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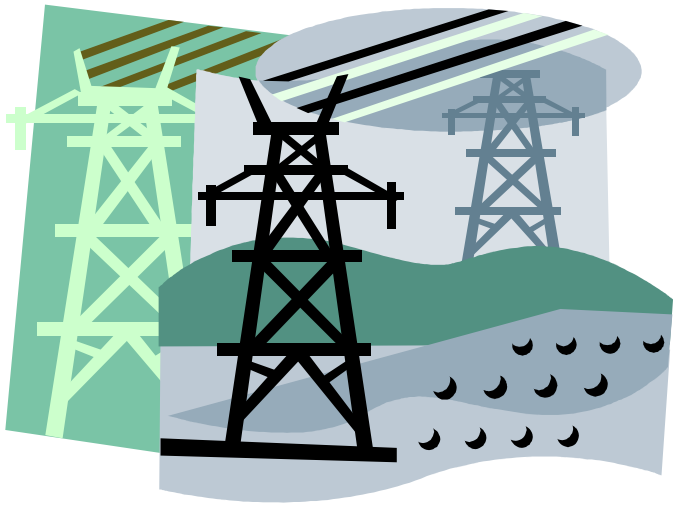
米国における スマートグリッド標準化動向と デマンドレスポンス



平成24年2月10日
インターテックリサーチ株式会社
新谷

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1.1　標準の種類

①デジュール標準

公的標準。公的で明文化され公開された手続きによって作成された標準。

（例）写真フイルム感度

ISO100
ISO400
：

②フォーラム標準

関心のある企業等が集まってフォーラムを結成して作成した標準。

（例）DVD

③デファクト標準

事実上の標準。個別企業等の標準が、市場の取捨選択・淘汰によって市場で支配的となったもの。

（例）Windows

出典：知的財産戦略本部　知的創造サイクル専門調査会「国際標準に関する基礎概念の整理」

スマートグリッドに関連して使われている標準には、デジュール標準（国際標準、国内標準）、及びフォーラム標準・業界標準が入り混じっている。

1.2　スマートグリッドに関連する標準化組織と標準

国際標準策定機関と、スマートグリッド関連の国際標準

- **IEC：国際電気標準会議（International Electrotechnical Commission）**
  IEC 60255、IEC 60870、IEC/TS 61085、IEC 61334、IEC 61400、IEC 61850 、IEC 61851、IEC 61968、IEC 61970 、IEC 62056、IEC 62196、IEC 62325、IEC 62351、IEC/TR 62357、IEC 62394/ 62457/ 62480・・・ ECHONET規格
- **ISO：国際標準化機構（International Organization for Standardization.）**
  ISO/IEC 12139-1、ISO/IEC 14543-4、ISO/IEC 15045-1、ISO/IEC 15067-3、ISO/IEC 18012-1、ISO/IEC 24767、ISO/IEC 27000、ISO/IEC 14908・・・ LonWorks規格
- **ITU：国際電気通信連合（International Telecommunication Union）**
  ITU-T勧告J.190、ITU-T G.hn

1.　米国におけるスマートグリッド標準化動向

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米国内／欧州内標準策定機関とスマートグリッド関連の国内標準

- **ANSI：米国規格協会（American National Standards Institute）**
  ANSI/ASHRAE 135-2008、ANSI C12スイート、ANSI/CEA 709及び852.1LONプロトコルスイート
- **CENELEC：欧州電気標準化委員会（Comite European de Normalisation ELECtrotechnique）**
  EN 13757-1、EN 50090 、EN 14908
- **ETSI：欧州通信規格協会（European Telecommunications Standards Institute）**
  ETSI M 2M （TS 102 689/690/921）
- **IEEE：米国電気電子学会（Institute of Electrical and Electronics Engineers, Inc.）**
  IEEE 802ファミリ、IEEE 1379-2000、IEEE 1547スイート、IEEE 1588、IEEE 1686-2007、IEEE 1888-2011、IEEE 61400-25、IEEE C37.118、IEEE P1901、IEEE P2030シリーズ
- **IETF：インターネット技術タスクフォース（Internet Engineering Task Force）**
  IETF RFC 791、768、2460等、IETF RFC 5548、IETF 4919
- **NAESB：北米エネルギー規格委員会（North American Energy Standards Board）**
  NAESB WEQ 015、OASIS EMIX、Energy Usage Information Model
- **NERC：北米電力信頼度協議会（North American Electric Reliability Corporation）**
  NERC CIP 002-009
- **NIST：米国国立標準技術研究所（National Institute of Standards and Technology）**
  NIST SP800-53、NIST SP800-82
- **NRECA：米国農業電力協同組合（National Rural Electric Cooperative Association）**
  Multispeak

1. 米国におけるスマートグリッド標準化動向

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米国／欧州のフォーラムとスマートグリッド関連標準

- ASHRAE：米国暖房冷凍空調学会（American Society of Heating, Refrigerating and Air-conditioning Engineers）
  ANSI/ASHRAE 135-2008、BACNet
- DLMSユーザ協会（DLMS User Association）
  DLMS/COSEM
- DNP ユーザグループ（Distributed Network Protocol Users Group）
  DNP3
- HomePlugパワーライン・アライアンス（HomePlug Powerline Alliance）
  HomePlug AV、HOMEPLUG C&C
- KNX協会（KNX Association）
  KNX
- LONMARKインターナショナル（LonMark International）
  ANSI/CEA 709及び852.1 LONプロトコルスイート
- NEMA：電機製造者協会（National Electrical Manufacturers Association）
  SG-AMI 1-2009
- 構造化情報標準促進協会（Organization for the Advancement of Structured Information Standards：OASIS ）
  EI1.0/OpenADR profile、EMIX
- OpenADRアライアンス
  OpenADR2.0
- SAE：米国自動車技術者協会（Society of Automotive Engineers）
  SAE J1772、SAE J2293、SAE J2836、SAE J2847
- UCA国際ユーザグループ（UCA International User Group：UCAIug）
  OpenADE、OpenADR、OpenHAN、AMI-SEC
- ZigBeeアライアンス
  ZigBee、Building Automation Profile、Home Automation Profile、Smart Energy Profile (SEP)
- Z-Waveアライアンス
  Z-Wave

1.3　NISTによるスマートグリッド標準化の経緯

- 米国の電力系統の事情
  - 送電系統が老朽化している
  - それにもかかわらず、電力需要が増加の見込み

  ➡ ICTを利用して既存の送配電網を近代化、スマートな電力網に

  ➡ そのためには、スマートグリッド関連標準の整理が必要

- エネルギー自給及び安全保障法（Energy Independence and Security Act of 2007：EISA2007）

  米国の送配電網を近代化し、スマートグリッドを構成するデバイスやシステムの相互運用を可能とするフレームワーク制定のコーディネータ役に国立標準技術研究所（National Institute of Standards and Technology：NIST）を指名

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- DEWG（Domain Expert Working Group）を組織

  NISTは、スマートグリッドの概念フレームワークの検討を目的として米国エネルギー省が有識者を集めて設立した産学協同の諮問機関であるGWAC（GridWise Architecture Council）と共同で、以下の6つのスマートグリッド関連領域ごとの専門家による作業グループ（Domain Expert Working Group：DEWG）を組織した。

  ①TnD（送配電分野の作業部会）
  ②H2G（宅内から系統への電力逆潮流に関する分野の作業部会）
  ③B2G（建物から系統への電力逆潮流に関する分野の作業部会）
  ④I2G（産業余剰電力の系統への電力逆潮流に関する分野の作業部会）
  ⑤BnP（ビジネスポリシーに関する分野の作業部会）
  ⑥Cyber（スマートグリッド関連のサイバーセキュリティ分野の作業部会）

1.　米国におけるスマートグリッド標準化動向

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3段階のスマートグリッド標準化作業計画

フェーズ1：スマートグリッドに関連する既存規格を洗い出し、洗い出した規格間に不整合がある場合、そのギャップを埋めるためのロードマップを作成する

フェーズ2：フェーズ1の作業を引き継ぎ、新たにスマートグリッド関連の標準として追加の提案や改定の提案が出てきた場合に、その検討を実施する官民連携の標準検討委員会：スマートグリッド相互運用性パネル（Smart Grid Interoperability Panel：SGIP）を設置し、標準化ロードマップ自体の進化を図る

フェーズ3：制定された標準規格に基づいた製品・サービスの試験と認証を行う基盤の確立

2009年9月

2010年

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フェーズ1作業進捗状況

- NISTはフェーズ1の作業の取りまとめを米国電力中央研究所（Electric Power Research Institute：EPRI）に委託。
- EPRIは、DEWGの専門家からの提言、並びに、数百のスマートグリッド関連ステークホルダの参加を得て開催した公開ワークショップの成果をとりまとめ、パブリックコメントも反映して2009年8月にNISTに提出。
- NISTはレビューを経て2009年9月に「NIST Framework and Roadmap for Smart Grid Interoperability Standards Release 1.0 (Draft)」として公開。
- 再度11月初旬までパブリックコメントを求め、その結果を反映して、2010年1月に「NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0」として正式に公開され、フェーズ1の作業は完了。
- 「Release 1.0」版では、スマートグリッドに関連するハイレベル概念参照モデルを定義するとともに、25の既存標準規格をスマートグリッド関連規格として特定し、更に、今後検討が必要なものとして50規格を追加指定している。また、その中で早急に解決が必要な15項目を選定し、一部は2009年中に、その他も2010年中に解決するべきという意欲的なマイルストーンが設定された優先行動計画（Priority Action Plan：PAP）が策定されている。

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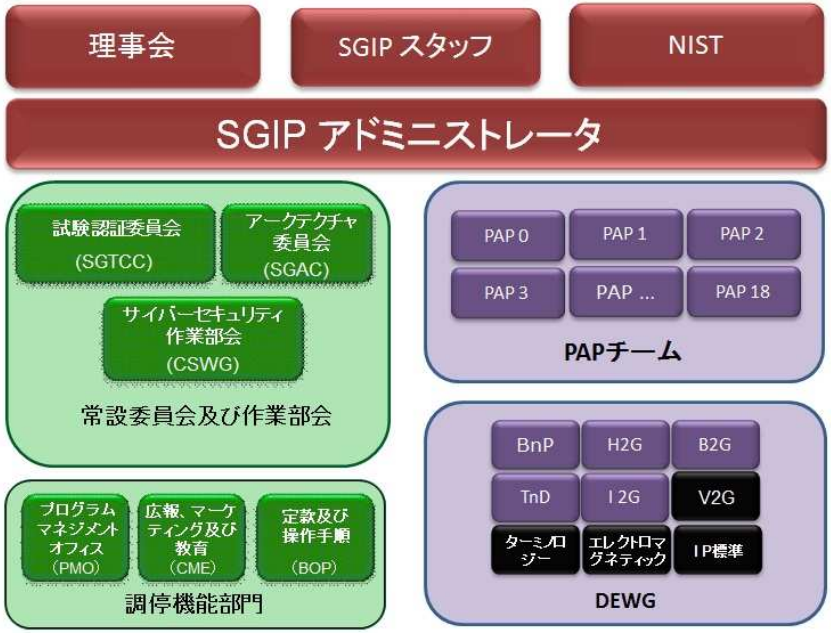
フェーズ2作業進捗状況

NISTは「Release 1.0 (Draft)」版をリリーズ後、スマートグリッドシステム全体の技術標準整備を支援するNIST内の組織として、2009年11月、SGIPを設立した。

SGIP の構成は以下のとおり。

- 理事会（Government Board）、SGIPスタッフ及びSGIPアドミニストレータ
- 常設委員会・作業委員会（Standing Committees & Working Groups：SC&WG）
- プログラムマネジメントオフィス（PMO）その他の調停機能部門
- PAPチーム（Priority Action Plan Team）
- 領域専門WG（DEWG）



フェーズ3作業進捗状況

SGIPの常設委員会の1つであるSGTCCは、SGIPが推奨するスマートグリッド標準のコンプライアンス、相互運用性、サイバーセキュリティの試験、認証を行うのに必要な書類、及び組織のフレームワークを作成、見直しを図ることを目的として設立された委員会で、テュフ ラインランド（TÜV Rheinland）、UL（Underwriters Laboratories） などの認証機関も含め、30名の委員で構成されている。

SGTCCのこれまでの成果は以下のとおり。

- SGTCC Testing & Certification Roadmap
  SGTCCの使命・役割とSGTCCでの検討内容についてのまとめ
- IPRM（Interoperability Process Reference Manual ）
  スマートグリッドの試験、認証のフレークワークをまとめた資料
- T&C Landscape Report
  スマートグリッド関連標準の現在の試験、認証状況を整理した資料
- T&C Framework Development Guide

現在、ロードマップ及びIPRMの改定、エンドツーエンドでの相互運用性試験などが進行中。

1.4　NISTスマートグリッド標準フレームワーク概要

- NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0
  - 2010年1月、3段階のスマートグリッド標準化作業計画フェーズ1の成果物として公開
  - スマートグリッドのビジョン、ハイレベル概念参照モデルを定義
  - 25の既存標準規格をスマートグリッド関連規格として特定
  - 更に、今後検討が必要なものとして50規格を追加指定
  - その中で早急に解決が必要な15項目を選定し、一部は2009年中に、その他も2010年中に解決するべきという意欲的なマイルストーンが設定された優先行動計画（Priority Action Plan：PAP）を策定
  - サイバーセキュリティに対する リスク管理フレームワークと戦略を定義

- NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0 （Draft）
  - 2011年10月、3段階のスマートグリッド標準化作業計画フェーズ2、3の進捗状況を反映したものを、パブリックコメント収集のためのドラフト版として公開
  - 大きな変更点は、アーキテクチャフレームワークに関してリリース1.0の概念参照モデルを大幅に拡張したことと、SGIPの活動内容報告、及び、サイバーセキュリティに関するその後の展開の記述
  - スマートグリッド関連規格として特定した既存標準規格数が、25から35に増加
  - スマートグリッドに適用するには今後検討が必要な規格数が50から62に増加
  - PAPの項目数は15から19に増加

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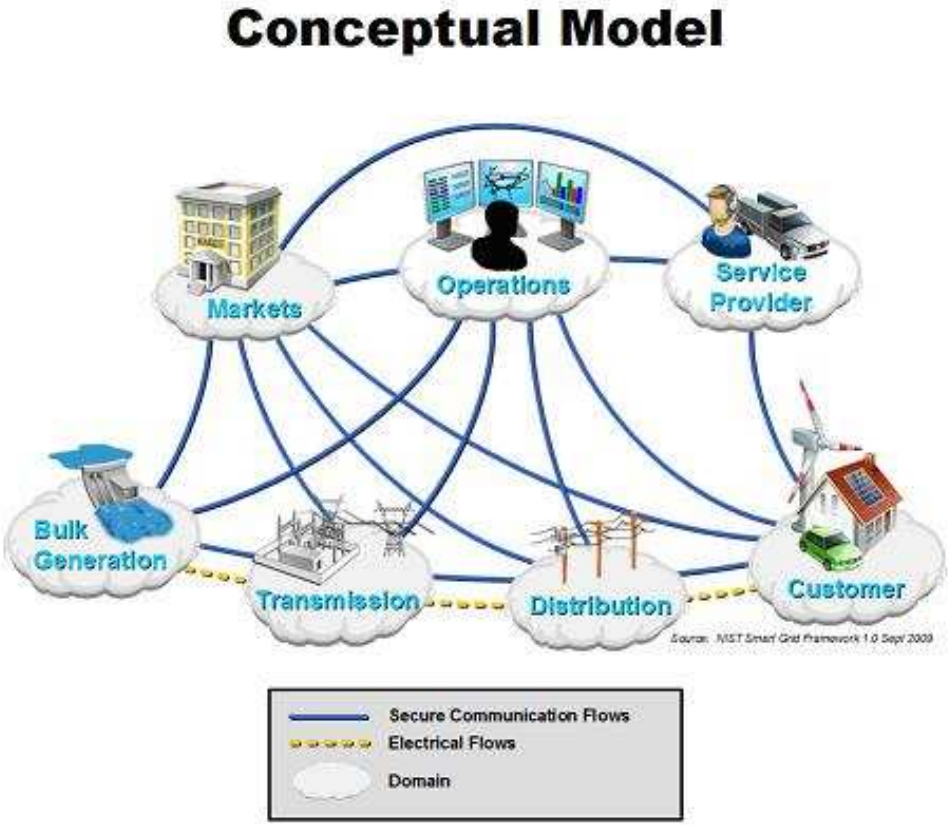
スマートグリッド概念参照モデル



ドメイン	ドメイン内のアクター
顧客 Customer	電気の最終需要家。ただし、単に電気を消費するだけでなく、発電、蓄電や、エネルギー利用管理も行う
市場 Market	電力市場のオペレータおよび市場参加者
サービス プロバイダー Service Provider	顧客側および電力会社側に対してサービスを提供する組織
運用 Operations	電気の移送の管理者
大規模発電 Bulk Generation	大規模の発電所・発電会社。後で電力供給するために蓄電することもある（揚水発電など）
送電 Transmission	遠隔地で「大規模発電」により生産された電気のキャリア。蓄電したり、発電したりすることもある
配電 Distribution	顧客に電気を届けるディストリビューター。顧客から電気を受けることもある。 また、蓄電したり、発電したりすることもある

1.　米国におけるスマートグリッド標準化動向

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- スマートグリッドに関連する既存標準規格
  参考1：リリース1.0及び2.0におけるスマートグリッド関連標準規格比較

- スマートグリッドに適用するには検討が必要な標準規格
  参考2：リリース1.0及び2.0における検討が必要な追加標準規格比較

- 参考優先行動計画（PAP）
  参考3：リリース1.0及び2.0におけるPAP比較

1.5 今後の標準化の進捗予想

2011年10月公開されたリリース2.0でのPAPのスケジュールでは、PAP7を除いて2011年中に対応完了予定だが

	完了予定月（2011 年）									状況			
	4	5	6	7	8	9	10	11	12	要件作成中	ハンドバック待ち	ガバニングボード承認	完了手続き中
PAP1				(●)								承認済	○
PAP2				(●)								まもなく承認	
PAP3									完了時期未定		(OASIS より)		
PAP4									完了時期未定		(OASIS より)		
PAP5			●									まもなく承認	
PAP6							●			○			
PAP7									2012 年 8 月		(IEC、UL より)		
PAP8								●			(IEC より)		
PAP9									完了時期未定		(OASIS より)		
PAP10									完了時期未定	○			○
PAP11						●						(一部承認)	
PAP12									●		(IEC より)		
PAP13									●		(IEC より)		
PAP14									完了時期未定	○			
PAP15									完了時期未定			(一部承認)	
PAP16									●		(IEC より)		
PAP17				(●)							(ASHRAE)		
PAP18							●			○			

（注）2011 年 4 月現在、( )内は見込み

出典：NEDO戦略的国際標準化推進事業 グリーンイノベーション推進事業「国際標準化における優先行動計画（PAP）動向等調査報告書」

実際には、左表のとおり、完了時期未定のものを含め、2011年中対応完了予定のPAPのかなりの部分でスケジュール遅れが出ている模様

2011年10月公開された「NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0 (Draft)」で検討が完了しているのは、表中のPAP1、PAP10のみ

（もう1つPAP0も完了）

目次

2.1 デマンドレスポンスの起源

米国の一部の地域では，2000 年以降から需要反応プログラム（Demand Response Program：DRP）と呼ばれる制度が導入され出した。

DRPは、米国の独立系統運用者（Independent System Operator：ISO）が実施する発電事業者、電力小売り事業者および大口需要家向けのプログラム。具体的には、次の2つがある。

1） 信頼度プログラム（Reliability Program）

ISOが、運転予備力が不足しそうな状況に応じて、大口需要家あるいは予備電源を持つ発電事業者に対して、負荷遮断／予備電源起動の指示を出すプログラム

※日本での大口需要家に対する随時調整契約に相当

2） 経済プログラム（Economic Program）

大口需要家や電力小売事業者は、卸電力市場メカニズムを用いて、万一系統運用時に供給不足が生じた場合削減できる需要量と、需要を削減した場合の報酬額を入札しておく。 ISOは、需給が逼迫すると、調達価格の安い大口需要家や電力小売事業者から必要な電力削減量分の「電力調達」を行い、系統の電力供給不足を回避する

この、経済プログラムに参加した電力小売事業者は、供給量を調整する方策として、DRPに対応する最終需要家向けの料金メニューを新たに考案した。主なものは以下のとおりで、これがDRの原型である。

- リアルタイム料金（Real-Time Pricing：RTP）
- 緊急ピーク時間帯料金（Critical-Peak Pricing：CPP）
- 需要買戻し（Demand Buyback）

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DRPで用いられた、需要家向け電気料金メニュー

- リアルタイム料金（Real-Time Pricing：RTP）

  日により／時間により（例えば1時間ごとに）電気料金が異なり、一日前や数時間前にその電力価格が需要家に通知される

  ※米国では、2003年時点で49の電気事業者が選択的なRTPを提供している

- 緊急ピーク時間帯料金（Critical-Peak Pricing：CPP）

  一日を3つの区間（ピーク、オフピーク、ミッドピーク）に分けた従来型の時間帯別料金（Time of Use：TOU）に加えて、年間で数回、需給が特に逼迫することが予見されるピーク時間帯に、更に高い料金を適用するもの

- 需要買戻し（Demand Buyback）

  電力小売事業者が、特定の時間帯の需要削減要求を出し、それに応じて需要家が需要を削減するもので、買い戻し単価は卸電力所の価格などと連動する

  ※DRの ピーク時間帯リベート料金（Peak Time Rebate：PTR）に相当

DRPは、卸電力市場における価格スパイクの抑制や供給信頼度の向上などの効果を期待して導入されたものであるが、以上のとおり、スマートグリッドという言葉が世に出るはるか以前に、デマンドレスポンスの仕組みが出来上がっていたことが分かる。

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2.2 デマンドレスポンスの理論的基礎

- デマンドレスポンス（Demand Response：DR）の定義

Demand Response : Changes in electric use by demand-side resources from their normal consumption patterns in response to changes in the price of electricity, or to incentive payments designed to induce lower electricity use at times of high wholesale market prices or when system reliability is jeopardized.

Demand Response Research Center, Lawrence Berkley National Lab

卸売電力価格の高騰が予見されたり、系統の信頼性が損なわれたりしそうな場合に、電力価格の変更その他の価格インセンティブを用いて通常の電力使用パターンより電力需要を低下させる仕組み

2. デマンドレスポンス

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- デマンドサイドマネジメント（DSM）、DRと省エネ（Energy Efficiency：EE）の相違点

	従来からあった 家庭向けピーク需要削減の仕組み	最近使われだした 家庭向けピーク需要削減の仕組み
仕組みの名称と特徴	デマンドサイドマネジメント：DSM ― 直接制御（DLC：direct Load Control）	デマンドレスポンス：DR ― スマートサーモスタット等
	普段の電気料金を割り引く代わりに、電力会社が系統の状況に応じて一般家庭のエアコンなどを運転を直接制御する	電力価格に変化をつける（ダイナミック料金）ことより、需要家の電力使用時間帯を系統負荷が少ない時間帯に誘導するが、需要の制御主体はあくまでも需要家側
関連する電気料金メニュー	時間帯別料金（TOU：Time-of-Use Rate）	緊急ピーク時課金（CPP：Critical Peak price） リアルタイム料金（RTP：Real-Time price） 緊急ピーク時リベート（PTR：Peak Time Rebate）
その他の特徴		電力需要に対して価格弾力性が増すので、より競争的な卸電力市場形成に貢献

	DSM	EE (Energy Efficiency)	DR
動機と電力需給との関係	電力需給（設備） ↓ 電力需要（対策） ⋮ 主に固定的な料金*	エネルギー・環境問題 （長期的視点） ↓ 年間を通じた省エネルギー	電力需給（変化） ↕ 電力価格（動的） ↕ 電力需要（反応） 特定時間帯におけるピークカット、ピークシフト
実施	静的	静的	PX,ICTの積極的な活用:動的価格
発送電設備の削減	計画による	省エネによる	運用による

*当時の技術では動的価格は、メータリングコストが嵩むため

出典：日本技術士会技術士CPDミニ講座「スマートグリッド技術の概要-再生可能エネルギー普及に向けた技術開発-」

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典型的なDR料金メニュー

- **緊急ピーク時課金（CPP：Critical Peak price）**

  翌日特に需給が逼迫しそうな場合、前日のうちに「ピーク時間帯に電気を使うと、通常のピーク料金よりもさらに高い価格設定が適用されること」を通告し、需要抑制を促進する。電力会社は、年間数十時間程度の緊急ピークに対応するためだけのピーク電源を確保するため膨大な設備投資をしているので、確実に需要を削減することができれば、設備投資の抑制に大きな効果があると期待されている。

- **リアルタイム料金（RTP：Real-Time price）**

  電気料金の発電費用の部分を卸電力市場価格などと連動させるのがRTPである。現在は、当日・当該時間（本当の意味のリアルタイム）の卸電力市場価格ではなく、前日の卸電力市場価格や、リアルタイム市場（電力需給調整市場）の前日予測値が用いられている。したがって、需要家は、翌日24時間の各時間帯の電力価格をあらかじめ把握できる、次図に例示されているように時間ごとに細かく電力価格が異なり、かつ、日々料金が変動するので、電気代を節約するには、それなりの努力が必要。

  ※米国では、2011年までにNear Real Timeベース（5分遅れ程度を想定）でメーター情報が提供出来るようになる。

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典型的なDR料金メニュー （続き）

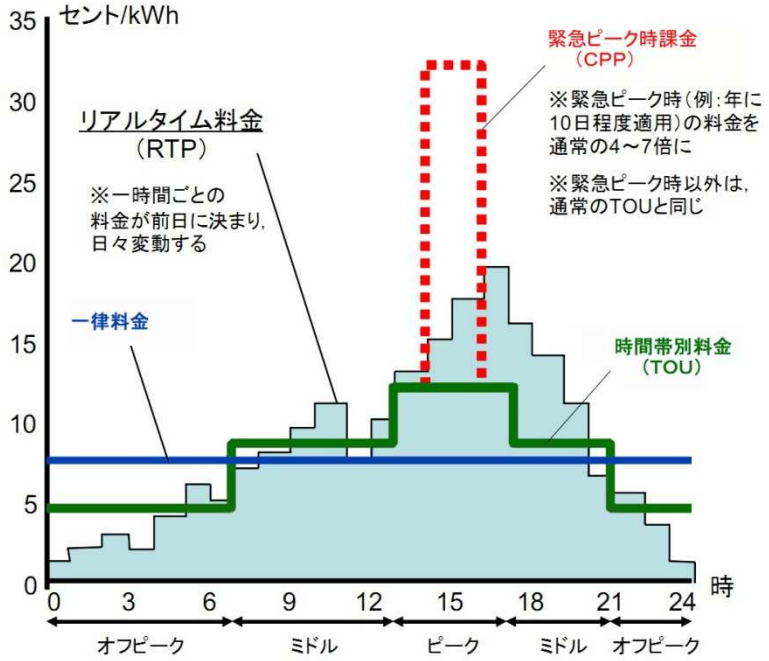
- **緊急ピーク時リベート**

（PTR：Peak Time Rebate）

PTRの料金メニューでは、ピーク時間帯の電力価格はTOUと同じく固定である。

ただし、PTRでは、翌日特に需給が逼迫しそうな場合、前日のうちに「ピーク時間帯に電気使用量を削減すると、その削減量に応じて払戻しを行う（リベートを払う）」ことを通告することで、ピーク需要の抑制を促す。

CPPやRTPで電気代を節約するには、需要家側は、いつ電力価格が高くなるのかを気にしなければならないが、PTRでは、翌日のある時間帯がPTR対象の時間帯であることを無視しても（あるいは知らなくても）、電気代が高くなることはないので、需要家にとって、“知らないと電気代が高くなる”という心理的な不安がなく、リスクフリーの料金メニューと呼ばれている。



一律料金、TOU、CPPとRTPの料金体系比較

出典：電力中央研究所：報告書「米国における需要反応プログラムの実態と課題」（報告書番号：Y05028）

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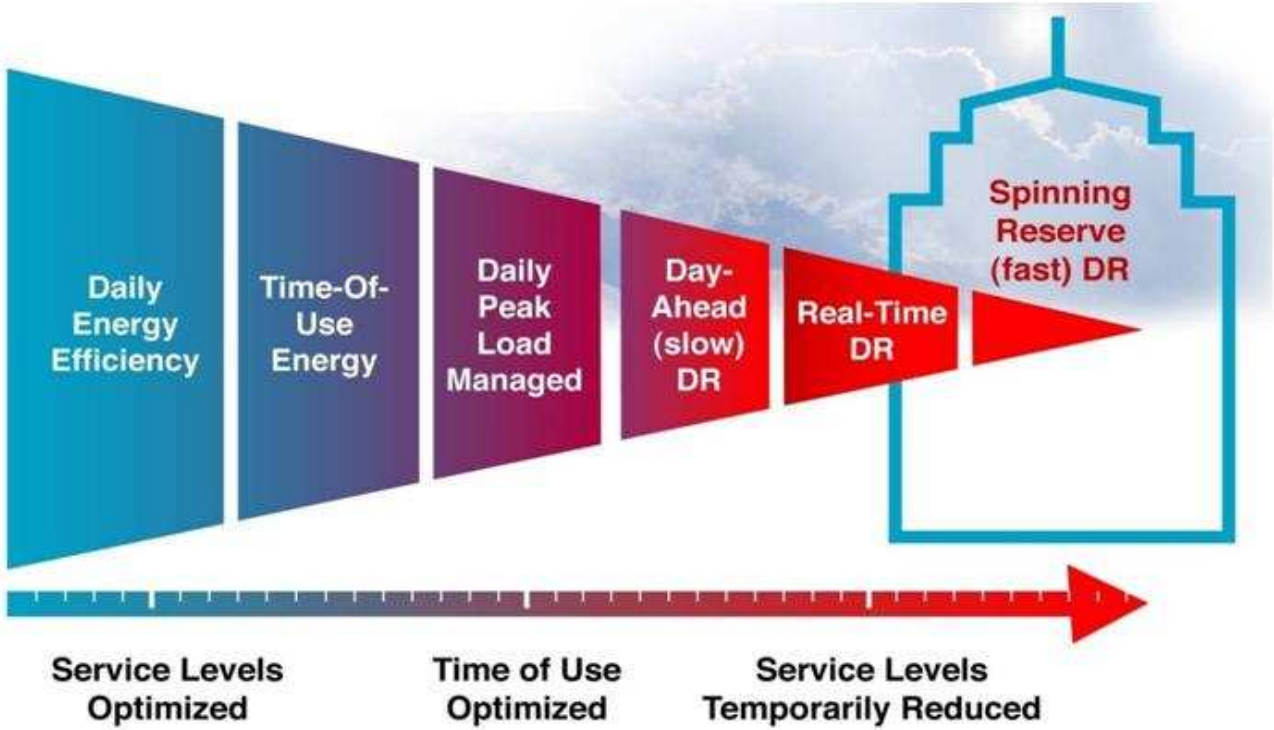
2.3 デマンドレスポンスのアンシラリーサービスへの適用

Role of Demand Response in Electric Power Systems



Demand Response Research Center, "Demand Response Best Practices, Design Guidelines and Standards, Work Papers", presentation to California Public Utilities Commission, December 2008.

出典：Bonnville Power Administration、「Demand Response in the Pacific Northwest」

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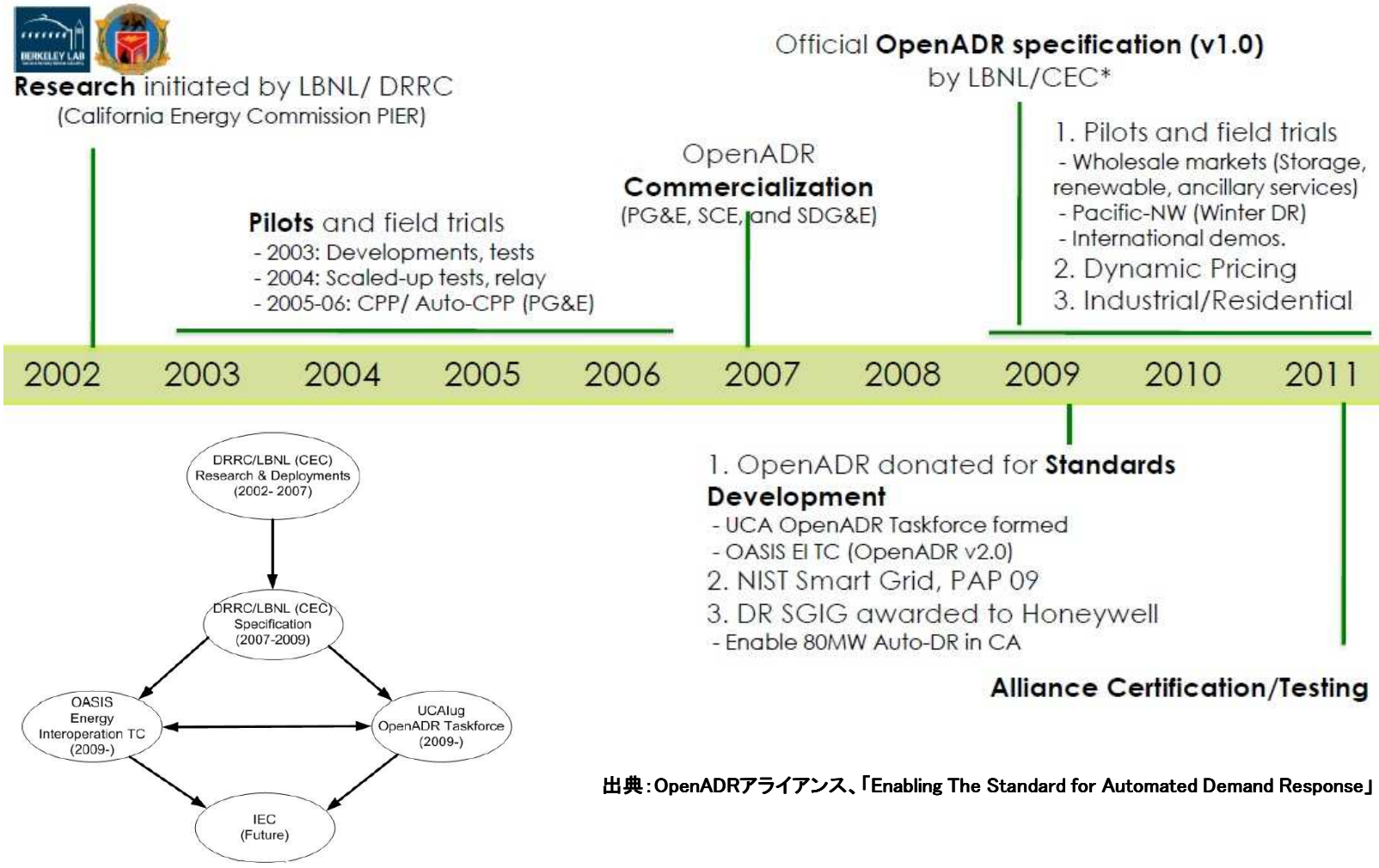
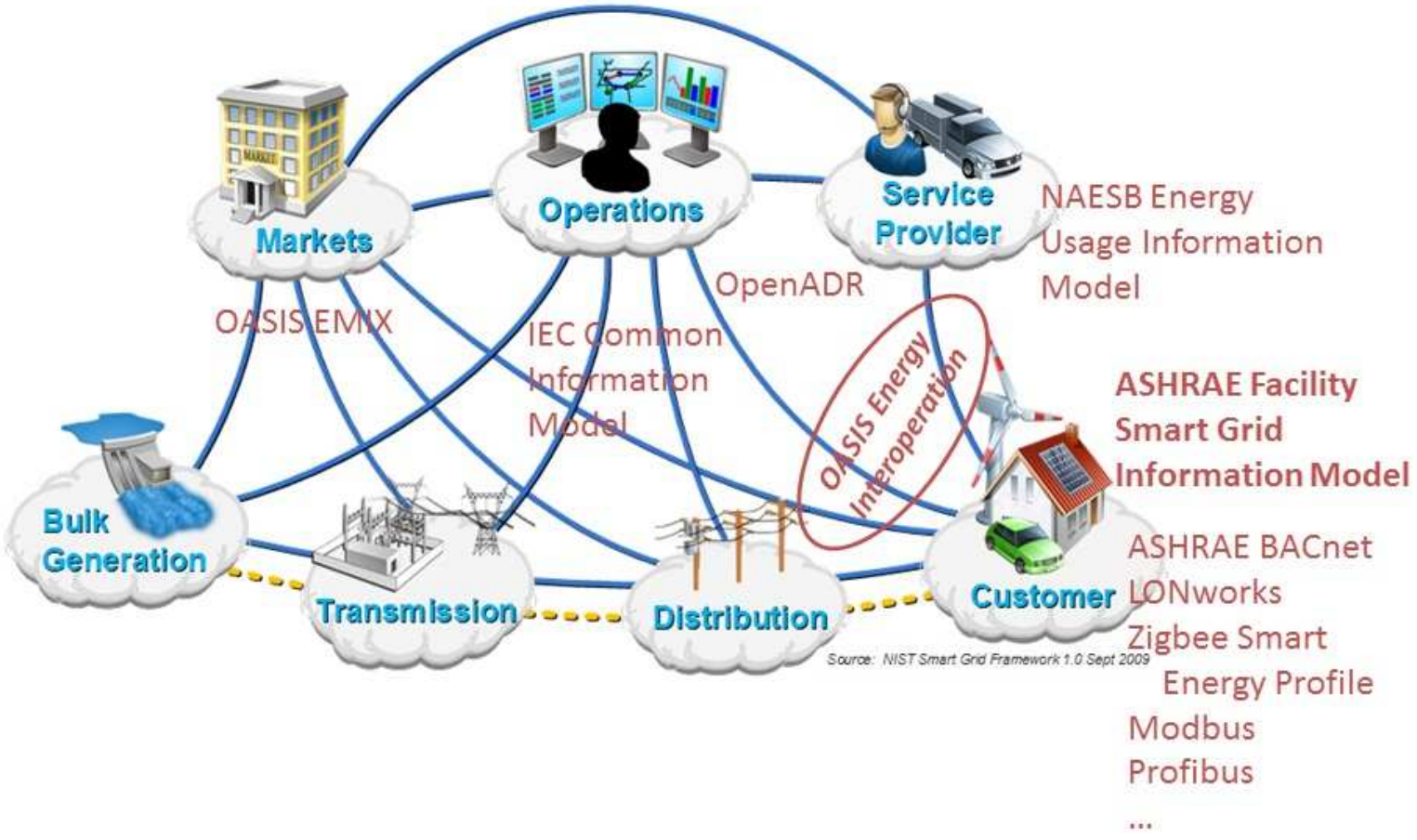
2.4 OpenADR出現の経緯



出典：OpenADRアライアンス、「Enabling The Standard for Automated Demand Response」

2. デマンドレスポンス

- デマンドレスポンスを実施する上でOpenADRと関連する標準



出典：SGIP－「Customer Energy Services Interface White Paper 」

2.5 OpenADRの概要

OpenADRとは

- OpenADRは、電力会社またはISOと需要家の間でDRシグナルを授受するための通信データモデルである。
- OpenADRは、DRシグナルの内容によって、人手を介さずに全自動でDRイベントに対応する、M2Mインフラ構築を目的としている。
- 具体的には、系統電力の需要逼迫時に自動的に電力需要を削減するための仕組みの提供を目指している。
- DRシグナルには、「電力価格シグナル」、「系統信頼性シグナル」、および「DR対策（電力需要削減策）起動シグナル」がある。
- DRシグナルを受け取るのは、ビル・工場施設などのエネルギー管理・制御システム（BEMS/FEMS）、一般家庭のエネルギー管理システム（HEMS）や、独自にDRシグナルに対応できるスマート家電。
- DRシグナルを受け取る側は、あらかじめDRシグナルの内容によってどのようなアクションをとるか事前設定しておくことで、自動的に電力需要削減が行われる。

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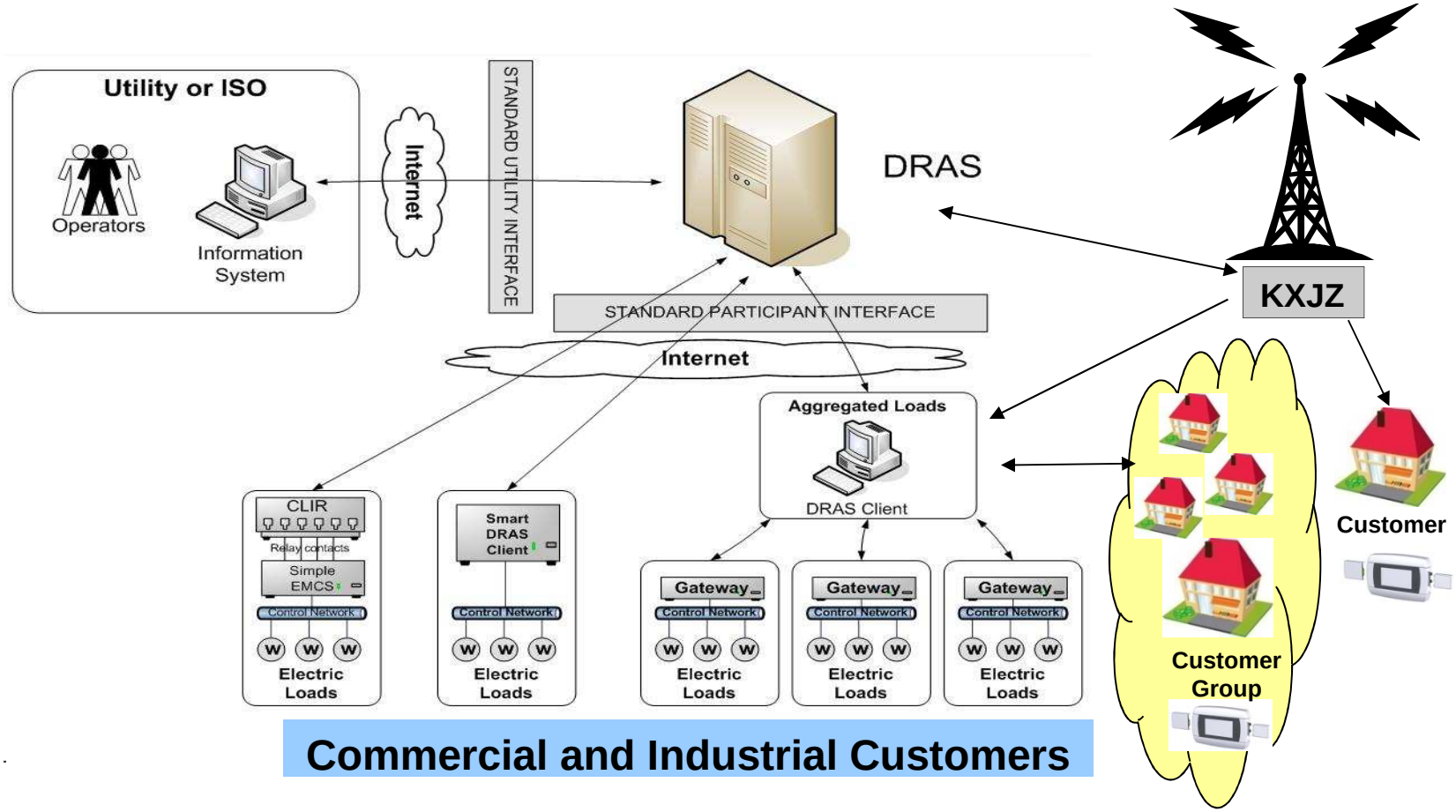
- OpenADRに基づいたシステム構成例



OpenADRを用いたシステム構成例
出典：ユタ州2009年スマートグリッドウィーク講演資料

まとめ

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1. 米国におけるスマートグリッド標準化動向
   - 1.1 標準の種類
   - 1.2 スマートグリッド関連標準策定機関
   - 1.3 NISTによるスマートグリッド標準化の経緯
   - 1.4 NISTスマートグリッド標準フレームワークの概要
   - 1.5 今後の標準化の進捗予想

2. デマンドレスポンス
   - 2.1 デマンドレスポンスの起源
   - 2.2 デマンドレスポンスの理論的基礎
   - 2.3 デマンドレスポンスのアンシラリーサービスへの適用
   - 2.4 OpenADR出現の経緯
   - 2.5 OpenADRの概要

まとめ

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- 米国におけるスマートグリッド標準化動向
  - スマートグリッドは、従来のように電力だけにとどまらず、通信、ITが融合したもの。
  - したがって、スマートグリッドをうまく機能させるには電力業界、通信業界、IT業界それぞれで通用していた規格をそのまま使うのではなく、それらの間の相互運用性を担保することが必要。
  - NISTが実施しているのは、スマートグリッドに関連して現在使われている既存のデジュール標準、フォーラム標準、デファクト標準を洗い出し、それらの間に不整合やギャップがあればPAPを作成して、関連する標準化策定組織に対応を求めること。
  - 実際に不整合・ギャップを埋める作業は、各々の標準策定組織に委ねているため、当初の目論み通りのスケジュールでスマートグリッド関連標準の整備が進んでいない。
  - NISTが狙っているのは、米国内でのスマートグリッドに関連する標準規格の相互運用性・セキュリティの確保。

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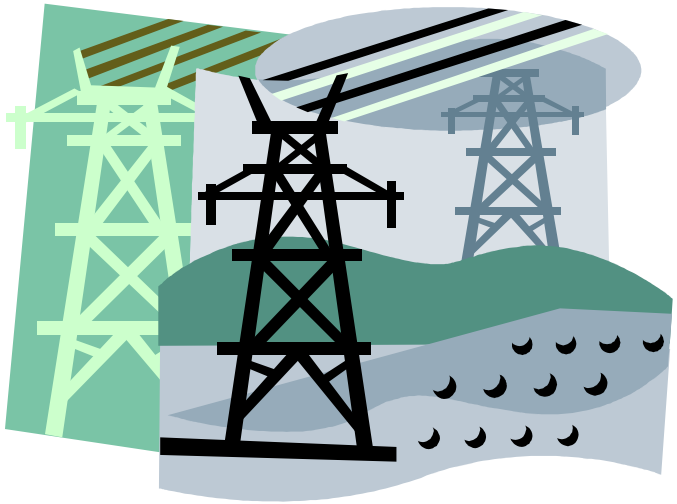
デマンドレスポンスのまとめ

- デマンドレスポンスは、系統の安定化に寄与する需要家側の仕組み。
- スマートグリッドに関連して、一般家庭向けの需要削減の仕組みという印象が強いが、スマートグリッドと合わせて出現した新しい試みではない。
- 今後の方向としては、OpenADRによる自動的な需要調整や、アンシラリーサービスへの適用が考えられている。
- OpenADRは、系統側とHEMS/BEMS間のM2Mインタフェースの標準で、自動的に需要調整を行うカリフォルニア州のローカル標準として出現した.
- 現在は、OpenADRアライアンスのフォーラム標準およびEI（Energy Interoperation）OASIS規格のOpenADRプロファイルという位置づけにあり、将来はIEC国際標準を目指している。



本日のプレゼン資料のダウンロード:
http://www.itrco.jp/libraries/NIST&OpenADR.pdf

関連資料
■IECのスマートグリッドに関連する国際規格
http://www.itrco.jp/reports/ITRReport-5.doc
■NISTのスマートグリッド概念モデル
http://www.itrco.jp/reports/ITRReport-6.doc
■IECのスマートグリッド標準化ロードマップ
http://www.itrco.jp/reports/ITRReport-12.doc

関連するブログ・トピック
■米国のスマートグリッド標準規格の動向
その1～その4
■デマンドレスポンス　その1～その7

■デマンドレスポンス・プログラムの現状と展望
その1、その2

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BLOG：http://www.itrco.jp/wordpress/

参考1：リリース1.0及び2.0におけるスマートグリッド関連標準規格比較

No.	Release1.0で選出された標準	No.	Release2.0で選出された標準
1	ANSI/ASHRAE 135-2008/ISO 16484-5 BACnet - A Data Communication Protocol for Building Automation and Control Networks	1	ANSI/American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) 135-2010/ISO 16484-5 BACnet
2	**ANSI C12 Suite** ・ANSI C12.1 ・ANSI C12.18/IEEE P1701/MC1218 ・ANSI C12.19/MC1219 ・ANSI C12.20 ・ANSI C12.21/IEEE P1702/MC1221	2	**ANSI C12 Suite** ・ANSI C12.1 ・ANSI C12.18-2006: ・ANSI C12.19-2008 ・ANSI C12.20 ・ANSI C12.21/IEEE P1702/MC1221
3	**ANSI/CEA 709 and CEA 852.1 LON Protocol Suite:** ・ANSI/CEA 709.1-B-2002 Control Network Protocol Specification ・ANSI/CEA 709.2-A R-2006 Control Network Power Line (PL) Channel Specification ・ANSI/CEA 709.3 R-2004 Free-Topology Twisted-Pair Channel Specification ・ANSI/CEA-709.4:1999 Fiber-Optic Channel Specification ・CEA-852.1:2009 Enhanced Tunneling Device Area Network Protocols Over Internet Protocol Channels	3	**ANSI/CEA 709 and Consumer Electronics Association (CEA) 852.1 LON Protocol Suite:** ・ANSI/CEA 709.1-B-2002 Control Network Protocol Specification ・ANSI/CEA 709.2-A R-2006 Control Network Power Line (PL) Channel Specification ・ANSI/CEA 709.3 R-2004 Free-Topology Twisted-Pair Channel Specification ・ANSI/CEA-709.4:1999 Fiber-Optic Channel Specification ・CEA-852.1:2009 Enhanced Tunneling Device Area Network Protocols Over Internet Protocol Channels
4	DNP3	4	IEEE 1815 (DNP3) IEEE Xplore - IEEE Std 1815-2010
5	IEC 60870-6 / TASE.2	5	IEC 60870-6 / Telecontrol Application Service Element 2 (TASE.2)
6	IEC 61850 Suite	6	IEC 61850 Suite
7	IEC 61968/61970 Suites	7	IEC 61968/61970 Suites
8	IEEE C37.118	8	IEEE C37.118-2005 (To be published as IEEE C37.118.1 and IEEE C37.118.2 in its new revision)
9	IEEE 1547 Suite	9	IEEE 1547 Suite
10	IEEE 1588	10	・IEEE 1588 ・IEEE C37.238
11	Internet Protocol Suite including, but not limited to :IETF RFC 2460 (IPv6) ・IETF RFC 791 (IPv4) ・Core Protocol in the Internet Suite, draft-baker-ietf-core-04	11	Internet Protocol Suite, Request for Comments (RFC) 6272, Internet Protocols for the Smart Grid.

参考1：リリース1.0及び2.0におけるスマートグリッド関連標準規格比較

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No.	Release1.0で選出された標準	No.	Release2.0で選出された標準
		12	Inter-System Protocol(ISP)-based Broadband-Power Line Carrier (PLC) coexistence mechanism: (Portion of) IEEE 1901-2010 (ISP) and International Telecommunications Union Telecommunication Standardization Sector (ITU-T) G.9972 (06/2010) IEEE 1901-2010
12	Multispeak	13	Multispeak
		14	EMA Smart Grid Standards Publication SG-AMI 1-2009 - Requirements for Smart Meter Upgradeability
		15	NAESB WEQ19, REQ18, Energy Usage Information
		16	NISTIR 7761, NIST Guidelines for Assessing Wireless Standards for Smart Grid Applications
13	OpenADR	17	Open Automated Demand Response (OpenADR)
14	OPC-UA Industrial	18	OPC-UA Industrial
15	Open Geospatial Consortium Geography Markup Language (GML)	19	Open Geospatial Consortium Geography Markup Language (GML)
16	ZigBee/HomePlug Smart Energy Profile 2.0	20	Smart Energy Profile 2.0
Requirements and Guidelines			
17	OpenHAN	21	OpenHAN
18	AEIC Guidelines v2.0	22	AEIC Guidelines
		23	SAE J1772: SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler
		24	SAE J2836/1: Use Cases for Communication Between Plug-in Vehicles and the Utility Grid
		25	SGTCC Interoperability Process Reference Manual (IPRM)
Cyber Security			
19	Security Profile for Advanced Metering Infrastructure, v 1.0, Advanced Security Acceleration Project - Smart Grid, December 10, 2009	27	Security Profile for Advanced Metering Infrastructure, v 1.0, Advanced Security Acceleration Project - Smart Grid, December 10, 2009
20	Department of Homeland Security, National Cyber Security Division. 2009, September. Catalog of Control Systems Security: Recommendations for Standards Developers.	28	Department of Homeland Security, National Cyber Security Division. 2009, September. Catalog of Control Systems Security: Recommendations for Standards Developers.
21	DHS Cyber Security Procurement Language for Control Systems	29	DHS Cyber Security Procurement Language for Control Systems

No.	Release1.0で選出された標準	No.	Release2.0で選出された標準
22	IEC 62351 Parts 1-8	30	IEC 62351 Parts 1-8
23	IEEE 1686-2007	31	IEEE 1686-2007
24	NERC CIP 002-009	32	NERC CIP 002-009
25	NIST Special Publication (SP) 800-53, NIST SP 800-82	33	NIST Special Publication (SP) 800-53
26		34	IEC 61851
27		35	NISTIR 7628 ・Introduction to NISTIR 7628 Guidelines for Smart Grid Cyber Security（Vol1、Vol2,Vol3）

Expression in Blue：2.0でタイトルが追加・変更されたもの

※ その他、各項目とも、詳細資料へのハイパーリンクやCommentsの追記あり

参考2：リリース1.0及び2.0における検討が必要な追加標準規格比較

InterTech Research Corporation

No.	Release1.0で選出された標準	Release2.0で選出された標準
1	・ANSI C12.22-2008/IEEE P1703/MC1222 ・ANSI C12.23 ・ANSI C12.24	・ANSI C12.22-2008/IEEE P1703/MC1222 ・ANSI C12.23 ・ANSI C12.24
2	CableLabs PacketCable Security Monitoring and Automation Architecture Technical Report	CableLabs PacketCable Security Monitoring and Automation Architecture Technical Report
3	Global Positioning System (GPS) Standard Positioning Service (SPS) Signal Specification	Global Positioning System (GPS) Standard Positioning Service (SPS) Signal Specification
4	HomePlug AV	
5	HomePlug C&C	
6	IEEE 61400-25	IEEE 61400-25
7	ITU Recommandation G.9960 (G.hn)	ITU Recommendation G.9960/G.9661 (G.hn)
8	IEEE P1901	IEEE P1901
		IEEE P1901.2 and ITU-T G.9955/G.9956 (G.hnem)
9	ISO/IEC 8824 ASN.1 (Abstract Syntax Notation)	ISO/IEC 8824 ASN.1 (Abstract Syntax Notation)
10	ISO/IEC 12139-1	ISO/IEC 12139-1
11	IEEE 802 Family	IEEE 802 Family
12	TIA TR-45/3GPP2 Family of Standards	TIA TR-45/3GPP2 Family of Standards
13	3GPP Family of Standards - Including 2G (CSD, HSCSD, GPRS, EDGE, EDGE Evolution), 3G (UMTS/FOMA, W-CDMA EUTRAN, HSPA, HSPA+, 4G (LTE Advanced)	3GPP Family of Standards - Including 2G (CSD, HSCSD, GPRS, EDGE, EDGE Evolution), 3G (UMTS/FOMA, W-CDMA EUTRAN, HSPA, HSPA+, 4G (LTE Advanced)
14	ETSI GMR-1 3G Family of standards	ETSI GMR-1 3G Family of standards
15	ISA SP100	ISA SP100
16	Network Management Standards - including Internet based standards such as DMTF, CIM, WBEM, ANSI INCITS 438-2008, SNMP v3, netconf, STD 62, and OSI-based standards including CMIP/CMIS	Network Management Standards - including Internet based standards such as DMTF, CIM, WBEM, ANSI INCITS 438-2008, SNMP v3, netconf, STD 62, and OSI-based standards including CMIP/CMIS
17	NIST SP 500-267	NIST SP 500-267
18	Z-wave	Z-wave

No.	Release1.0で選出された標準	Release2.0で選出された標準
19	IEEE P2030	**IEEE 2030 Standards:** ・IEEE P2030 ・IEEE P2030.1 ・IEEE P2030.2
20	IEC 60929 AC-supplied electronic ballasts for tabular fluorescent lamps - performance requirements	IEC 60929 AC-supplied electronic ballasts for tabular fluorescent lamps - performance requirements
		・IEC/TR 61000-1-2 (2002-06) Ed. 1.0 ・IEC/TR 61000-1-5 (2004-11) Ed. 1.0 ・IEC 61000-2-5 ・IEC 61000-2-9 (1996-02) Ed. 1.0 ・IEC 61000-2-10 (1998-11) Ed. 1.0 ・IEC 61000-2-11 (1999-02) Ed. 1.0 ・IEC 61000-2-13 (2005-03) Ed. 1.0 ・IEC 61000-4-2 ・IEC 61000-4-3 ・IEC 61000-4-4 ・IEC 61000-4-5 ・IEC 61000-4-6 ・IEC 61000-4-8 ・IEC 61000-4-11 ・IEC 61000-4-18 ・IEC 61000-4-23 (2000-10) Ed. 1.0 ・IEC 61000-4-24 (1997-02) Ed. 1.0 ・IEC/TR 61000-4-32 (2002-10) Ed. 1.0 ・IEC 61000-4-33 (2005-09) Ed. 1.0 ・IEC/TR 61000-4-35 (2009-07) Ed. 1.0 ・IEC/TR 61000-5-3 (1999-07) Ed. 1.0 ・IEC/TS 61000-5-4 (1996-08) Ed. 1.0 ・IEC 61000-5-5 (1996-02) Ed. 1.0 ・IEC 61000-5-6 (2002-06) Ed. 1.0 ・IEC 61000-5-7 (2001-01) Ed. 1.0 ・IEC/TS 61000-5-8 (2009-08) Ed. 1.0 ・IEC/TS 61000-5-9 (2009-07) Ed. 1.0 ・IEC 61000-6-5 ・IEC 61000-6-6 (2003-04) Ed. 1.0

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No.	Release1.0で選出された標準	Release2.0で選出された標準
21	IEC 62056 Device Language Message Specification (DLMS)/Companion Specification for Energy Metering (COSEM)) Electricity metering – Data exchange for meter reading, tariff and load control	IEC 62056 Device Language Message Specification (DLMS)/Companion Specification for Energy Metering (COSEM)) Electricity metering – Data exchange for meter reading, tariff and load control
22	IEC PAS 62559	IEC PAS 62559
		IEC 60870-2-1
		IEC 60255- 22-x -1 : Relay immunity -2: ESD -3: RF immunity -4: EFT -5: Surge -6: Conducted Immunity
		IEC CISPR 22 and IEEE C63.022 – 1996
		IEC CISPR 24
		IEC 61326x series
		IEEE 1560
		IEEE 1613
		IEEE P1642
		IEEE 473
		IEEE P1775/1.9.7, March 2009
		IEEE C63.16-1993
		IEEE C37.90-2005IEEE C37.90-2005 ・C37.90.1-2002 (electrical transient immunity) ・C37.90.2-2004 (radiated EM immunity) ・C37.90.3-2001 (electrostatic discharge immunity)
23	IEEE C37.2-2008 IEEE Standard Electric Power System Device Function Numbers	IEEE C37.2-2008 IEEE Standard Electric Power System Device Function Numbers
24	IEEE C37.111-1999 IEEE Standard Common Format for Transient Data Exchange (COMTRADE) for Power Systems (COMTRADE)	IEEE C37.111-1999 IEEE Standard Common Format for Transient Data Exchange (COMTRADE) for Power Systems (COMTRADE)
25	IEEE C37.232 Recommended Practice for Naming Time Sequence Data Files	IEEE C37.232 Recommended Practice for Naming Time Sequence Data Files
26	IEEE 1159.3 Recommended Practice for the Transfer of Power Quality Data	IEEE 1159.3 Recommended Practice for the Transfer of Power Quality Data
27	IEEE 1379-2000	IEEE 1379-2000

No.	Release1.0で選出された標準	Release2.0で選出された標準
28	ISO/IEC 15045, "A Residential gateway model for Home Electronic System."	ISO/IEC 15045, "A Residential gateway model for Home Electronic System."
29	ISO/IEC 15067-3 "Model of an energy management system for the Home Electronic System."	ISO/IEC 15067-3 "Model of an energy management system for the Home Electronic System."
30	ISO/IEC 18012, "Guidelines for Product Interoperability."	ISO/IEC 18012, "Guidelines for Product Interoperability."
31	・North American Energy Standards Board (NAESB) ・Open Access Same-Time Information Systems (OASIS)	・North American Energy Standards Board (NAESB) ・Open Access Same-Time Information Systems (OASIS)
32	NAESB WEQ 015 Business Practices for Wholesale Electricity Demand Response Programs	NAESB WEQ 015 Business Practices for Wholesale Electricity Demand Response Programs
		OASIS Energy Interoperation (EI)
33	NEMA Smart Grid Standards Publication SG-AMI 1-2009 - Requirements for Smart Meter Upgradeability	
34	OASIS EMIX (Energy Market Information eXchange)	Organization for the Advancement of Structured Information Standard (OASIS) EMIX (Energy Market Information eXchange)
35	Fix Protocol, Ltd. FIXML Financial Information eXchange Markup Language	Fix Protocol, Ltd. FIXML Financial Information eXchange Markup Language
36	OASIS oBIX	OASIS oBIX
37	OASIS WS-Calendar	OASIS WS-Calendar
38	SAE J1772 Electrical Connector between PEV and EVSE	
39	SAE J2836/1-3 Use Cases for PEV Interactions	
40	SAE J2847/1-3 Communications for PEV Interactions	SAE J2847/1-3 Communications for PEV Interactions
41	W3C Simple Object Access Protocol (SOAP)	W3C Simple Object Access Protocol (SOAP)
42	W3C WSDL Web Service Definition Language	W3C WSDL Web Service Definition Language
43	W3C XML eXtensible Markup Language	W3C XML eXtensible Markup Language
44	W3C XSD (XML Definition)	W3C XSD (XML Definition)
45	W3C EXI	W3C EXI

参考2：リリース1.0及び2.0における検討が必要な追加標準規格比較

InterTech Research Corporation

No.	Release1.0で選出された標準	Release2.0で選出された標準
46	US Department of Transportation's Federal Highway Administration's Intelligent Transportation System (ITS) Standard NTCIP 1213, "Electrical Lighting and Management Systems (ELMS)	US Department of Transportation's Federal Highway Administration's Intelligent Transportation System (ITS) Standard NTCIP 1213, "Electrical Lighting and Management Systems (ELMS)
		OpenADE Energy Service Provider Interface
		UL-1741 The Standard for Static Inverters and Charge Controllers For use in Photovoltaic Power Systems
Cyber Security関連標準		
47	ISA SP99	ISA SP99
48	ISO27000	ISO27000
49	NIST FIPS 140-2	NIST FIPS 140-2
50	OASIS WS-Security and OASIS suite of security standards	OASIS WS-Security and OASIS suite of security standards

Expression in Geen：2.0でスマートグリッド関連標準として認定されたもの
Expression in Blue：2.0で新たにスマートグリッド関連標準としてレビュー候補に加えられたもの
Expression in Red：2.0でスマートグリッド関連標準としてレビュー候補のリストから消えたもの

参考3：リリース1.0及び2.0におけるPAP比較

InterTech Research Corporation

No.	Release1.0時点でのPAP（What）の記述	Release2.0時点でのPAPの状況
0	なし	**Meter Upgradeability Standard** **Scope:** PAP00 defined requirements including secure local and remote upgrades of smart meters. **Output:** National Electrical Manufacturers Association (NEMA) Meter Upgradeability Standard SG-Advanced Metering Infrastructure (AMI) 1-2009. **Date:** Completed 2009
1	Given that Internet technologies play an important role in support of the Smart Grid information networks, it is critical to identify the appropriate Internet standards or Internet Engineering Task Force "requests for comments" (RFCs) that are suitable for use in the context of the Smart Grid. This action plan presents steps for developing guidelines for the use of the IP protocol suite by working with key SDO committees to determine the characteristics of Smart Grid application areas and domain types and the applicable IP protocols that are suitable for use by these applications and domains. The networking standards identified under this action plan will define a significant portion of the interfaces to Smart Grid equipment and systems for both intra-domain and inter-domain applications. NIST expects the initial guidelines, based on the existing Smart Grid requirements, to be completed by mid-year 2010.	**Role of IP in the Smart Grid** **Scope:** For interoperable networks it is important to study the suitability of Internet networking technologies for Smart Grid applications. PAP01's work area investigates the capabilities of protocols and technologies in the Internet Protocol Suite by working with key SSO committees to determine the characteristics of each protocol for Smart Grid application areas and types. **Output:** This PAP's work culminated in publication of a Request for Comment (RFC) cataloguing a core Internet Protocol Suite for IP-based Smart Grid and its acceptance by the SGIPGB in December 2010 as a Smart Grid standard. **Date:** Completed 2010.
2	Wireless technologies can be used in field environments across the Smart Grid, including generation plants, transmission systems, substations, distribution systems, and customer premises communications. The choice of wireless, type of wireless, or non-wireless must be made with full knowledge of the appropriate use of the technology. This plan will investigate the use of wireless communications for different Smart Grid applications by assessing the strengths, weaknesses, capabilities, and constraints of existing and emerging standards-based technologies for wireless communications. The approach is to work with key SDO committees to determine the characteristics of each technology for Smart Grid application areas and types. Results will be used in evaluations of the appropriateness of wireless communications technologies for Smart Grid applications. NIST expects the initial guidelines, based on the existing Smart Grid requirements, to be completed by mid-year 2010.	**Wireless Communications for the Smart Grid** **Scope:** This PAP's work area investigates and evaluates existing and emerging standards-based physical media for wireless communications. The approach is to work with the appropriate SDOs to determine the communication requirements of Smart Grid applications and how well they can be supported by wireless technologies. Results are used to assess the appropriateness of wireless communications technologies for meeting Smart Grid applications. **Output:** PAP02 compiled Smart Grid communication requirements and a catalog for wireless standards and their characterizations. The PAP developed an evaluation methodology published in "Guidelines for Assessing Wireless Communications for Smart Grid Applications, Version 1.0" in July 2011. **Date:** 2011.

No.	Release1.0時点でのPAP（What）の記述	Release2.0時点でのPAPの状況
3	Actions under this plan will result in a common specification for price and product definition. This specification will be used in demand response applications, market transactions, distributed energy resource integration, meter communications, and many other inter-domain communications. Businesses, homes, electric vehicles, and the power grid will benefit from automated and timely communication of energy prices, characteristics, quantities, and related information. Price is a number associated with product characteristics, including delivery schedule, quality (reliability, power quality, source, etc.), and environmental and regulatory characteristics. Price also is a common abstraction for abundance, scarcity, and other market conditions. A common price model will define how to exchange data on energy characteristics, availability, and schedules to support efficient communication of information in any market.	**Common Price Communication Model** **Scope:** Coordination of energy supply and demand requires a common understanding of supply and demand. A simple quotation of price, quantity, and characteristics in a consistent way across markets enables new markets and integration of distributed energy resources. Price and product definition are key to transparent market accounting. Better communication of actionable energy prices facilitates effective dynamic pricing and is necessary for net-zero-energy buildings, supply-demand integration, and other efficiency and sustainability initiatives. Common, up-to-the-moment pricing information is also an enabler of local generation and storage of energy, such as electric-charging and thermal-storage technologies for homes and buildings. PAP03 builds on existing work in financial energy markets and existing demand response programs to integrate with schedule and interval specifications under development. This PAP overlaps with others that include price and product information (4, 6, 8, 9, 10, and 11). **Expected Outputs:** OASIS Energy Market Information Exchange standard version 1.0, Zigbee Smart Energy 2.0. **Date:** 2011.
4	Already important, coordination of supply and demand in the grid will be critical as distributed energy resources increase and as renewable energy resources account for a growing share of electric power. Beyond electromechanical devices and equipment, it is necessary to coordinate enterprise activities, home operations and family schedules, and market operations. Thus, a common schedule specification is required for the Smart Grid and the many sectors that interact with the grid. Under this plan, NIST and collaborators are surveying existing calendaring specifications. They will develop a standard for how schedule and event information is passed between and within services. The output will be a micro-specification that can then be incorporated into price, demand-response, and other specifications. Easy integration of the specification will facilitate a common scheduling operation across different domains and diverse contracts. A draft is scheduled for completion by the end of April 2010 so that it can be included in the Common Specification for Price and Product Definition plan.	**Common Schedule Communication Mechanism** **Scope:** Under this plan, NIST and collaborators will develop a standard for how schedule and event information is passed between and within services. The output will be a specification that can then be incorporated into price, demand-response, and other specifications. This Project Plan was developed in conjunction with PAP03 (Develop Common Specification for Price and Product Definition). Participants include, but are not limited to, International Electrotechnical Commission (IEC), North American Energy Standards Board (NAESB), other OASIS Technical Committees, and ZigBee Smart Energy Profile. **Expected Outputs:** A common standard for transmitting calendaring information will enable the coordination necessary to improve energy efficiency and overall performance. The Calendar Consortium will complete its current work in 2011 on eXtensible Markup Language (XML) serialization of iCalendar into a Web-service component (OASIS Web Services-(WS)-Calendar). **Date:** 2011.

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No.	Release1.0時点でのPAP（What）の記述	Release2.0時点でのPAPの状況
5	This action plan will define meter data in standard profiles. The common profiles will benefit not only the utility company, but also customers and the devices they use to manage their energy consumption, such as thermostats and building automation systems. Other potential clients exist inside and outside of the customer premises. Action plan tasks include completion of AEIC Guidelines v2.0, mapping utility requirements expressed via AEIC Guidelines v2.0 to ANSI C12.19 device classes by March 2010, and expressing AEIC Guidelines v2.0 in terms of one or more additional ANSI C12.19 device classes by May 2010. Other tasks include socializing the existence of additional tables within ANSI C12.21-2006 and C12.22-2008 and socializing the existence and application of existing default sets, and the definition of new default sets, device classes, and profiles via Web conferences, all by fourth quarter 2010.	**Standard Meter Data Profiles** **Scope:** The Smart Grid recognizes that several clients may require local access to meter data, and these data may be on the same order of complexity as the meter itself. Such potential clients might range from thermostats to building automation systems. Other potential clients will exist inside and outside of the customers' premises. Meter interface will reach across various domains including Operations (e.g., Metering System), Customer (e.g., Customer Energy Management System (EMS) and Submeter), and Distribution (e.g., Workforce Tool and Field Devices). The ANSI C12.19 standard contains an extensive set of end device (e.g., meter) data tables. This large set of tables makes it time-consuming for utilities (and other service providers) to understand the standard and specify the proper tables for specific applications. The objective of this Priority Action Plan is to develop a smaller set of data tables that will meet the needs of most utilities and simplify the meter procurement process. **Expected Outputs:** Minimize variation and maximize interoperability of application services and behaviors within ANSI C12.18-2006, ANSI C12.19-2008, ANSI C12.21-2006, and ANSI C12.22-2008. **Date:** 2011.
6	なし	**Common Semantic Model for Meter Data Tables** **Scope:** There are currently several "meter models" in standard existence. These include ANSI C12.19, Device Language Message Specification (DLMS)/ Companion Specification for Energy Metering (COSEM)/IEC 62056, IEC 61968 CIM, and IEC 61850. As the Smart Grid requires interoperation between meters and many other applications and services, the existence of unique forms of data representation pertinent to a single actor is problematic, requiring complex gateways to translate this representation into alternate formats for information sharing. PAP06 works with industry stakeholders to translate the ANSI C12.19 End Device (meter) data model to and from a common form that will allow the semantics of this and End Device models in other standards to be more readily harmonized. The objective is to allow the lossless translation from the common form to the various syntactic representations prevalent in each domain. Details will include the representation of the Decade/Table/Element model. PAP06 develops an exact and reusable representation of the ANSI C12.19 data model in the presentation form of Unified Markup Language (UML). **Expected Outputs:** A side-by-side comparison of the ANSI C12.19 UML model and the IEC 61968-9 UML model to illustrate gaps and overlaps. **Date:** 2011.

No.	Release1.0時点でのPAP(What)の記述	Release2.0時点でのPAPの状況
7	Energy storage is required to accommodate the increasing penetration of intermittent renewable energy resources and to improve Electric Power System (EPS) performance. Consistent, uniformly applied interconnection and information model standards, supported by implementation guidelines, are required for energy storage devices (ES), power electronics interconnection of distributed energy resources (DER), hybrid generation-storage systems (ES-DER), and plug-in electric vehicles (PEV) used as storage. A broad set of stakeholders and SDOs have been enlisted to address this need. Significant progress has been made in meeting the objectives of the Energy Storage PAP. The first draft of a Scoping Document defining interconnection requirements across a broad range of anticipated ES-DER scenarios (including islanding) has been completed and posted on the NIST Smart Grid Collaboration Site. The Scoping Document describes EPS applications of dispatchable ES-DER, multifunctional operational interface capabilities of mechanical generators (rotating machines) and electronic generators (power electronics-based inverters), business and regulatory issues influencing the deployment of ES-DER devices, and emerging storage and power electronics technologies that will influence the timeline for introduction of ES-DER devices. A process has also been initiated to identify and develop ES-DER use cases (UCs), and to prioritize and roadmap the standards development required to meet urgent near-term deployments while ensuring consistency of standards for the broad spectrum of future ES-DER applications. The Scoping Document and the prioritized timeline for ES-DER applications will expedite the formation of new standards projects for Smart Grid dispatchable ES-DER extensions of the IEEE 1547 series of standards, which define the physical and electrical interconnection of DERs with the grid. The Scoping Document and UCs will also be used by a similar fast-tracking effort focused on defining ES-DER object models in the IEC 61850-7-420 standards to accommodate Smart Grid requirements. Collaborations with UL, SAE, NEC-NFPA70, and CSA also have been initiated to focus on specifications for safe and reliable implementation.	**Energy Storage Interconnection Guidelines** **Scope:** Energy storage is expected to play an increasingly important role in the evolution of the power grid, particularly to accommodate increasing penetration of intermittent renewable energy resources and to improve electrical power system (EPS) performance. Coordinated, consistent, electrical interconnection standards; communication standards; and implementation guidelines are required for energy storage devices (ES), power-electronics-connected distributed energy resources (DER), hybrid generation-storage systems (ES-DER), and the ES-DER aspects of plug-in electric vehicles (PEV). A broad set of stakeholders and SDOs are needed to address this coordination and evolution in order to update or augment the IEEE 1547 electrical interconnection standards series as appropriate to accommodate Smart Grid requirements and to extend the ES-DER object models in IEC 61850-7-420 as needed. Coordination with Underwriters Laboratories (UL), Society for Automotive Engineers (SAE), National Electrical Code-(NEC-) National Fire Protection Association (NFPA)70, and Canadian Standards Association (CSA) will be required to ensure safe and reliable implementation. This effort will need to address residential, commercial, and industrial applications at the grid distribution level and utility/Regional Transmission Operator (RTO) applications at the grid transmission level. **Expected Outputs:** IEEE 1547.8, IEC 61850-7-420. **Date:** 2012.

No.	Release1.0時点でのPAP(What)の記述	Release2.0時点でのPAPの状況
8	This action plan intends to ensure that new Smart Grid equipment for distribution grid operations, currently deploying in many different grid environments, can readily communicate with new and legacy equipment and act on the information exchanged. To ensure the interoperability of new equipment, the strategy calls for defining the key distribution applications that will enable Smart Grid functions for substation automation, integration of distributed energy resources, equipment condition monitoring, and geospatial location; evaluating existing standards; and coordinating the necessary standards development work. This work will enable the integration of data and information from equipment in the distribution grid with information used for enterprise back-office systems. Efforts are focusing on three standards used in North American distribution systems. The standards differ in the type of data models they use. Their integration will enable many new Smart Grid applications and will lower technical barriers to the implementation of these applications. Currently, none of these standards has a complete data model for distributed energy resources, equipment condition monitoring data, geospatial location, and other information that will underpin Smart Grid technologies and applications. It is critical to act quickly on the initial tasks defined in this action plan since deployments, particularly those funded by the Department of Energy Smart Grid grants and demonstration projects, are under way.	**CIM for Distribution Grid Management** **Scope:** Standards are urgently needed to enable the rapid integration of wind, solar, and other renewable resources, and to achieve greater reliability and immunity to grid instabilities resulting from their wide-scale deployment, which is radically changing how the power system must operate. The use of standardized object models, such as the CIM and 61850, will support the interoperability of information exchanges that is critically needed to ensure a more reliable and efficient grid. PAP08 will coordinate with: PAPs 3, 4, 9, or 10 on any use cases involving Demand Response (DR), pricing signals, and other customer interactions; PAP07 on any use cases involving energy storage and Distributed Energy Resources (DER); PAP11 on any use cases involving PEVs; PAP14 on any use cases involving "CIM wires models" or transmission-related interactions; and CSWG on security efforts. **Expected Outputs:** IEC 61968, IEC 61970, and IEC 61850. **Date:** 2011.
9	While the value of DR is generally well understood, the interaction patterns, semantics, and information conveyed vary. Price (often with the time that the price is effective), grid integrity signals (e.g., event levels of low, medium, high), and possibly environmental signals (e.g., air quality) are components of DR communications. Defining consistent signal semantics for DR will make the information conveyed more consistent across Smart Grid domains. The swift deployment of smart meters and the integration of distributed energy resources (DER) into the grid require DR standards. As represented in this plan, the focus of the DR standards effort is to integrate the standards work in OpenADR, OpenSG, IEC TC57, and NAESB efforts, along with the input of other stakeholders to deliver a draft DR specification in January 2010. The initial emphasis is on meeting utility DR requirements, while developing an extensible signaling framework that allows continued development of DER semantics.	**Standard DR and DER Signals** **Scope:** Demand Response communications cover interactions between wholesale markets and retail utilities and aggregators, as well as between these entities and the end-load customers who reduce demand in response to grid reliability or price signals. While the value of DR is generally well understood, the interaction patterns, semantics, and information conveyed vary. Defining consistent signal semantics for DR will make the information conveyed more consistent across Smart Grid domains. **Expected Outputs:** OASIS Energy Interoperation standard version 1.0, Zigbee Smart Energy 2.0. **Date:** 2011.

No.	Release1.0時点でのPAP（What）の記述	Release2.0時点でのPAPの状況
10	This action plan will lead to data standards to exchange fine-grained and timely information about energy usage. The first goal is agreement on a core information set to enable integration of usage information throughout facility decision processes. Customers and customer-authorized third-party service providers will use these standards to access energy usage information from the Smart Grid and meter, enabling them to make better decisions about energy use and conservation. Consumers and premises-based systems will use these standards to provide real-time feedback on present and projected performance. Using the Smart Grid infrastructure, this information will be shared with the facility: a home, building, or industrial installation. Two-way flows of usage information will improve collaboration and thereby energy efficiency. The data standards will enable immediate and widespread benefit. They will support access to monthly usage information, which may already be available, as well as near-real-time information as smart meters and other devices are deployed. The standards will enable innovation by third-party service and software providers in providing novel ways to help consumers and operations manage their energy usage. In the absence of these standards, software developers and utilities would have to negotiate pair-wise interfaces, an impractical situation. The standards will also promote more responsive facilities. Devices that deliver and understand common usage information can be deployed more quickly. These standards must be developed on an aggressive timetable. States such as California and Texas have mandated that consumers have electronic access to such data in 2010. This action plan will result in both an initial specification of narrower information to satisfy regulatory mandates by February 2010 and a requirements-based definition for standard energy usage within the facility as well as to and from the Smart Grid by mid-2010.	**Standard Energy Usage Information** **Scope:** This action plan led to data standards to exchange detailed information about energy usage in a timely manner. The first goal was agreement on the core information set to enable integration of usage information throughout facility decision processes. Customers and customer-authorized third-party service providers will use these standards to access energy usage information from the Smart Grid and meter, enabling them to make better decisions about energy use and conservation. Consumers and premises-based systems will use these standards to provide real-time feedback on present and projected performance. Using the Smart Grid infrastructure, this information will be shared with the facility: a home, building, or industrial installation. Two-way flows of usage information will improve collaboration and energy efficiency. **Outputs:** Implementation of a plan to expedite harmonized standards development and adoption: OASIS, IEC61970/61968, IEC61850, ANSI C12.19/22, PAP17/ American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) SPC201, and ZigBee Smart Energy Profile (SEP) 2.0. **Date:** Completed 2011.

No.	Release1.0時点でのPAP(What)の記述	Release2.0時点でのPAPの状況
11	This action plan will define data standards to enable the charging of plug-in electric vehicles (PEVs). The specifications will cover charging at home or away from home using a special rate schedule, discharging of PEV energy storage for demand response purposes, and administration and monitoring. The standards will allow the charging flexibility necessary for PEVs to meet customer needs. They also will encourage the adoption of electric vehicles for general-purpose transportation. This anticipated trend would favorably affect the nation's energy portfolio. The standards developed under this action plan will benefit electric utilities by supporting charging during off-peak, low-demand periods and enabling energy stored in PEVs to be returned to the grid during high-demand periods. The objectives described below are expected to be completed by December 2010.	**Common Object Models for Electric Transportation** **Scope:** PAP11 ensures that the grid can support the massive charging of cars and help to popularize the adoption of PEVs. Standards will optimize charging capabilities and vendor innovation, allowing for more creative engineering and automobile amenities. This PAP also supports energy storage integration with the distribution grid as addressed by PAP07. **Expected Outputs:** SAE J1772, SAE J2836/1, and SAE J2847/1. SAE J1772 and SAE J2836/1 standards have been completed and approved, and they are included in the Catalog of Standards. SAE J2847/1 will be submitted for approval later in 2011. **Date:** 2011.
12	There is an urgent need for distribution and transmission communication networks currently using the legacy DNP3 protocol to support the exchanges of larger volumes of data (with low latency/time delays) necessary to achieve new Smart Grid capabilities. This action plan focuses on developing the means to enable transport of select Smart Grid data and related services over legacy DNP3 networks. This will be accomplished, in part, by defining a method to map the exchange of certain data types and services between DNP3 and the newer IEC 61850 Standard for Communication Networks and Systems in Substations. IEC 61850 is considered to be a standard better suited to support Smart Grid functions. IEC 61850 is a comprehensive standard for substation automation that supports monitoring and control of grid equipment (relays, circuit breakers, transformers) as well as renewable energy resources. Many of the new Smart Grid deployments, including those funded under Department of Energy Smart Grid grants programs, will require rapid, high-bandwidth communications that are better supported by IEC 61850. The tasks of this action plan include performing a gap analysis to identify the extent to which DNP3 meets Smart Grid requirements. Guidelines for achieving interoperable integration of DNP3 with EC 61850 and other Smart Grid standards will be produced in 2010.	**Mapping IEEE 1815 (DNP3) to IEC 61850 Objects** **Scope:** This action plan focuses on developing the means to enable transport of select Smart Grid data and related services over legacy Distributed Network Protocol (DNP)3 networks. This will be accomplished, in part, by defining a method to map the exchange of certain data types and services between DNP3 and the newer IEC 61850 Standard for Communication Networks and Systems in Substations. This is to be published as IEC 61850-80-2, Standard for Exchanging Information between Networks Implementing IEC 61850 and IEEE Std 1815 (DNP3). DNP3 was adopted by IEEE as Standard 1815 in 2010. IEEE is now developing Standard 1815.1 which includes upgraded security. **Expected Outputs:** IEC 61850-80-2, IEEE 1815.1. **Date:** 2011.

No.	Release1.0時点でのPAP（What）の記述	Release2.0時点でのPAPの状況
13	For the integration of PMU and PDC data based on IEEE C37.118 into IEC 61850, a new work item has already been issued as a joint work item for IEEE and IEC. The work has been circulated within IEC TC57. Within the IEC, a task force as part of working group 10 may be created to support that work from the IEC side. In IEEE, the Power System Relaying Committee (PSRC) H11 Working Group (WG) is responsible for C37.118. These will be the key SDOs for that part of the work. From a procedural viewpoint, the integration of PMU and PDC data into IEC 61850 cannot be considered as an independent standard. Integration will affect several parts of the existing IEC 61850 standard. Therefore, NIST recommends the development of a technical report (similar to IEC 61850-90-1) that addresses all the issues related to the problem. While the final responsibility of the work will be in the joint IEEE/IEC task force, the PAP collaborators will provide technical input to the SDO, will interact with the stakeholders like NASPI, and support demonstration activities. For time synchronization, this action plan focuses on ensuring that Smart Grid deployments use a common format and have common meaning for time data so that the applications are readily interoperable. The approach will determine detailed requirements for Smart Grid applications and in particular, for synchrophasor measurements used to monitor conditions in the transmission grid. Additionally, the plan tasks cover harmonizing the differences in time data formats used by Smart Grid standards, promoting rapid prototype development and interoperability testing, and developing guidelines on how to achieve uniform time stamping throughout the Smart Grid. Since the IEEE PSRC WG H7 work on developing a profile for accurate time synchronization for power system applications is supported by IEC TC57 WG10, no harmonization is required here. The current activities in the WG are driven on one side by the requirements of PMUs and on the other side by the requirements for accurate synchronization of instrument transformers in a substation that are transmitting sampled values as a stream of data for protection and control applications. The PAP13 WG will interact with the IEEE working group by developing the requirements for the different applications of Smart Grid, by contributing technical work and by supporting demonstration activities. In addition, several other aspects need to be considered like loss of synchronization, dealing with synchronization islands and resynchronization. Calendar models are required. Also, other mechanisms for time synchronization using the global positioning system (GPS) or inter-range instrumentation group (IRIG-B) approaches need to be discussed.	**Harmonization of IEEE C37.118 with IEC 61850 and Precision Time Synchronization** **Scope:** The current primary standard for the communication of phasor measurement unit (PMU) and phasor data concentrator (PDC) data and information is the IEEE Standard C37.118, which was published in 2005. This standard also includes requirements for the measurement and determination of phasor values. IEC 61850 is seen as a key standard for all substation and field equipment operating under both real-time and non-real time applications. The use of IEC 61850 for wide-area communication is already discussed in IEC 61850-90-1 (Draft Technical Report) in the context of communication between substations. It appears possible to use a similar approach for the transmission of PMU and PDC data, but the capability needs to be formally defined in IEC 61850. This action plan seeks to assist and accelerate the integration of standards that can impact phasor measurement and applications depending on PMU- and PDC-based data and information. **Expected Outputs:** IEEE C37.118.2 (updated version), IEC 61850-90-5, and IEEE C37.238. **Date:** 2011.

No.	Release1.0時点でのPAP（What）の記述	Release2.0時点でのPAPの状況
14	This plan will define strategies for integrating standards across different utility environments to support various real-time grid operations (relay, circuit breaker, transformer operations) and back-office applications for customer services, meter data and billing, and other business operations. The work must be completed on an aggressive schedule to enable ready nteroperability of ongoing Smart Grid deployments funded by federal and industry investments. Modeling of the electric power system, multifunctional Intelligent Electronic Devices (IEDs), and definition of standard methods for reporting events and exchanging relay settings will enable improving the efficiency of many protection, control, engineering, commissioning, and analysis tasks. Tasks include identifying issues that stand in the way of harmonizing potentially conflicting standards and identifying information requirements for relay settings in the Smart Grid. Some of the tasks identified for this action plan overlap with those in PAP 08 "Develop Common Information Model (CIM) for Distribution Grid Management," and are covered by it as noted in the objectives given below.	**Transmission and Distribution Power Systems Model Mapping** **Scope:** PAP14's work defines strategies for integrating standards across different environments to support different real-time and back-office applications. Strategies call for defining key applications and evaluating the available standards for meeting the requirements of such applications. Modeling of the electric power system, multifunctional Intelligent Electronic Devices (IEDs), and definition of standard methods for reporting events and exchanging relay settings will meet the requirements for improvements of the efficiency of many protection, control, engineering, commissioning, and analysis tasks. Field equipment can supply the raw data for objects and measured parameters used across the enterprise based on the standard models and file formats defined. **Expected Outputs:** updates to IEC 61850, IEC 61970, IEC 61968, IEEE C37.239, IEEE C37.237, and MultiSpeak v1-v4. **Date:** 2011.
15	Several power line-based communications technologies are being considered for appliances, meters, and PEV communications in and across the customer premises. Relevant standards include ITU G.Hn (HomeGrid), IEEE P1901 (HomePlug™), and ANSI/CEA 709.2 (Lonworks™). However, these technologies are currently not interoperable and may not coexist successfully, and their operation in proximity may cause harmful mutual interference. Given the cost, complexity, and physical constraints of the medium, it is imperative that coexistence and some interoperability be achieved. The purpose of this PAP is to achieve that resolution.	**Harmonize Power Line Carrier Standards for Appliance Communications in the Home** **Scope:** The goal of this PAP is to enable the development of an interoperable profile containing common features for home appliance applications where the resulting implementation of this profile leads to interoperable products. **Expected Outputs**: Updates to relevant standards including ITU G.Hn (G.9960, G.9961, G.9972), IEEE P1901 (HomePlug ™, High Definition Power Line Communication (HD-PLC™), and Inter-System Protocol (ISP)), and ANSI/ Consumer Electronics Association (CEA) 709.2 (Lonworks™). **Date:** 2011.
16	なし	**Wind Plant Communications** **Scope:** The goal of PAP16 is development of a wind power plant communications standard. **Expected Output:** IEC 61400-25, Wind Plant Communications, based on IEC 61850. **Date:** 2011.

No.	Release1.0時点でのPAP（What）の記述	Release2.0時点でのPAPの状況
17	なし	**Facility Smart Grid Information Standard** **Scope:** This priority action plan will lead to development of a data model standard to enable energy-consuming devices and control systems in the customer premises to manage electrical loads and generation sources in response to communication with the Smart Grid. It will be possible to communicate information about those electrical loads to utilities, other electrical service providers, and market operators. This PAP will leverage the parallel PAP10 effort and other related activities and models, such as IEC CIM, SEP 2.0, IEC 61850.7-420, and PAPs 3, 4, and 9. **Expected Output:** Development of an ANSI-approved Facility Smart Grid Information Standard that is independent of the communication protocol used to implement it. **Date:** 2011.
18	なし	**SEP 1.x to SEP 2 Transition and Coexistence** **Scope:** This action plan focuses on developing specific requirements to allow the coexistence of SEP 1.x and 2.0 and to support the migration of 1.x implementations to 2.0. Because it is a deployment-specific issue, the PAP will not address whether new deployments should be 1.x or 2.0. The effort assumes 1.x in the field as the starting point and assumes that the meters themselves are capable of running SEP 1.x or 2.0 via remote firmware upgrade. **Expected Output:** The PAP has produced a white paper summarizing the key issues with migration and making specific recommendations and a requirements document to be submitted to the ZigBee Alliance for consideration in developing the technology-specific recommendations, solutions, and any required changes to the SEP 2.0 specifications themselves. **Date:** 2011.

Expression in Blue：2.0で新たにPAPに加えられたもの
：既に完了したもの