

Bifrost Inbox Organizer: Giving users control over the inbox

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ABSTRACT

Many email users, especially managers, receive too many email messages to read in the time available to them. The solutions available today often require programming skills on the part of the user to define rules for prioritizing messages or moving messages to folders. We propose a different approach: categorize messages in the inbox with predefined rules that do not require maintenance and are scalable to handle anything from 50 to thousands of messages.

Keywords

Email, inbox, organize, prioritization, categorization

INTRODUCTION

Many email users, especially managers, receive too many email messages to read in the time available to them. The solutions available today often require programming skills on the part of the user to define rules for prioritizing messages or moving messages to folders. Constructing and maintaining rules is time consuming, as well as difficult for many users who do not have sufficient programming skills. Furthermore, the prioritization rules cannot meet the needs of users because user priorities can change significantly in a short period of time. For example, after a person talks with a colleague at the watercooler, she could have a new reason for checking her email, but when she meets her manager, who has a new task for her, her priorities can change again. Using learning to determine how a user would like to read messages offers one remedy, but would require users to give feedback and understand the agent's behavior. Managers and other people overloaded with email have especially little time to devote to these activities. Furthermore, using rules to move messages to folders automatically causes an "out of sight, out of mind" email situation, that is, email that is not in the inbox tends to be ignored and become forgotten.

1. This work was conducted when both authors were members of the Lotus Research Group at Lotus Development Cooperation.

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We propose a different approach: provide an inbox with several distinct categories of interest. These categories result from the use of a set of general rules that are predefined and which can be customized by individual users. These general rules liberate users from reinventing and maintaining situationally relevant rules for handling their email because the user does not need to develop the rules; the user only tailors them via a form to his or her use. The rules we propose are derived from user studies and experiments with a prototype named the Bifrost² Inbox Organizer. Our experience with Bifrost, which we will discuss in this paper, indicates that this inbox not only liberates users from rule construction but also provides them with a breakdown of their email into categories of interest. These categories allow users to quickly zero in on the email that is most relevant to a particular work task and not to be distracted by email that concerns other tasks.

PREVIOUS RESEARCH

Information overflow, or overload, can be described as "information received at such a rapid rate that it cannot be assimilated" [23]. Email overflow may cause users to answer only parts of the incoming mail, to ignore incoming information systematically, and even to stop using the email system [9]. The feeling of being overloaded varies widely; independent of the number of messages they send and receive [13]. Demands from management to prioritize messages from customers and error reports cause delays in other messages, especially if they needed a longer informative answer. This process sometimes results in forgotten messages [11].

Email users can be categorized into four defined main groups based on folder usage and cleaning [25, 5]. These groups are a result of a natural development from novice to experienced user [5] that can be explained by a mathematical model [8]. We conclude from these observations that the different user groups need different types of support to maintain control over their inboxes.

The Coordinator system [26] took a different approach to email use. Rather than organizing the inbox, Communicator controlled users' behaviour by structuring their conversational exchanges according to a set of rules.

2. Bifrost is the name of the rainbow colored bridge between this world and Valhalla, the Viking conception of Heaven. Only the righteous may pass this bridge, in this case referring to the messages that should be brought to the user's attention.

Using filters to store messages in folders or to prioritize them in the inbox can reduce email overflow. This change could reduce the stress involved in decision-making tasks that are lower for sorted email than unsorted [21].

Many of the ideas for filtering email originated in the Information Lens systems developed at MIT. The filtering system was designed both to save users from junk mail and to find messages of interest, even though the messages were not directed to the user originally [17, 2].

Filtering rules have to be defined in some way. This may be simple for programmers, but not for ordinary users [3]. An attempt to use a filter to automatically redirect user messages to the persons responsible for different parts of a help system failed because more than 50% of the messages ended up as unsortable. Many users simply wrote e.g. "Help!" in the subject line [4].

Automatically moving messages into folders before the user has viewed them often makes the messages invisible. An analogy to the office desktop explains this claim. There are perfectly good reasons why office workers create piles of papers on their desks instead of filing them into folders. The purpose of these piles is not only to store information for later retrieval, but also to remind the worker to do something [16]. Two quotes from the subjects in that study illustrate the behavior:

If I don't put it here where I can visually see it, I won't do it (p 107).

You don't want to put it [a pile on the desk] away because that way you never come across it again (p 107).

One way for users to avoid writing programs is to design the filtering system in such a way that the system can learn from users how to sort messages. A formal model based on economical and statistical decision theory to rank messages on a scale of interest has been developed [12]. In the PRIORITIES system messages were classified as High or Low Criticality with good precision [10]. Segal developed an adaptive classifier that predicted most likely folder based on a collection of messages previously placed in folders by the user. This classifier worked well to help archive messages after reading them, but not to prioritize reading [22]. Similar suggestions have been made by [24, 14, 15], who propose intelligent agents that learn from users by training, imitating users' actions, and receiving negative feedback when it takes the wrong actions. These agents work as a complement to user defined filtering rules.

A difficulty with learning filtering systems is that the user can feel out of control if they do not understand why the system acts the way it does. Also, the system cannot learn without feedback from the user, and feedback consumes the time that the user is trying to save. A system that prioritizes messages will not know if the prioritization is right until the user has read all messages, which is exactly what the user is trying to avoid.

Given the preceding criticism of filtering, what conclusions can we draw about filtering and prioritizing? Would it be possible to define general rules that would be applicable to most or all users?

What general rules would be application to most or all users for filtering and prioritizing? [20] claim that email and newsgroups could be structured as conferences, comment trees, keywords, subject, selection by others, author, and abstract writing. Arenburger and Rosenfeld [1] suggest several categories (e.g. personal, listserv, ccs) and informal definitions of those categories. However, they also claim: *The rules ... will almost certainly not apply to anyone else.* Other suggestions includes timely messages (messages containing calendar information in the header or responses to recent messages) [19] as well as high priority, low priority, social and announcements [3].

CURRENT APPROACH

We believe that a general categorization system should ideally fulfill four conditions:

- 1) No work, or as little work as possible, should be done manually. That is, the categorization should be based on information already in the messages.
- 2) All messages should be categorized. A category for "other messages" could make the user curious about their content and therefore waste time reading them.
- 3) The categorization should be scalable, that is be possible to use regardless of whether there are 50 or 5000 messages in the inbox.
- 4) No messages should be misclassified.

We selected the rules defined by others mentioned above that fulfill our four conditions. Before changing a user's inbox to use these rules, we first undertook a study of users' daily email use.

METHODS

Eight email users in five different departments of a software company were interviewed and observed during their morning reading of email. Some of the subjects were interviewed when they returned from a business trip or a vacation. The subjects were selected based upon an expected large volume of incoming messages, preferably more than 30 messages a day. The interviews were taped and lasted between 30 and 120 minutes.

Based on the results of these interviews and observations a prototype was developed to categorize email messages in the inbox. This prototype was developed on top of the Lotus Notes™ email system. Ten users then used this prototype for a period of two to seven months. During that time period, the prototype was refined by requests from the users several times. Finally the prototype users were interviewed. Six of the initially interviewed subjects were also users of the prototype.

RESULTS OF THE FIRST USER STUDY

From the initial interviews the following observations were made:

- All users but one scanned new messages several times in order to read the most important messages and at the same time delete the least interesting. However, few users succeeded. Most took care of the easy ones first, and the second and third scan revealed that they were not very successful even in doing this.

- Messages related to events in the calendar for the day were judged important, regardless of arrival date.
- Users changed (already read) opened messages to unread as a reminder that they were unfinished tasks.
- In general, the fewer recipients there were of a message, the more important the user considered it.
- Replies were important as they often contained a solution to a problem posted by the recipient.
- More than half of the subjects did not read all of their messages.
- Some subjects feared that they would miss important messages during their scanning of the new messages.
- Subjects who mentioned filtering feared that filtering would move messages out of sight.
- For most users, carbon copies were judged as less interesting than other messages, but not always.
- Four of the subjects did not delete any messages with the exception of failed delivery reports.

Details about individual users' number of messages are displayed in table 1. The observations above lead us to believe that ccs were not important enough to qualify as a separate category, while both calendar related messages and replies did. Also, all messages should be categorized and there is an important difference between distribution lists and group messages.

PROTOTYPE

Bifrost was implemented in Notes' standard programming environment. Similar possibilities exist in most advanced email clients. Bifrost categorizes messages in five main categories, as shown in figure 1, where category numbers and headings are presented in addition to the single line descriptions of individual email messages.

The first category, Timely, contains messages that have a word in the subject or sender in common with an entry in the calendar for the current day. In the example in figure 1, this category comprises the two messages from Susan Lanza. The message about directions to an outing may be extremely useful on the day of the meeting, but any other time it would be categorized as a Large distribution message because the number of recipients is more than seven. The message from Lanza (first in the list) is obviously critical since it indicates that the outing was canceled.

The second category, VIP Platinum can be used for people whose messages the user always considers as potentially important or urgent regardless of the number of recipients. Users choose such senders, who are dubbed "VIPs."

The Personal category contains messages sent exclusively to the user by name. In the example in figure 1 this category is subdivided into an unnamed list, a list of "replies," and a list entitled "unclassified." Messages in the unnamed list are sent by people entered by the user in the VIP Gold field (see figure 3) The personal category is intended for messages that only the user can handle (hence only one recipient and by name). The replies are often answers to questions posted by the mailbox user, or at least messages from people with whom the user has communicated before. These messages

are therefore probably of higher interest than messages sent by others.

The Small distribution category is intended for group messages. It is divided into named groups and unclassified. The user defines the named groups.

| Category | Sender | Date | Subject |
|----------------------|-----------------|----------|--|
| 1 Timely | Susan Lanza | 09/01/99 | KNO OUTING IS CANCELLED |
| | Susan Lanza | 09/01/99 | KNO OUTING - DIRECTIONS |
| 2 Personal | John Gold | 12/15/99 | Say so loud... DON PAULIE - TONIGHT TONIGHT |
| | John Gold | 12/15/99 | Mail from the past - Leslie Langport talk |
| 3 Small distribution | Unclassified | 12/15/99 | High intake of omega fat is associated with decreased risk of prostate cancer |
| | Unclassified | 12/15/99 | Re: How to uninstall Bifrost |
| 4 Large distribution | Michael Muller | 12/15/99 | Re: Free homemade bun in the open world (cc) |
| | Candy Soares | 12/15/99 | Re: Could I borrow your laptop for the presentation on Monday/Tuesday |
| | Candy Soares | 12/15/99 | Re: When will we leave today for Hyatt? Caterina will probably join us here (cc) |
| | Cristian Eggler | 07/25/99 | Re: cc:Case in Java |

Figure 1: Categorized inbox. Unread messages marked with a star to the left.

The Large distribution category is intended for listserv messages and messages with more than seven recipients. It has the same subdivision as Small distribution.

This structure is intended to support users in identifying important messages and in weeding out the less interesting ones. The ordering of the categories implies an order of importance, but in fact any of the categories can become a priority depending on the ever-changing events in the user's life.

If the inbox contains a large number of messages, the number of messages in each category will of course be very large, and it will be difficult to get a snap shot of all of them, unless the user deletes messages or store messages in folders. For many users, deleting messages is out of the question since they want to have a record of their communication. Also, deleting messages requires that the user decide that he or she never wants those messages again, a decision many users are not willing to make [6]. Folder usage requires naming and maintaining folders, which is a time consuming task, and also requires a decision for each message about the correct folder. Some messages fit several folders, and some do not fit any, which makes storing decisions complicated or even impossible.

However, by categorizing only the unread messages, the number of categorized messages can be kept low and easy to view; see figure 2. Marking messages unread as a reminder of tasks was a common habit among the users in the first study, and this sorting gave these users a to-do list, while the already read and no longer needed messages sunk away to the bottom of the inbox in the "Not Categorized" section.

Table 1: User data from the first round of interviews

| Position | Estimated # new messages per day | New messages at time of interview | Total # messages | % in inbox | # folders | Scans of inbox | Deletes messages | Reads all messages |
|-------------|----------------------------------|-----------------------------------|------------------|------------|-----------|----------------|------------------|--------------------|
| Researcher | 30 | 140 | 1,257 | 62% | 24 | 3 | Yes | Yes |
| Researcher | 30 | 30 | 10,000 | 95% | 8 | 2 | No | No |
| Admin staff | 10-20 | 10 | 3,200 | 10% | 50 | 2 | Yes | Yes |
| Researcher | 20-30 | 35 | 3,300 | 28% | 150 | 3 | Yes | No |
| Researcher | 200 | 470 | 6,340 | 13% | 70 | 3 | Yes | No |
| Manager | 30 | 19 | 5,400 | 100 % | 0 | 2 | Yes | Yes |
| Manager | 20-40 | 15-20 | 7,000 | 100 % | 0 | 1 | Few | Yes |
| Manager | 30-40 | 0 | 5,000 | 96% | 10 | 2 | Yes | No |
| Manager | 100 | 120 | 20,000 | 90% | 200 | 3 | No | No |
| Researcher | 30 | 120 | 20,000 | 100 % | 6 | 2 | Few | No |

Messages sent as carbon copies are marked with a little icon to help the user identify them (see the message from Olle Balter in figures 1 and 2, about halfway down the figure). This icon was added because some subjects in the first study reported that cc's were less interesting than other messages.



Figure 2: Inbox with unread messages categorized.

To improve the precision of the pre-defined categorizing rules, the user could to enter information about his or her communication partners as shown in figure 3.

The only mandatory field is MyNames where the name of the user must be entered. The VIP Platinum field is used for senders whose messages go into the VIP Platinum category, (for example, a user's manager). The VIP Gold field is used for senders whose messages are displayed first among the Personal or Small distribution messages, depending on the number of recipients. Typical VIP Gold are colleagues and friends. The senders and receivers entered in the Small and Large distribution fields will be displayed first in their category, respectively, while other messages will be displayed as unclassified within each category. The information in the

user-defined fields is used by the pre-defined categorization rules shown in figure 4.

RESULTS OF THE SECOND USER STUDY

Ten of the Bifrost users were interviewed after having access to Bifrost in their ordinary mail system for at least a month. All but one found Bifrost useful. All were experienced email users; the median starting year for email use was 1982, and several users reported being overloaded with email. Basic user data are displayed in table 2.

I look at email negatively. I look at it as a burden, I look at it as a necessary evil for my job, its usefulness has outweighed itself for me. For really truly important things I have to ask people to use voice mail. So I see Bifrost as a way to help me tackle this beast that I depreciate [sic].

This user study resulted in “scalable categorization”: choices were added to categorize messages only from the last day, two days, week, and month. A manager with 200 new messages per day requested this. Four other manager related changes to Bifrost categorization were the addition of the VIP Platinum category and the subcategories for calendar related messages, approvals, and Bccs (rule 3, 4 & 8 respectively in figure 4).

Usage

We observed a number of changes in user email behavior with Bifrost which we will present in this section. First, Bifrost produced differential use in Bifrost users. A few used Bifrost as a replacement for the standard inbox and categorized messages daily. The possibilities to go back and forth between the Bifrost view and the standard view made it easy for the users to use Bifrost when they really needed it. A majority used Bifrost categorization when their new email messages had built up to more than a full screen. One user described the effects of email build up:

It took me two-three weeks to catch up from one weekend of not reading.

The frequency of categorization varied a lot between users, from twice a week to once a month.

Bifrost is really a tool to help me attack my email.

Table 2: User data from the second round of interviews

| Manager | New messages / day | Sent messages / day | Total # of stored messages | % in inbox | # folders |
|---------|--------------------|---------------------|----------------------------|------------|-----------|
| No | 30 | 25 | 1,705 | 64% | 22 |
| No | 20-30 | 5 | 3,800 | 2% | 30-40 |
| No | 15-20 | 5-10 | 3,261 | 54% | 10 |
| No | 30-40 | 10-20 | 17,119 | 0.4% | 240 |
| No | 30 | 15 | 1,635 | 38% | 13 |
| No | 200-300 | 10-40 | 39,882 | 2% | 82 |
| Yes | 20-50 | 12-25 | 7,402 | 47% | 11 |
| No | 40-80 | 5-10 | 699 | 92% | 4 |
| Yes | 100-200 | 100 | 2,477 | 2% | 14 |
| Yes | 80 | 20 | 25,099 | 1% | 130 |



Figure 3: User defined fields. The “Senders” fields are not used by the pre-defined rules. The Subject fields are used to identify certain distribution lists, calendar related information, and work flow approvals.

Evidence that email overload is not caused by the media, but by the people using it, can be illustrated by the response of a managermanager when he was asked what he wanted from Bifrost in the future:

A feature that allows me to electronically hunt down and kill people that pointlessly copies [sic] me.

As a second result, we observed that Bifrost changed user behavior in prioritizing their mail. Several of the subjects reported that they sifted less through messages or through fewer messages when they sifted.

If I am just running through an inbox, I might be tempted to read a title and get sucked in because it is interesting. Whereas if it is in a pile of listserv stuff, I just ignore it altogether. That was a nice thing when I was busy, to not get distracted by unimportant mail.

One of the subjects described how a group message (categorized as small distribution) about a meeting was ignored until his manager sent a message (categorized as VIP Platinum) stating that he would like at least one of the people in

the group to go to the meeting. The prioritization is of course especially valuable when the number of new messages is large and the time to read messages is short.

Bifrost allows me to take things out of the chronology order and deal with them in their importance level.

I feel this silly sense of accomplishment if I'm actually on top of [my email]. ... A couple of days ago I categorized, by the last week unread, I have gone through the important stuff ... That means for a short period of time when I come in I can deal with [the new messages]. So I have totally adopted the tool (Bifrost).

We also observed that Bifrost provided to-do list support, which users took advantage of in two different ways. Among those who maintained unread marks as a way to remind themselves that a message represents an unfinished task, they continued to remark read messages as unfinished. The Bifrost categorization provided a means for keeping the messages in the priority categories, because already read messages (i.e. ones already attended to) moved to the

bottom of the inbox. One user, however, did not bother to mark messages unread, but instead used the Bifrost categorization itself to keep the interesting messages at the top of his inbox. He kept messages that he wanted to have at the top as categorized, and he uncategorized messages manually when he wanted them to fall down.

I sort of keep <messages in the inbox> as a to-do list. Something I always felt I would like to have.

It is a way to give me a "To-do" kind of feature right in my mail file ... It helps me to group important messages at the top of my mail file so I can easily find them.

It holds together a stream of thought.

A third result we saw concerns large distribution messages. Bifrost chunks listserv messages together. Users then find it easy to delete these large distribution messages because Bifrost has pre-identified them.

For all the spam mail that I get, it kind of appears in one place, and the titles sort of give it away anyway, but since it is all sort of there together I find it easier to chuck, chuck, chuck, chuck, chuck. <Delete messages>

Finally, the Bifrost organization of the inbox improved the user's ability to see an overview of all the messages. Users could collapse categories that were not of interest to reduce clutter and release screen real estate:

Collapsing uninteresting categories helps getting an overview. When the scroll bar is gone I immediately feel that I am in more control over my life.

We also believe that Bifrost resulted in less unproductive time spent on email, but are not able to support this claim quantitatively. The time spent on email is difficult to estimate because it depends on the content of the messages, workload, interruptions, etc. However, several of the users reported that Bifrost helped them to focus on the important messages, so that they spent less time handling unimportant ones. One of the managers, who used to schedule the first hour every day to read email, stopped doing so. Bifrost helped him to control his own time since he no longer needed a full hour to identify the most urgent messages.

Advantages

The Bifrost rules include all messages. The only misclassifications result from listserv and spam messages that are disguised as messages with only one recipient. The user can eliminate listserv misclassification by entering the name of the listserv in the appropriate field (see figure 3). Bifrost's two main advantages are a reasonable prioritization of messages, and simplified maintenance of a to-do list in the inbox.

It (Bifrost) really helps me like a machete in a forest to clear a way.

Three of the Bifrost users did not add any names to the fields in figure 3. The remaining six users added between 6 and 47 names with a median of 16. None of the users changed the predefined rules that interpret the user-defined fields.

I haven't changed them, Half out of laziness, but also half out of not needing to. I mean, they are at an OK granularity for me.

Two users claimed that Bifrost reduced their usage of folders for archiving messages while one user started to use folders after the installation of Bifrost.

It moved me into folders.

Now I can use the Bifrost categories, and use folders only for long-term storage.

These contradictory behaviors have a simple explanation: Bifrost brings order to the inbox. For some users, order gives them the organization they need to stop using folders, or reduce folder usage. For others who previously found folder usage too cumbersome, Bifrost provided an organization for the messages that are difficult to put in a folder. This automatic organization liberates users from the burden of archiving messages that are too complicated to put in folders. The difficult messages simply remain in the inbox with the Bifrost categorization.

Disadvantages

The main disadvantages of Bifrost reported by the users result from its current implementation. Bifrost is slow to perform categorization when the inbox is located on a server rather than a local machine (as was the case for most users). Delays are especially common for users accessing their mail over a slow modem. A second possible disadvantage concerns the user interface: users initiated the categorization of the inbox manually, because Bifrost was an add-on to Notes email. However, these two problems could be addressed by additions to the implementation.

The only user who did not like Bifrost had an unrelated problem with her unread marks. Occasionally her unread marks became corrupted in her base mail system, and she could not use the color red¹ as a means of identifying new, unread messages. Bifrost made this problem worse by splitting the new messages into several "buckets".

All the other users found the disadvantages of Bifrost to be of minor importance and related to their own maintenance of the user defined fields in figure 3:

Flaws, there is changes in what is important and who is important, but that is OK, because it [Bifrost] is still more, at a greater percentage, than not helpful, it is just something I have to remember. It is only as smart as I can keep it smart.

Differences between users

Is it possible to create a set of rules that are so general that they can be applied to all users? Perhaps not, but Bifrost comes close. The user studies indicated only one problem: blind carbon copies (known as Bccs).

Sending blind carbon copies is a common trick among spam senders to make the message appear as an important message. For most users, these messages should be considered as less important. However, especially for managers

1. In Notes™ email, messages that have not been read are indicated by the color red. Read messages are colored black.

who often receive real messages as Bccs, such messages may be more important. The current solution is to place Bccs in a sub-category of Personal messages. Bccs from VIP Platinum will still end up in the VIP Platinum category.

Another difference observed among users was the number of days over which to categorize messages. Most users only chose to categorize "selected" messages or "all unread" messages. However, one manager frequently categorized the last day and week when he was behind in his reading. This only influenced the number of menu alternatives, not the rules per se.

CONCLUSIONS

We have described the development of the Bifrost Inbox Organizer and its warm reception by users. Bifrost consists of a rule set that can be used to categorize email messages, without burdening users with creating or maintaining rules. The intention was to support users who have more than 30 new messages to prioritize their reading.

Similar techniques could be applied to other messaging systems, such as hand held devices, cell phones, and voice mail. When it comes to phone messages, the notion of group and distribution messages may be inadequate, but the notion of VIP's, replies, and unclassified callers are vital to users' phone inboxes.

According to nine of the ten interviewed users, Bifrost was an excellent tool for prioritizing email reading, and it also provided assistance in maintaining a to-do list in the inbox and simplified folder usage. Bifrost has advantages over traditional filtering systems: it does not require programming skills nor maintenance of the rules; the categorization includes all messages and is understandable to users; and the ability to categorize only the unread messages and to limit the categorization in time (e.g. last day) made it scalable. The advantages makes Bifrost a good choice for most users, if not all, and their inboxes.

With only ten users of the Bifrost system, it would be pretentious to claim that Bifrost is a remedy for all users. More users would reinforce the validity of our observations and make statistical analysis possible. However, few users are willing to allow others to tamper with their personally valuable email inbox. Furthermore, email experiments must be done with users who are under time pressure, experience frequent interrupts, and uncertain and changing priorities and who are willing to undertake a new email system while experience such work demands. It goes without saying that finding such users is a continuing scientific challenge.

We conclude that it is extremely difficult for an automatic agent system to handle prioritization tasks well due to the rapid changes in the users' off-line world. Furthermore, offering user feedback to assist agents in prioritizing messages makes demands on users' time and knowledge of the variations in their email needs. Bifrost offers straightforward techniques to these difficulties while at the same time reducing the attentional demands email makes on users.

A Bifrost-like categorization could be implemented in any programmable email client. The headers available in Notes simplify the users' understanding of the system, but the categorization could be done as a priority list or in folders.

Even though Bifrost seems to be a step in the right direction, there is no support in email systems today for implicit task handling. Our suggestion is to take advantage of a 2.5-D interface design in email systems as well. Thanks to the categorization made possible by Bifrost, these visualizations offer the user a fast and natural way to overview messages [7].

Email is one of the most widely used communication systems, but the inbox has changed little since the beginning of the seventies. Bifrost offers a methodology as well as a worked example for change.

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