Green Solution with Simegy

要 旨

オフィス環境における、複合機やプリンターの消費電力の見える化や、消費電力の削減のためのグリーンソリューションが近年強く求められている。富士ゼロックスは、複合機やプリンターを管理/活用するための ApeosWare Management Suiteのようなソフトウェアに対して、ゼロックスの Simegy 技術をインテグレーションすることで、富士ゼロックスのグリーンソリューションを提供している。Simegy はエンドユーザーへの影響を最小限におさえて、自動的に複合機やプリンターの最も良いエネルギー節約方法を提案する。

Abstract

Optimizing energy use in large multi-function and printer fleets is an increasingly popular customer request. Fuji Xerox has collaborated with Xerox Innovation Group in order to leverage Simegy in FX green solution as part of ApeosWare Management Suite. Simegy provides an automated energy savings optimization engine capable of proposing the best energy saving strategy while reducing the end user impact.

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1. **Motivate**

Why do you start to research this type of technology?

Simgy was developed by Xerox Innovation Group (XIG) – Xerox Research Centre Europe (XRCE) as part of its research activities in the area of mathematical behavior modeling of printer and multi-function devices usage. Modeling the interaction between a user and a printer aims at making devices and device management tools like ApeosWare Management Suite (AWMS) smarter and capable of optimizing the customer satisfaction and reduce Total Cost of Ownership (TCO).

The developed mathematical models are based on statistical machine learning techniques capable of learning from data the parameters that characterize every interaction. For example, it is possible to model a unique user’s preference for a printer among all the printers in a company or a building floor by observing the print events associated to the user and stored in the job accounting records. Machine learning models as probabilistic latent clustering [1],[2] allow to learn and infer from data non-obvious relations like the most likely printer that a user may choose in the case of the preferred device not being available.

Furthermore, taking into account the time dimension it is possible to elaborate models capable of detecting changes in the behavior of users and infer whether a device maybe malfunctioning just by observing the sequences of print jobs[3],[4].

Simgy is a natural next step in the research agenda of behavioral modeling. In this case the goal is to actively optimize the parameters of the device in order to reduce its energy use while not impacting the user. The target is to develop a software embedded in a device management tool like ApeosWare Management Suite in order to make it capable of adjusting the printer power saving strategy in an intelligent way to reduce energy use and hence carbon emissions.

2. **Simgy Technology Summary**

Printers and multi function devices are basically state machines with states characterized by its function (eg: printing, scanning, sleeping, etc) but also by the energy used at each level. The transitions between states are caused either by an external action like a print request or by a strategy embedded in the firmware of the device. The power saving strategies refer to the rules or policies which control state transitions between a high readiness and high energy use state (e.g. idle mode) and a lower readiness and energy use state. In most devices the power saving strategy is based on timeouts determining the time a device needs to stay in state without receiving an external request before transitioning to the next lower energy and readiness state. Figure 1 illustrates a typical device’s set of states and transitions.

In Figure 2 the energy use of a FUJI XEROX ApeosPort-II C4300 multi-function device is illustrated as well as some of its states and transitions. A higher energy use state as idle mode means four times more energy used in
making the printer available by heating some of the device subsystems in order to achieve a ready state in a quick way.

The perfect energy saving strategy would be one that guesses when it makes sense to enter a lower energy use state while not impacting the device availability and the quality of service.

Therefore developing software able to determine the best timeouts strategies adapted to the usage of the device required a combined approach to solve three interdependent problems as shown in Figure 3:

These challenges are:

- **Device energy use modeling and simulation** in a generic way and allowing the support of both simple devices as printers as well as complex multi function devices.

- **Model users’ behavior or print demand** by using the job accounting records in order to build an understanding of the activity patterns (e.g: active and inactive hours and days of the week) and the shape of the print demand.

- **Optimize the energy saving strategy given the user behavior**, the device energy use model and a user impact parameter.

The main scientific challenges were concentrated on the user behavior models and the optimization of the strategies. Modeling and simulating the device energy use required the formulation of a flexible model capable of embedding energy states, device transitions and device functionalities (e.g.: scan, print) with a standardized state machine representation based in an XML schema.

The behavior model elaboration was more complex and required the study of several millions of real device print logs coming from several thousands of devices. This study allowed understanding how to statistically characterize the user behavior by:
• **Analyzing the inter-job arrival times distributions** in order to learn from the accounting records the print demand patterns.

• **Identifying time frames with differentiated demand patterns** like week days vs. weekends or hours of activity vs. hours of inactivity. An example of how the identification of activity hours is shown in Figure 4.

Once the user behavior characterized the optimization engine explores timeout strategy values space combining the user behavior with the device energy use model. Combining both elements is crucial.

Figure 5 aims at providing a graphical explanation by showing the difference between two identical devices (same model) but with different print demands. Both figures show graphics representing for a given user behavior the power consumption on the vertical axis and the percentage of additional wake-up events that an energy saving strategy may involve compared to the factory default. More aggressive or shorter timeouts strategies can reduce energy consumption at the cost of impacting the user. A trade-off exploration between energy and user impact is needed as part of the optimization process.

Simegy explores for every device the energy and user impact trade-offs and assesses the value of a more or aggressive energy saving strategy in an automated way. For example, a device like the one represented in Figure 5a shows a device increasing significantly the number of wake-up events for more aggressive energy saving strategies but with smaller energy savings. In this case the use of very short timeouts is not of interest as it creates a significant user impact for reduced energy savings. In Figure 5b a device with a different print demand shows to be reducing more quickly its energy use with more aggressive timeouts while the number of wake-up events increases but a smaller rate.

All the technologies developed for Simegy have proven their ability to automate and optimize the selection of the optimal parameters in printers and multi-function devices by taking into account the user behavior, the printer or multi-function energy use and the reduction of the user impact.
3. Solution Integration

In February 2009 Fuji Xerox announced its 2020 greenhouse gas reduction as part of corporate sustainability initiatives. These targets included a first internal target of reducing the CO₂ emissions in the life cycle of Fuji Xerox by 30%. The green solution allows Fuji Xerox make an effective contribution to the second target of contributing to the reduction of customer emissions by 7 million tons of CO₂.

Fuji Xerox’s vision is to provide customers with a solution able to optimize energy use in the entire office environment in order to achieve the 2020 target. Starting by the optimization of multi-function devices was a first step in the execution of this vision. (Figure 6)

A valuable green solution contributing to customer emissions reduction requires to run in a continuous and automated manner. Moreover, it also needs to communicate the measured emission reduction in a visible way to the customer. contribute to the reduction of CO₂ without customer. But above all, the solution needs to forcing customers to change their behavior or impact productivity even if the solution guarantees emission reductions.

FX improves every year the power consumption in newly launched devices. In 2009, a field survey was conducted among 50 office devices installed in 43 different customers. The observations resulting from this survey showed that only 10% of the devices had the default factory sleep timeout value. The remaining 90% of customers having changed the sleep timeout values in their devices to higher values in order to reduce the impact in productivity and increase operational performance. Furthermore, a group of less than 30% of the customers decided to set the sleep mode timeout values to the maximum value allowed in their devices.

In an ideal world customers would automatically update their printer or multi-function devices fleet to the latest technology in order to

FX Green Solution concept

![FX Green Solution Concept](Figure 6. FX Green Solution Concept)
take advantage of the latest and greatest energy savings features. The reality is that customers want to keep their current devices to preserve their investment while reducing their devices’ energy use. The best way of answering both requirements is to propose our customers a solution capable of handling a diverse fleet of devices comprising old models and new models in a mixed environment and optimizing their energy use in an automated way.

Simgy is a technology that optimizes automatically the energy use of multi-function device and printers without impacting end-users’ productivity which was and is a very important point to take this technology into FX Green Solution.

4. Example for integrated solution

4.1 Green Solution with Image Gateway for Apeos (Australian case)

Fuji Xerox Australia provides many solutions sharing in their conception the importance of sustainability in the enterprise domain in Australia. The contribution to the environmental issue in sustainability is a fundamental focus. Offering to FX Australia customers a Green Solution for Managed Services can help them to contribute to improve their sustainability metrics. Fuji Xerox Australia proposes Image Gateway for Apeos (IGA) (Figure 7). IGA focuses on three areas: Improving Business Efficiency, Reducing Costs and Streamlining Customer Business Processes.

The goal of IGA is offering a solution able to reduce energy consumption and not requiring any administration effort. The integration of Simgy with IGA makes it possible. Furthermore, Simgy has a simulation function allowing the estimation of the total amount of energy use per device and for a full fleet of devices. Customers using IGA are able to assess the effect of the optimized energy management policies deployed by Simgy visualizing a comparison between the before and after state.

4.2 Green Solution with ApeosWare Management Suite (Japan and Asia case)

ApeosWare Management Suite (AWMS) (Figure 8) is a multi-function device and printer fleet management software that offers customers’ TCO reduction and security enhancement. Since March 11, 2011 earthquake in Japan customers consider energy savings an even more crucial feature. An increasing number of customer inquiries contain requests as "We want to know the usage of multi-function devices and printers and the energy savings that can be achieved". Customers also request to simply visualize their fleet’s total amount of energy consumption even without an active energy saving strategy in place. AWMS provides the ability of viewing CO₂ emissions and thanks to its integration of Simgy a stronger value proposition as green solution.
AWMS provides three levels of visualization of CO₂ emissions. A first level of reporting for the end user level is proposed and informs about CO₂ emissions at the time of use of the multi-function device. A second level of information provides the total fleet CO₂ report for administrators. Finally AWMS integrates with Fujitsu SystemWalker which reports the total energy use at the IT systems equipment and office devices level allowing to evaluate the part of energy use due to multi-function devices and printer fleets in the broader context of office equipment. The integration of Simegy in AWMS adds to this solution the value of reducing energy use and therefore CO₂ emissions without additional administration needs and widely supporting devices including older and newer models.

5. TRADEMARKS

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6. References


