



RELIABLE
AND
SUSTAINABLE
POWER

GO15 Expert Network Webinar



CIM-based information model management for Russian System Operator hierarchical control system

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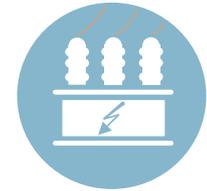
2018



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United Power System of Russia



950

Power
Plants

(>1MW)

> 10700

Lines

(110-750 kV)

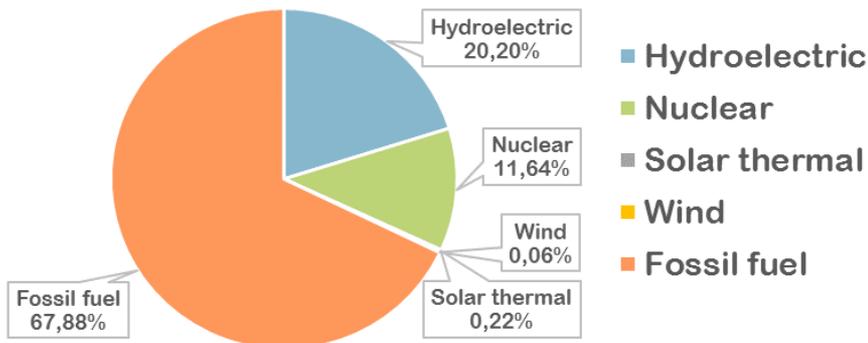
~ 480000 km

> 9000

Substations

(110-750 kV)

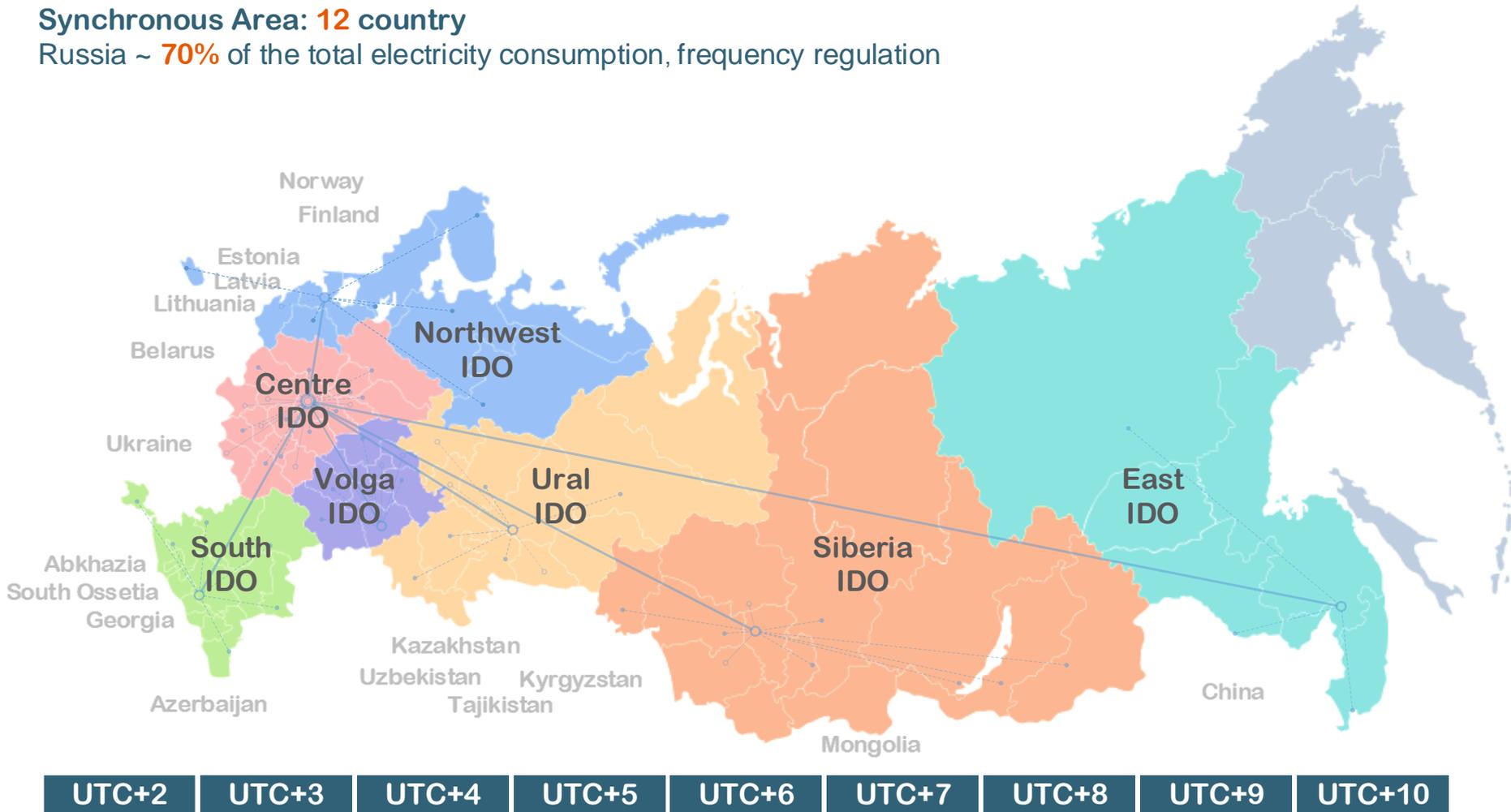
Total Rated Power ~ 240 GW





Synchronous Area: **12** country

Russia ~ **70%** of the total electricity consumption, frequency regulation





SO UPS JSC three-level hierarchical structure:

The Central Dispatching Office

7 Interregional Dispatching Offices (IDO)

49 Regional Dispatching Offices + 16 Representative offices;

9 Time Zones



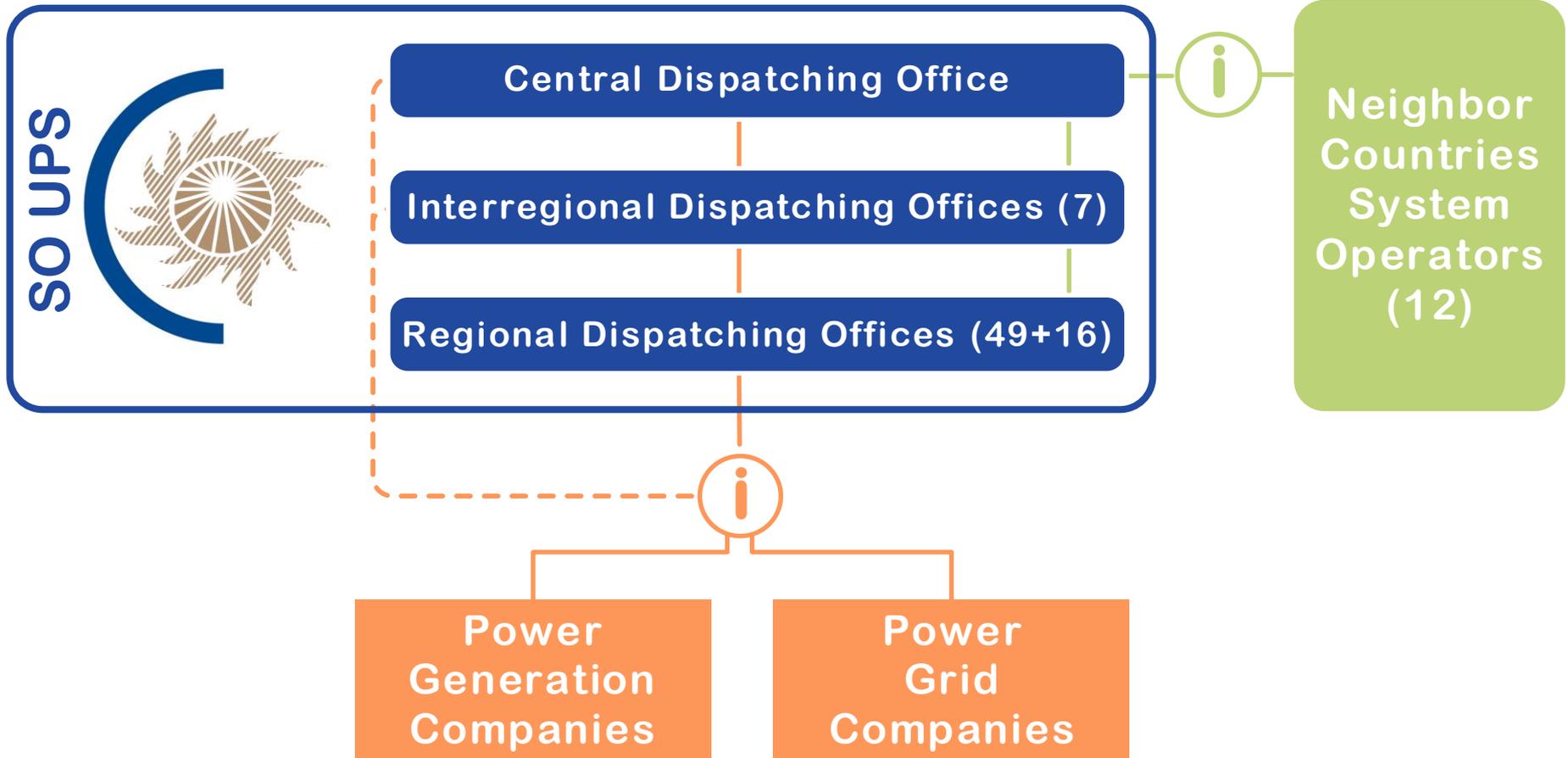
UTC+2	UTC+3	UTC+4	UTC+5	UTC+6	UTC+7	UTC+8	UTC+9	UTC+10
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Information Flows

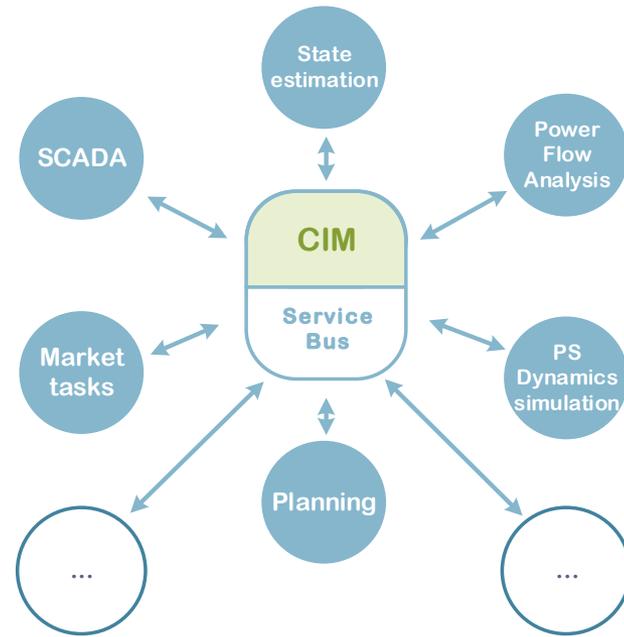
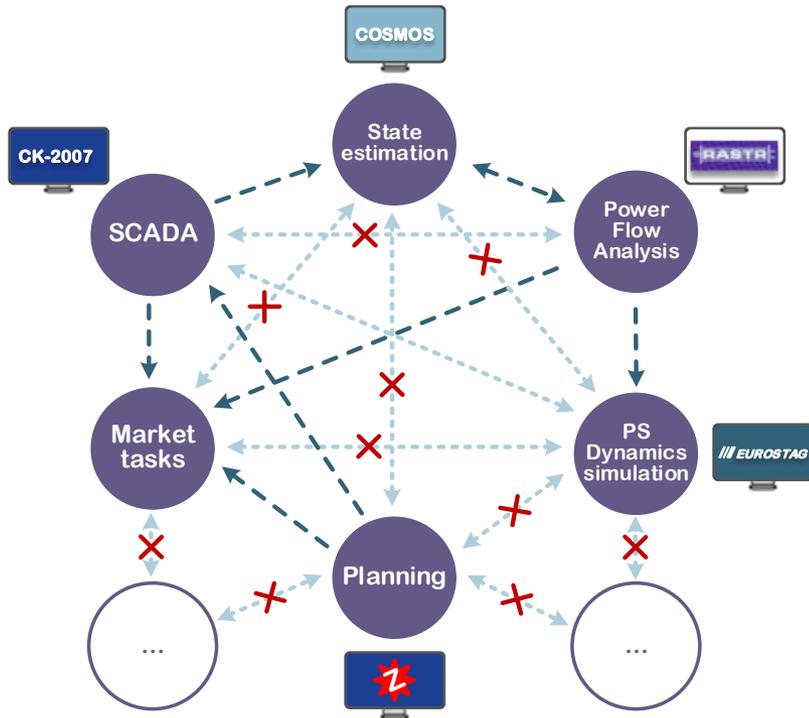




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IT-infrastructure



Point-to-point
 Data Growth
 Integration Complexity
 × 57 Dispatching Offices

Service Bus
 Data Structuring
 Enterprise Application Integration
 Optimization of Maintenance and Support Costs



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CIM SO UPS



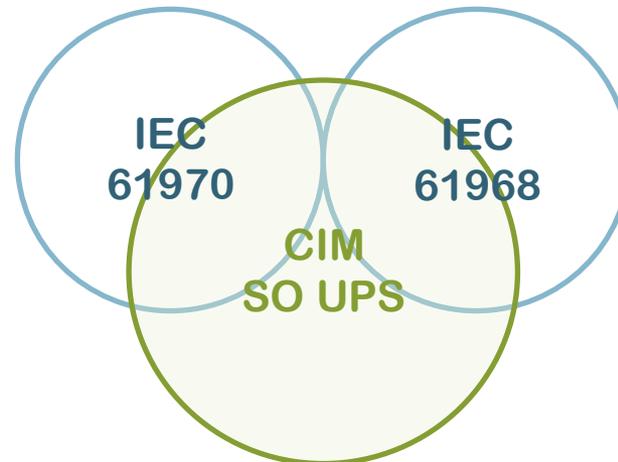
IEC 61970



IEC 61968



SO UPS Practice





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Specificities



Specificities

Hierarchical structure of dispatch control

Expanded Geography of Power System. Various equipment and configuration of regional electric systems

Autonomy Requirements for Dispatching Offices

9 Time Zones

Consequences

IT-systems Require a ***Distributed Structure*** as well as Data ***Integrity and Consistency*** in All Dispatching Offices

Each Dispatching Office is a ***Competence Center*** in Its Operating Area. Unique Competencies are Spread ***Across the Country***

Requirements for the Availability of a Model ***in Any Situations***, as well as the Competence for Its Management ***in Each Dispatching Offices***

The Difficulty of Fast Information Model Update

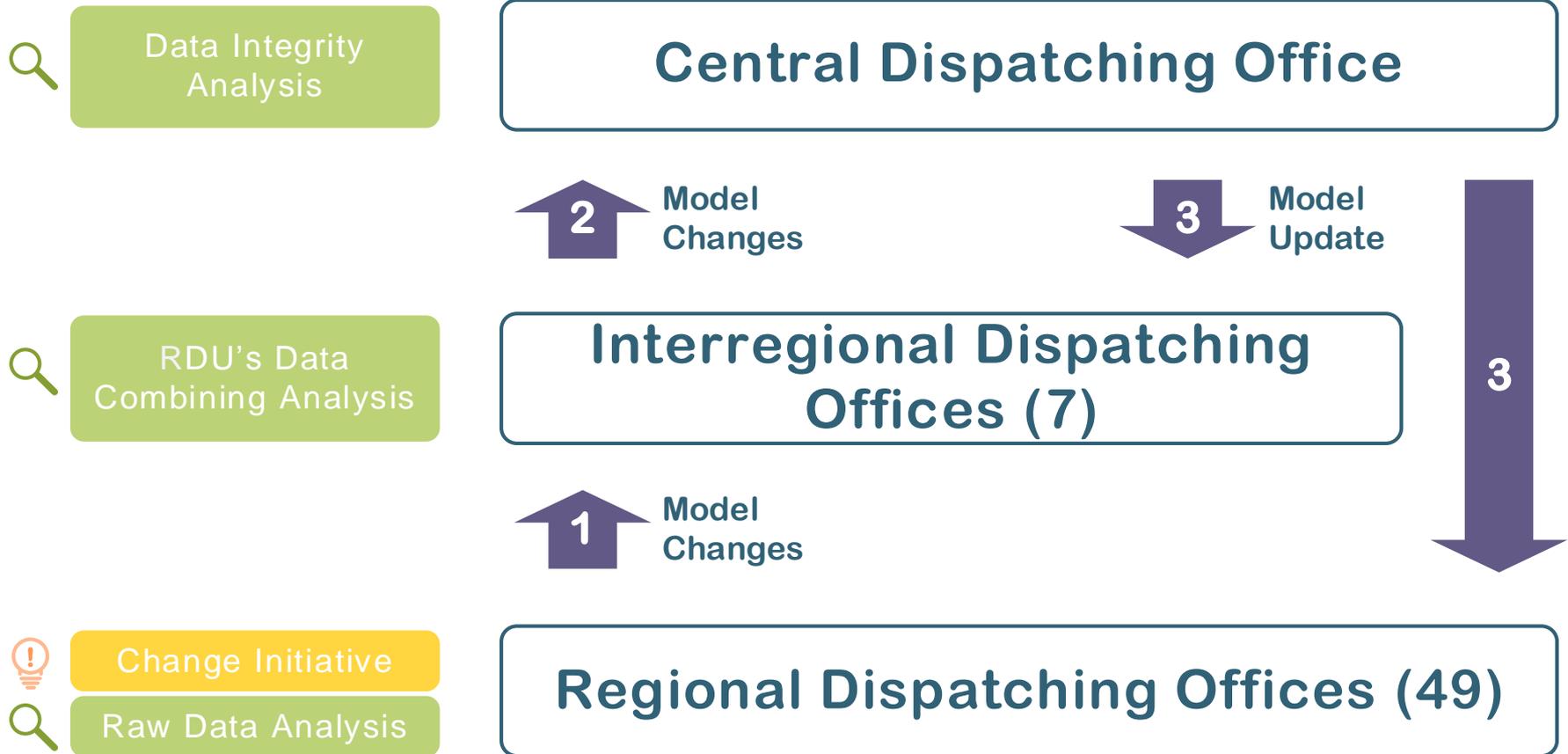


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Information Model





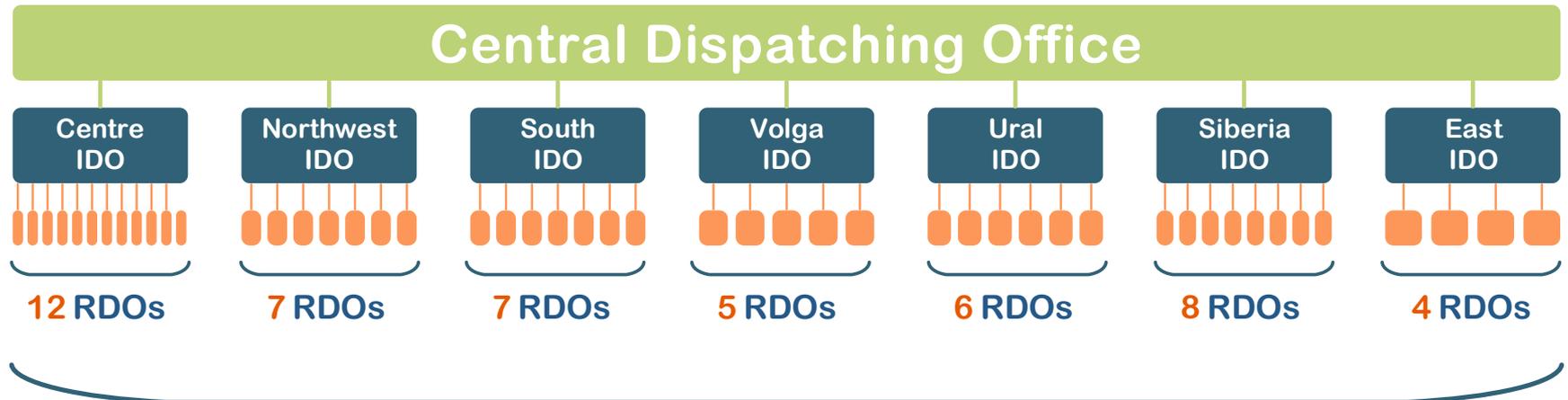
From Power Grid and Generation Companies



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Information Model Analysis



57 Models



Extending the Requirements of Data Verification and Data Integrity Analyses Tools



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Information Model Analysis



Formal Control

```

osim_ConductingEquipmentRule_1 X
Имя: osim_ConductingEquipmentRule_1  Исклонить из проверки  Запустить проверку
10  if(testObject == null)
11  result.Add(new CheckResult(0, ValidationSeverity.Warning, "Не передан объект для проверки.");)
12
13  var nodes = new[] { new (node = (ConnectivityNode)null, terminal = (Terminal) null).ToList();
14  nodes.Clear();
15
16  foreach(var t in testObject.Terminals)
17  {
18  nodes.Add(new (node = t.ConnectivityNode, terminal = t));
19  }
20  var groups = (from el in nodes
21  group el by el.node into g
22  where g.Count() > 1
23  select g).ToList();
24  foreach(var group in groups)
25  {
26  List(Terminal) terminals = new List(Terminal)( group.Count() );
27  foreach(var node in group){
28  terminals.Add(node.terminal);
29  }
30  if (testObject is PowerTransformer){
31  var brbr = from el in terminals
32  group el by el.TransformerEnd.BaseVoltage into g
33  where g.Count() == 1
34  select g;
35  if (brbr.Count() < 2) return result;
36  }
37
38  result.Add(new CheckResult(testObject.Id,
39  ValidationSeverity.Warning,

```

Ошибок: 0 Предупреждений: 295 Сообщений: 2 Сохранить

Правило	Текст	Имя объекта	Класс объекта
76654149	У транс-ра 110 кВ, 40,5 МВА с 3 линейными выводами при питании со стороны 1 и замыкании на стороне 2 Ххз=17,3% вне диапазона 9,45-12,1%	T-6	СиловойТрансформатор
76654149	У транс-ра 220 кВ, 63 МВА с 3 линейными выводами при питании со стороны 2 и замыкании на стороне 3 Ххз=39,7% вне диапазона 19,9-24,2%	T-1	СиловойТрансформатор
76654149	У транс-ра 220 кВ, 63 МВА с 3 линейными выводами при питании со стороны 1 и замыкании на стороне 3 Ххз=21,2% вне диапазона 31,5-38,5%	T-1	СиловойТрансформатор
76654149	У транс-ра 220 кВ, 63 МВА с 3 линейными выводами при питании со стороны 1 и замыкании на стороне 2 Ххз=21,2% вне диапазона 9,9-12,1%	T-1	СиловойТрансформатор
76654149	У транс-ра 220 кВ, 63 МВА с 2 линейными выводами при питании со стороны 1 и замыкании на стороне 2 Ххз=12,8% вне диапазона 9,9-12,45%	AT - 1	СиловойТрансформатор
76654149	У транс-ра 110 кВ, 100 МВА с 2 линейными выводами при питании со стороны 1 и замыкании на стороне 2 Ххз=12,0% вне диапазона 9,45-11,55%	T-4	СиловойТрансформатор
76654149	У транс-ра 110 кВ, 63 МВА с 3 линейными выводами при питании со стороны 1 и замыкании на стороне 3 Ххз=22,5% вне диапазона 15,3-20,35%	T-2	СиловойТрансформатор
76654149	У транс-ра 220 кВ, 63 МВА с 3 линейными выводами при питании со стороны 1 и замыкании на стороне 2 Ххз=21,5% вне диапазона 9,9-12,1%	T-2	СиловойТрансформатор



Technological Analysis

✓ Steady State Load Flow Analysis

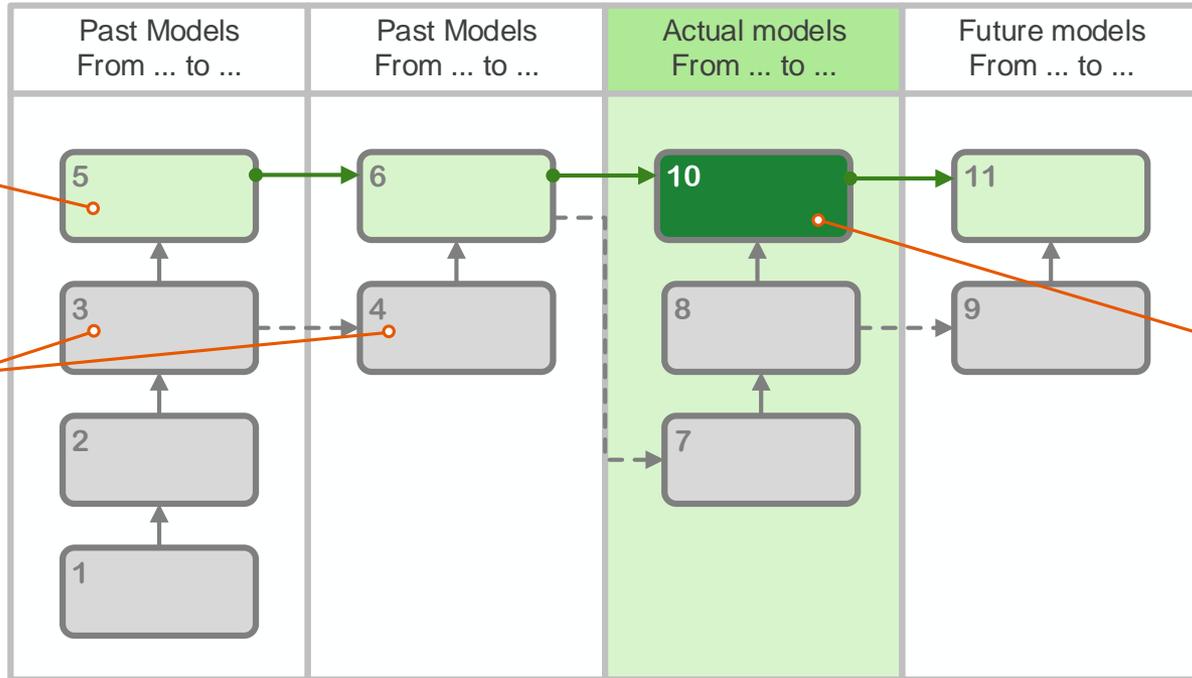
✓ State Estimation Analysis

✓ Diagram Analysis

✓ Etc.



✓ 100 % Temporality Implementation



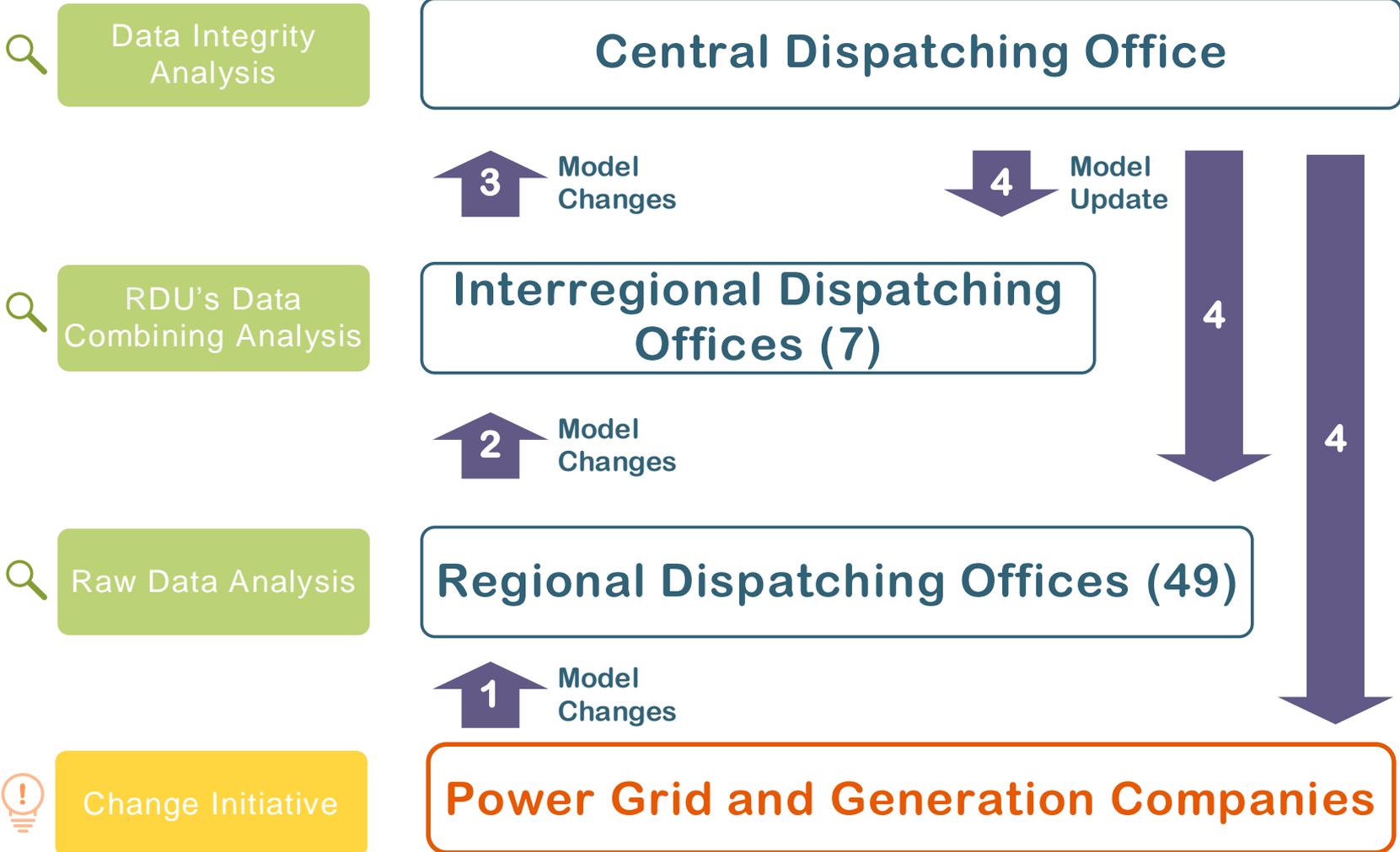
Retrospective
Analysis

Current
Tasks

Long-Term
Planning and
Future
Development



- ✓ The implemented common information model complying with the **hierarchical structure** of Russian UPS operational dispatch control, takes into account distribution of competencies and provides the possibility to manage individual power systems independently.
- ✓ The connectivity and integrity of the data contained in the models of **57** dispatching offices with **3** hierarchy levels is ensured.





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Thank you for attention!

**SO UPS
Russia**



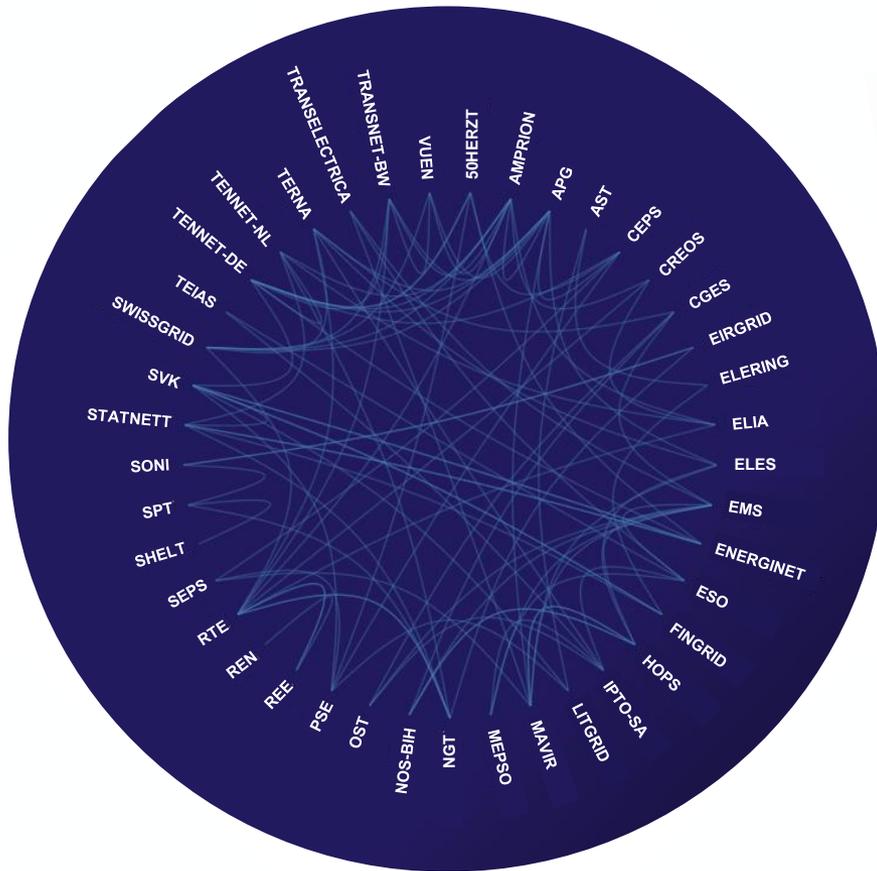
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Annex

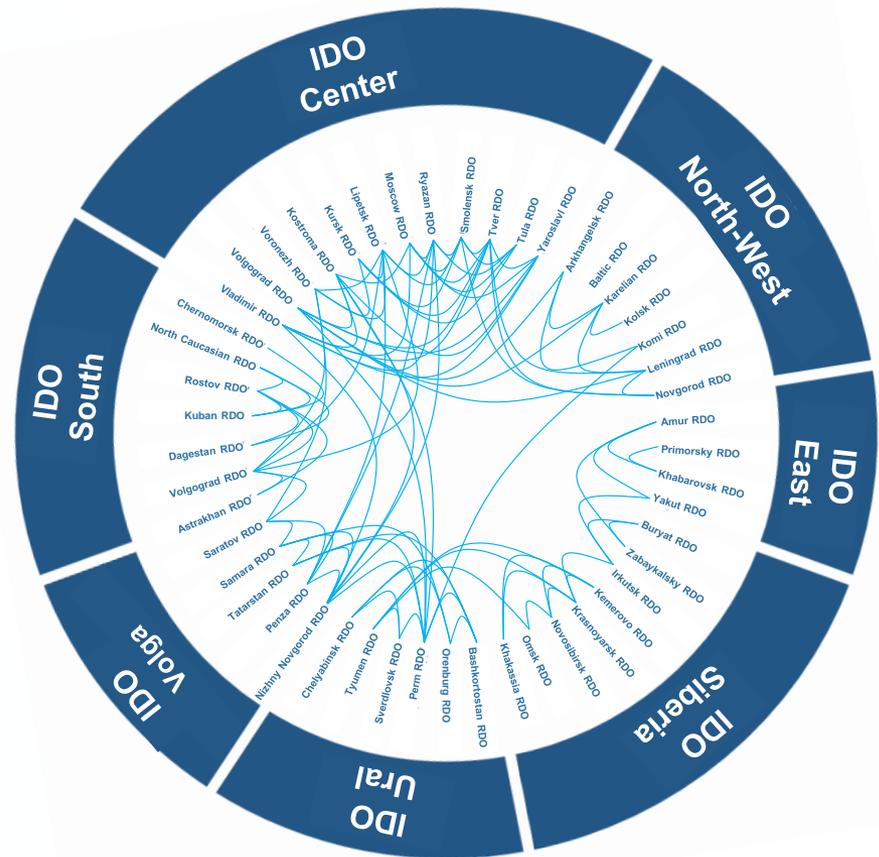


ENTSO-E*



* From <https://www.entsoe.eu/regions/#history>

Russian SO-UPS**



** Without neighbor countries