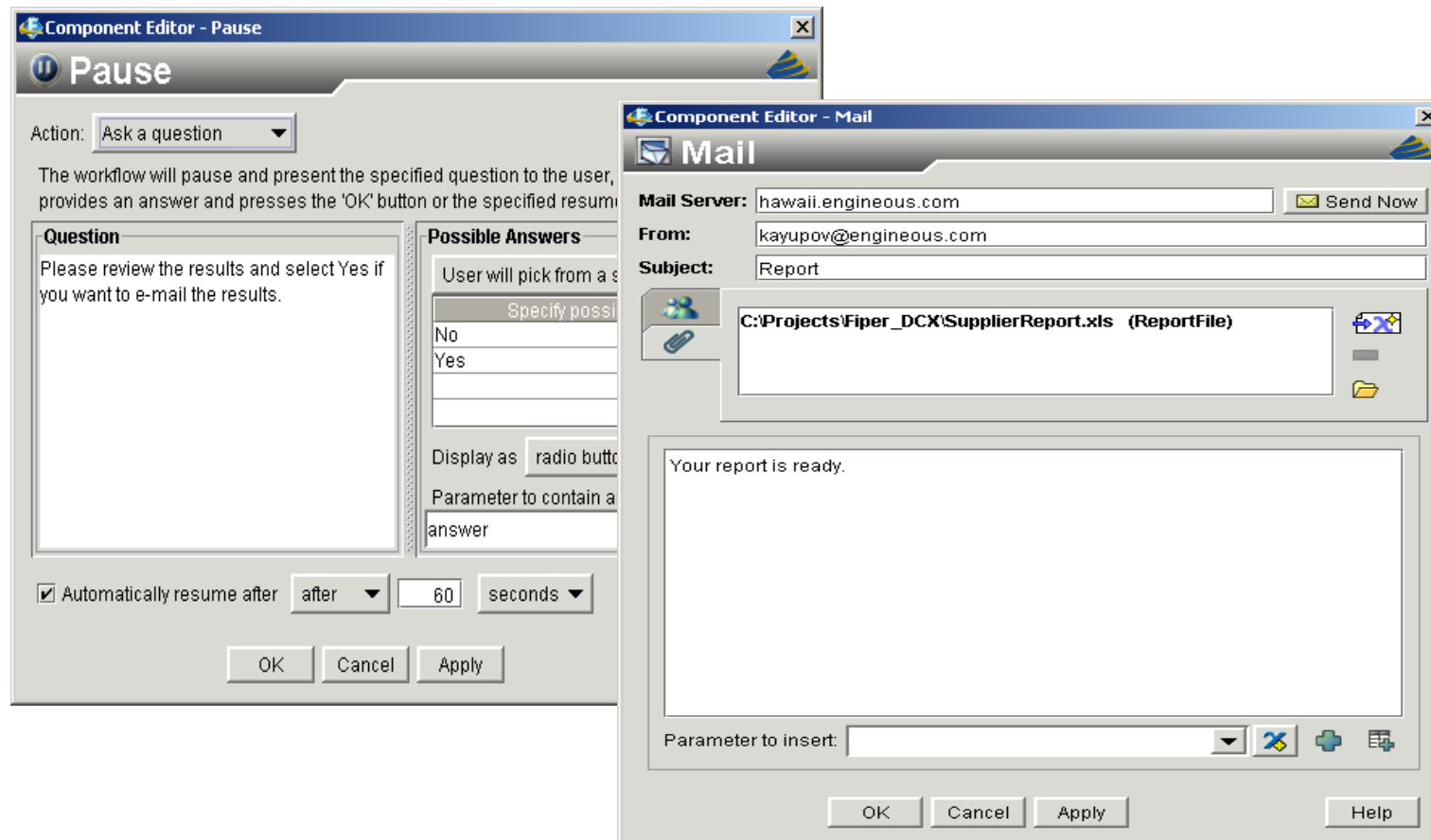
The screenshot displays the iSIGHT-FD Runtime Gateway interface for the 'Radiator Loop (Supplier_FIPER_Task.zmf)' model. The interface includes a menu bar (File, Edit, Run, View, Window, Help), a toolbar, and a status bar. The main window is titled 'OEM Cooling System Model' and shows a table of results for four different radiators. The table has columns for 'Run Path', 'Air Mass Flow (kg/s)', 'Fan Power (kW)', 'Rad Heat (kW)', and 'Rad Top Tank Temp (°C)'. The results are as follows:

Run Path	Air Mass Flow (kg/s)	Fan Power (kW)	Rad Heat (kW)	Rad Top Tank Temp (°C)
1 1	3.3393605655	5.2963010722	119.9047749854	99.3172320506
1 2	3.1496911149	5.2692101305	119.893166908	92.8412410471
1 3	2.8740371993	5.2120349519	119.8894695624	93.1051571416
1 4	2.9430425663	5.2277821319	119.8706229051	90.3365490429

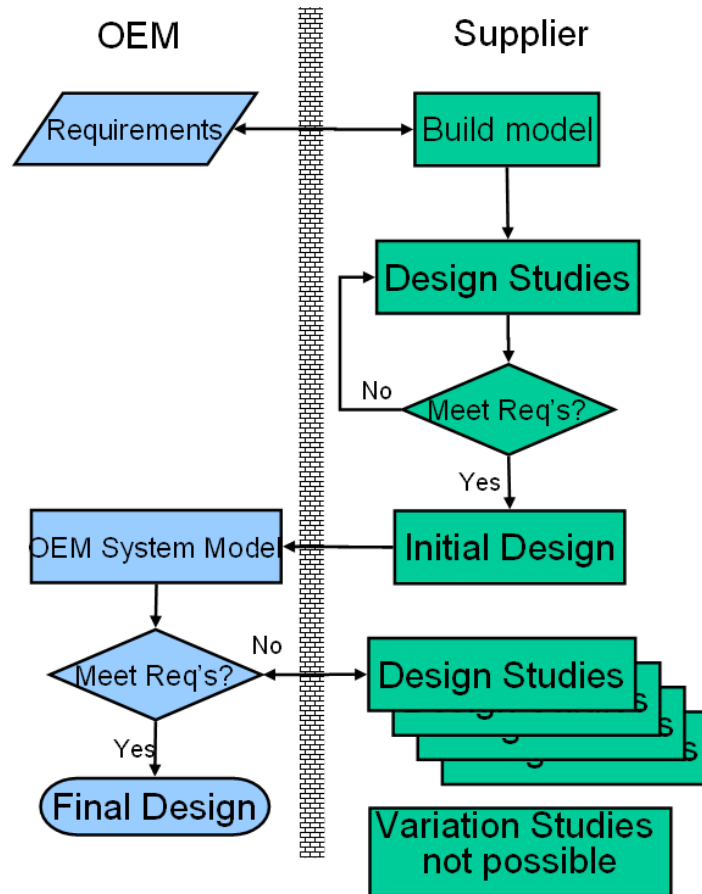
At the bottom of the interface, a status bar indicates 'Job completed successfully'. There are also buttons for 'Log' and 'Standalone'.

E-mail Communication with OEM

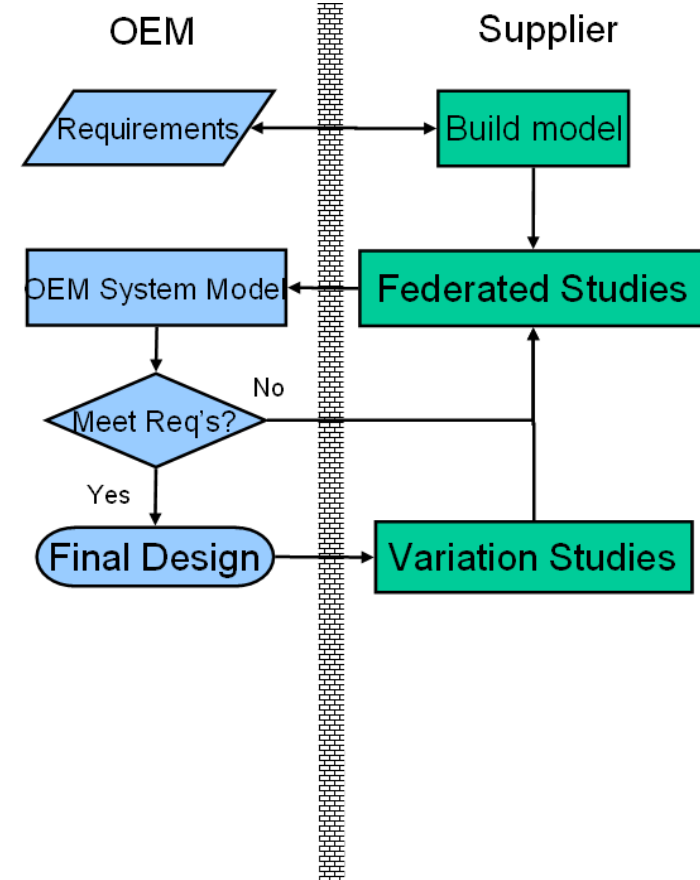
Pause Block that Allows an Interactive Workflow and Mail Block that Sends the Report to the OEM



Current Process vs. Federated Process



Current Process



Federated Process

Conclusions

- Global development environment needs
- Reducing data chasing between OEMs and Suppliers
- More connection between testing and simulation
- Reduce possibility of error during data inputs
- Optimization, Design of Experiment & Design for Six Sigma
- Protect intellectual property of each party