# Material Design

Today we'll talk about material design. Specifically, how and why Google created material design, and the 4 fundamental aspects of material design. We'll focus primarily on its impact on Android design, but a lot of the stuff herein applies across platforms.

A long time ago…

How did we get here?

Gmail.com   Android   Mobile Web

computer.howstuffworks.com   majorgeeks.com   zdnet.com
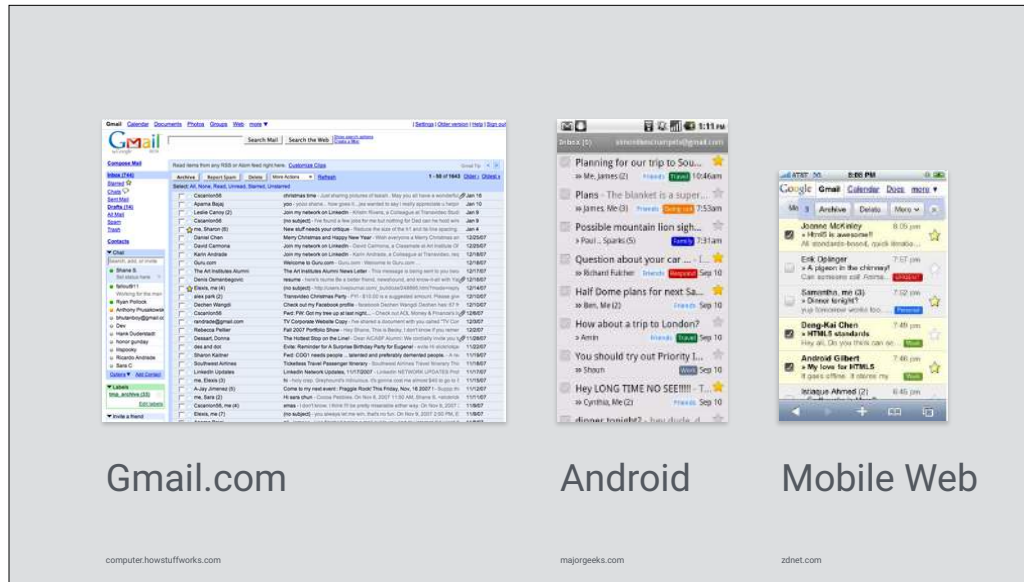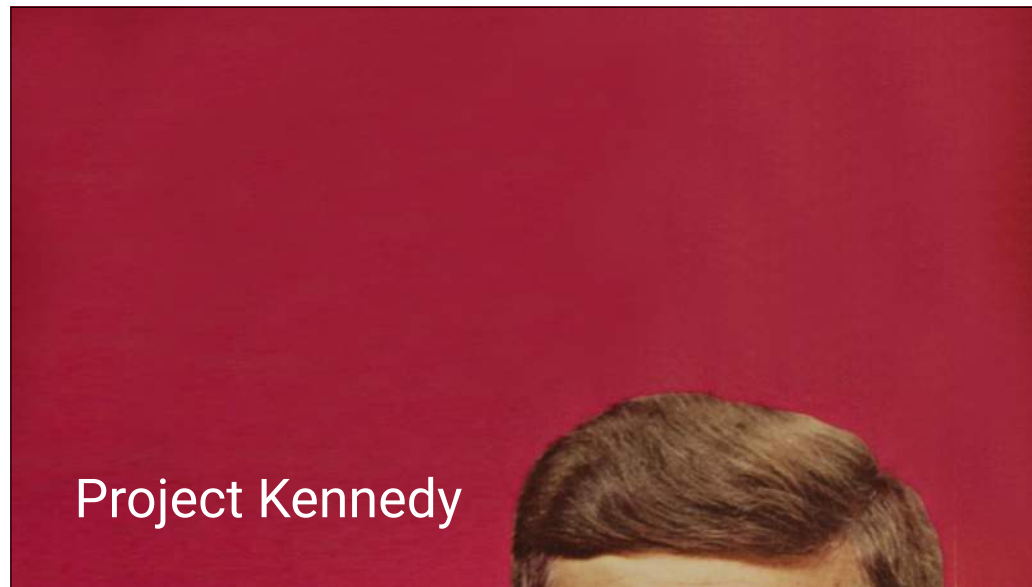
Years ago, Google's products all looked and felt kind of different.

Furthermore, services like Gmail had different expressions on different platforms. Gmail on Android looked and felt very different from Gmail on the desktop and mobile web.
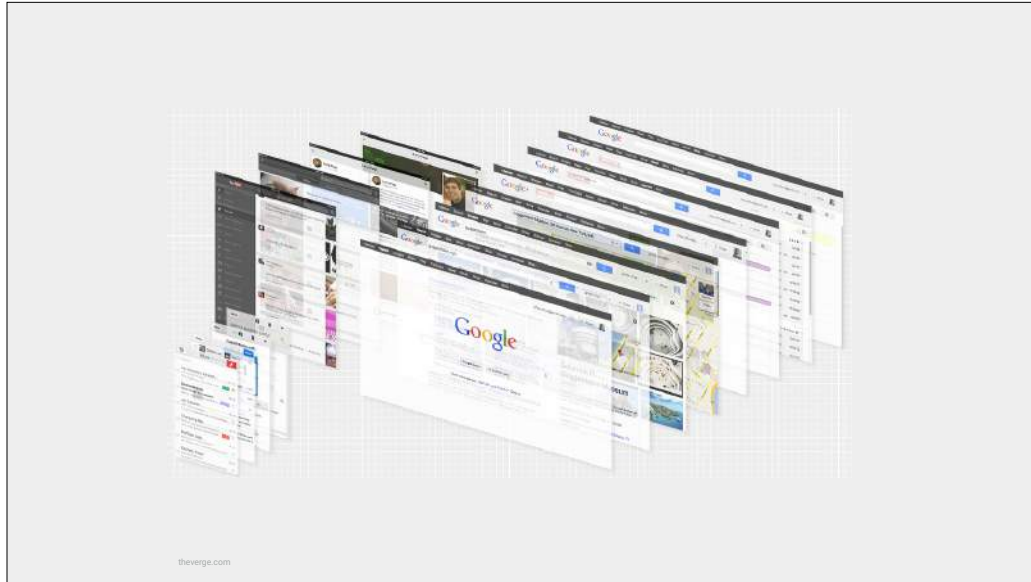
2011

Fast forward to 2011…

Project Kennedy

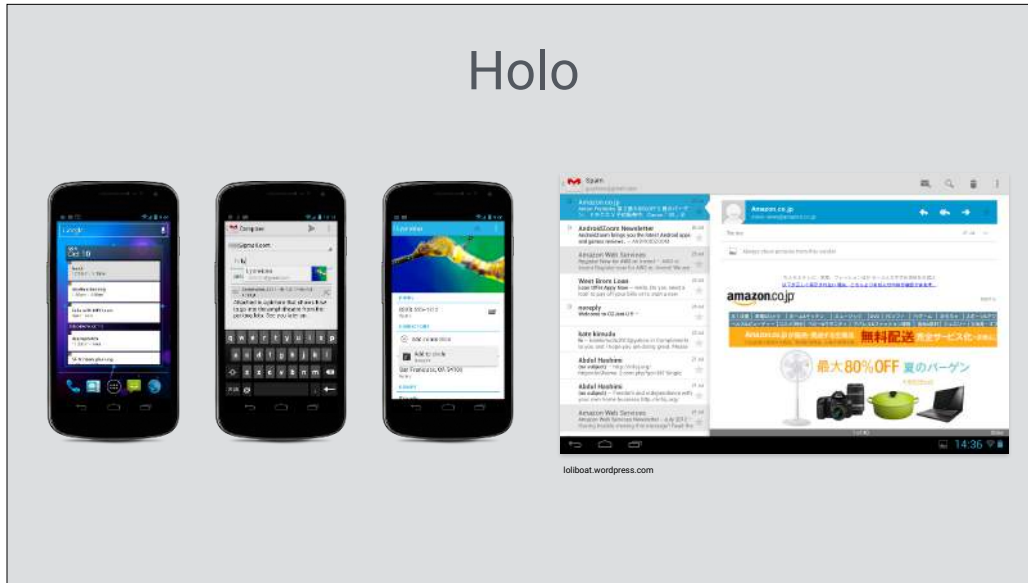…Google started working on a unified visual identity across our products, especially on the desktop web, and to some degree for the mobile web. Internally it was known as Project Kennedy.
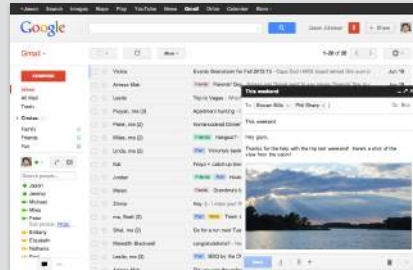
Project Kennedy succeeded in unifying the visual and interaction design language across many of Google's web properties, even touching some of our iOS apps.
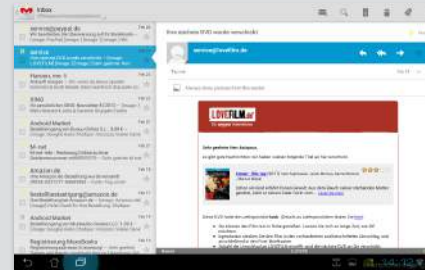
Around the same time, Holo, the design language for Android, was coming into its own and starting to bring order and beauty to Android amidst the visual chaos of previous releases.

Gmail.com
(Kennedy)

Gmail for Android
(Holo)

smartphoneblogging.com

But we still had this same issue — Holo and Kennedy still felt somewhat different. When coming to Android, existing Gmail.com users had to learn a new set of gestures and visual elements. They had to learn and remember how to interact with two different representations of a Gmail conversation, label and message.

This was a problem, especially for novice and nontechnical users.

This was an industry-wide problem.

This cross-platform design challenge didn't, and doesn't, only affect Google. It's something that any designer of a cross-platform service wrestles with today. It was truly an industry-wide problem.

And on Android, while the Holo visual language worked well for non-Google apps, we often heard the feedback that the design guidelines were somewhat rigid, and often too prescriptive. Designers felt overly constrained.
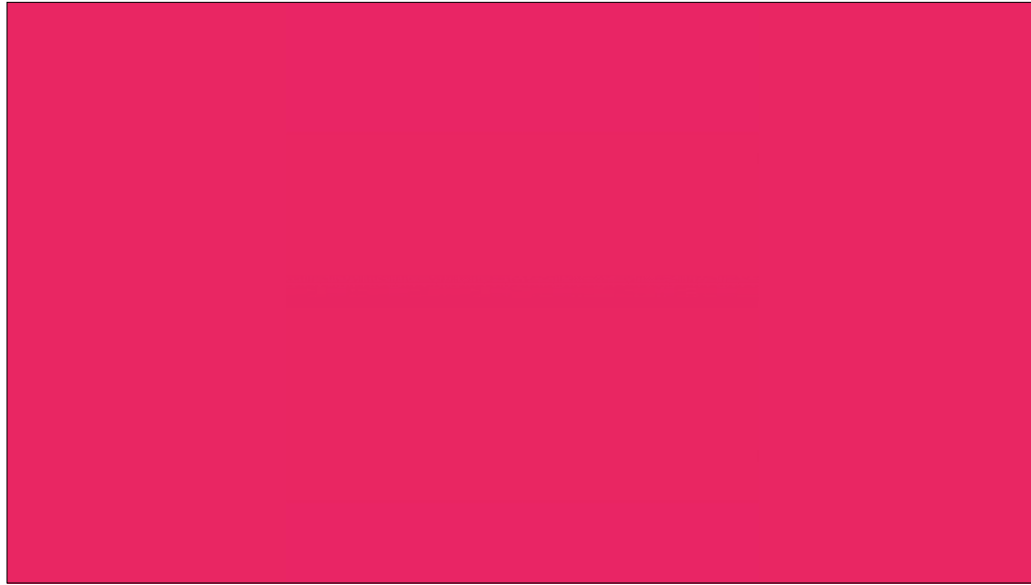
So a few years ago, a bunch of designers from across Google, including members of the Android Design and Project Kennedy teams, put their heads together and started working on a solution to this problem of cross-platform UI design.

And at Google I/O 2014, we published the results of that work…
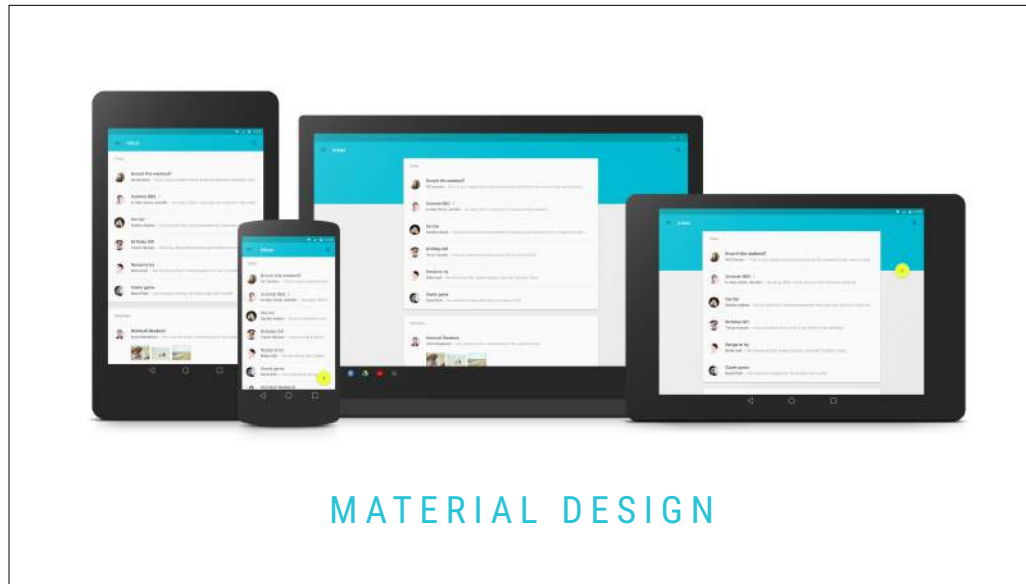
MATERIAL DESIGN

…a design system and approach that we call "material design."

A coherent cross-platform experience

Material design is Google's solution to providing a coherent, cross-platform experience for your users. You can apply it to design for the desktop and mobile web, mobile phones, tablets, wearables, TV, cars and more.

A coherent cross-platform
experience

A more flexible design system
for Android

For Android apps, material design is an evolution of the existing Holo visual language and design guidelines. In many ways, it offers a higher degree of flexibility and open-mindedness, and was designed from day one with third parties in mind. Google apps weren't the primary target audience, Google was just the first customer.

A coherent cross-platform
experience

A more flexible design system
for Android

**A rational approach to visual,
interaction, and motion design**

Finally, material design offers a rational approach to making visual, interaction and motion design decisions. It helps you make objective design choices by establishing a consistent environment grounded in, but not limited to, our understanding of the real world as humans.

Tangible surfaces

Print-like design

Meaningful motion

Adaptive design
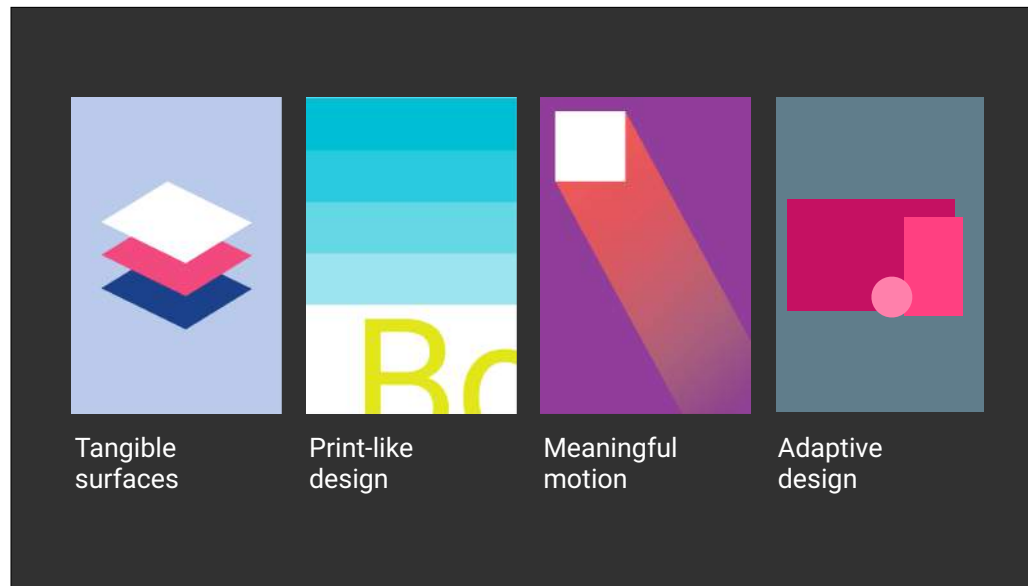
So lets talk a little bit about what that means… that "understanding of the real world" is a bit vague, so let's dive a little deeper. At its core, material design is about 4 key concepts.

Tangible surfaces | Print-like design | Meaningful motion | Adaptive design
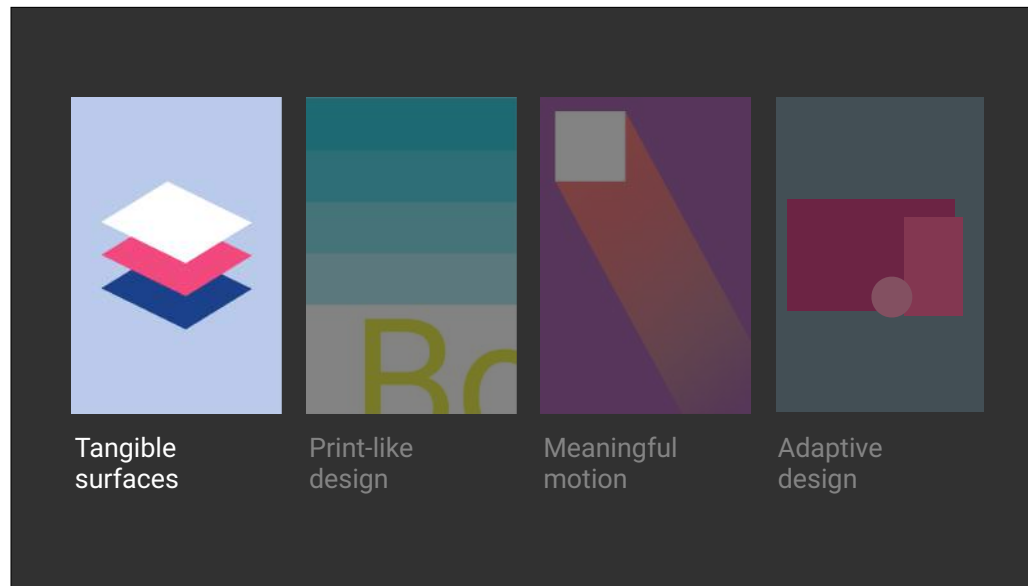
The first is tangible surfaces. In material design, a screen is composed of a number of surfaces, or as we sometimes say, "pieces of digital paper." These surfaces are arranged in front of and behind one another, and cast shadows. These arrangements help us as users understand the overall structure of an interface, and what types of things we can do with that interface.

Tangible surfaces | Print-like design | Meaningful motion | Adaptive design
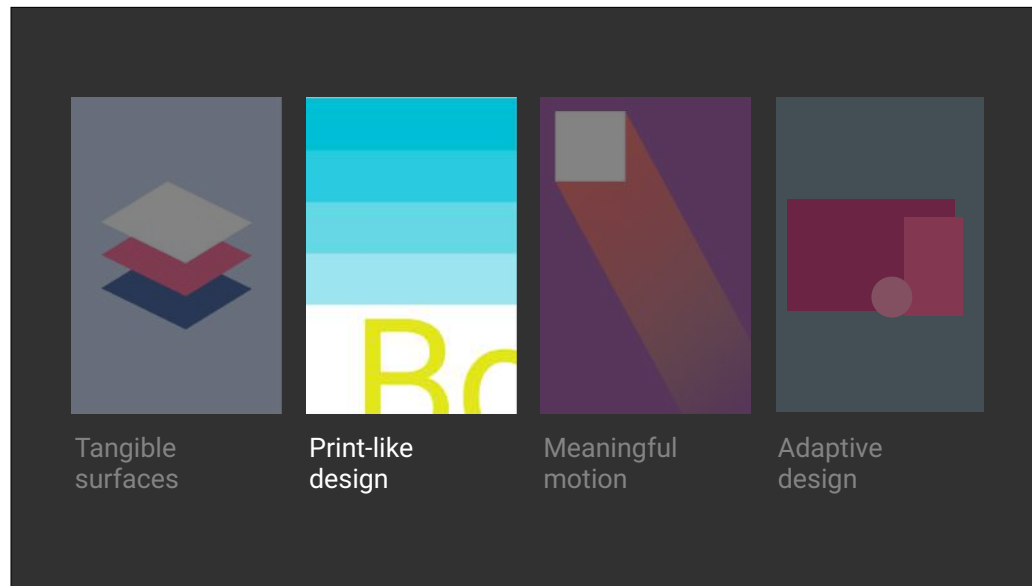
The second is the print-like design approach. If surfaces are "pieces of digital paper," we use classic techniques from graphic design to imagine what the "digital ink" (things like text, icons, and media) looks like on that paper.

Tangible surfaces   Print-like design   **Meaningful motion**   Adaptive design
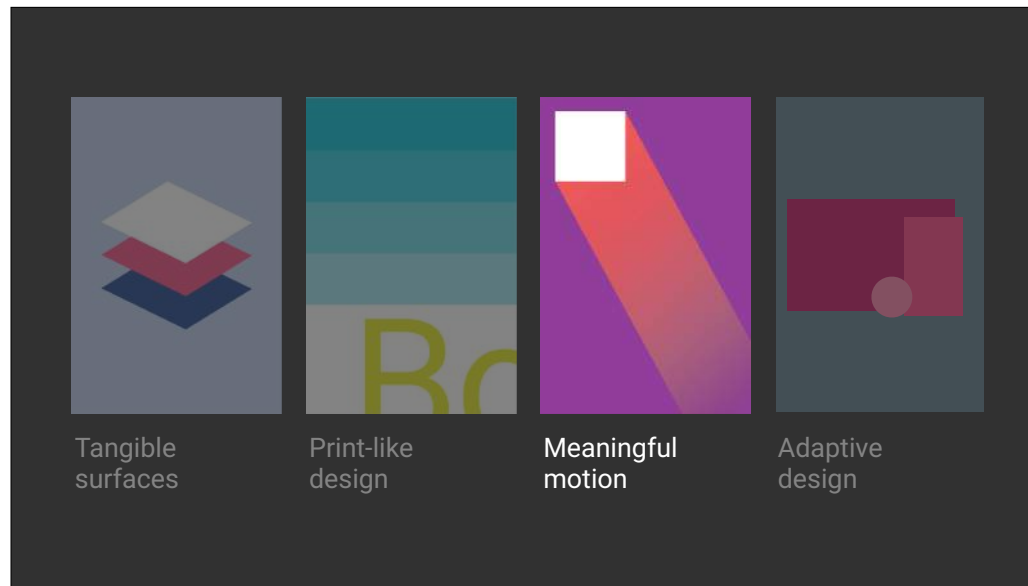
The third aspect is meaningful motion. In the real world, things don't just appear and disappear. There aren't any "jump cuts" like there are in the movies. That's why in material design, we imagine, how can we animate these pieces of digital paper and drops of digital ink in a way that helps users understand the interface, how to interact with it and how it changes state.

Tangible surfaces • Print-like design • Meaningful motion • Adaptive design
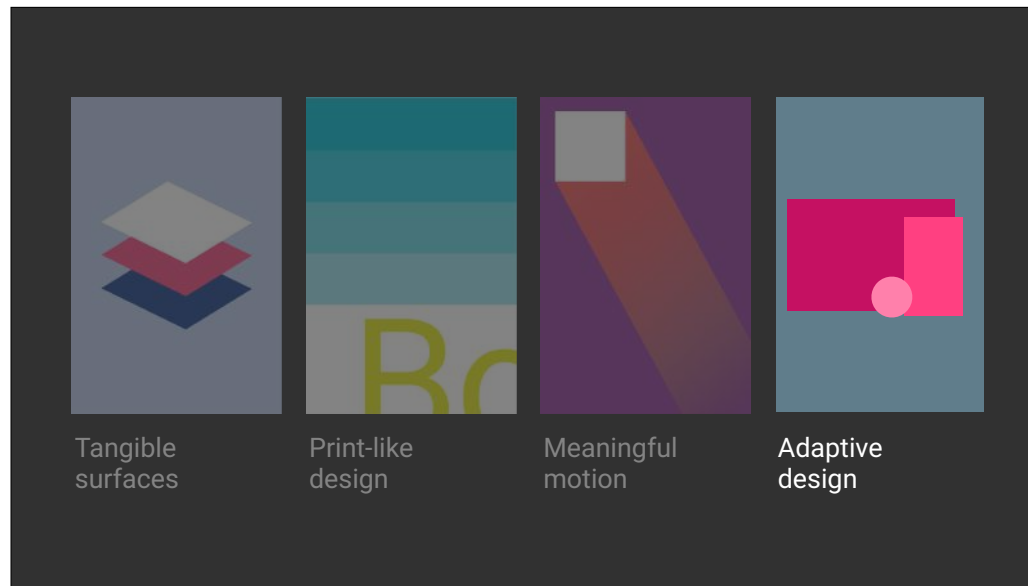
The final aspect is adaptive design, or how we can take these first three concepts and apply them across different form factors. Adaptive design techniques help us realize the vision that each device reflects a different view of the same underlying system. Each view is tailored to the size and interaction appropriate for that device. Colors, iconography, hierarchy, and spatial relationships remain constant.

So let's jump into some more detail on these 4 concepts, starting with tangible surfaces.

1 Tangible surfaces
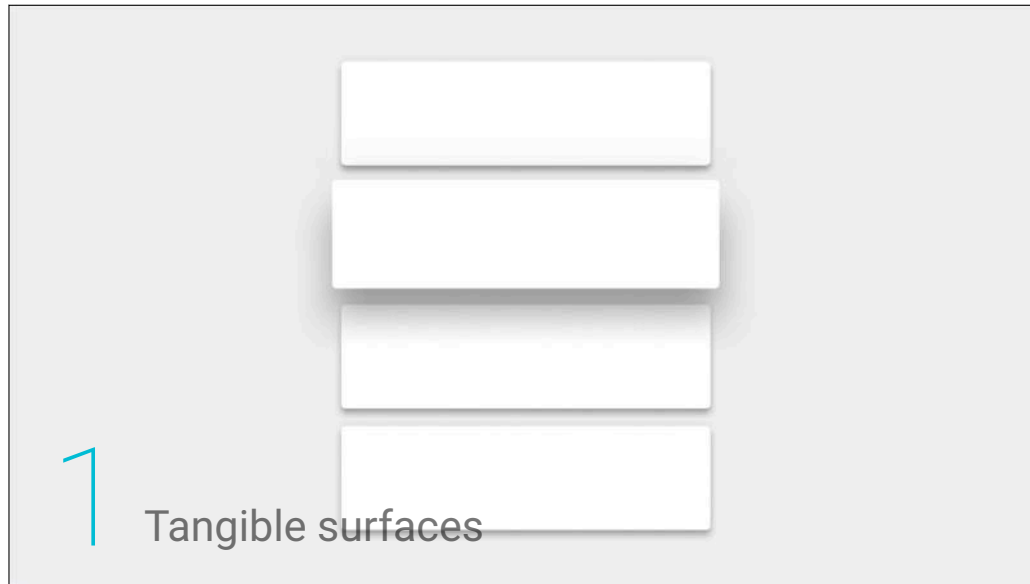
Those surfaces, or "pieces of digital paper," they have some properties that pieces of real paper don't. Unlike real paper, they can stretch, split, and re-combine.
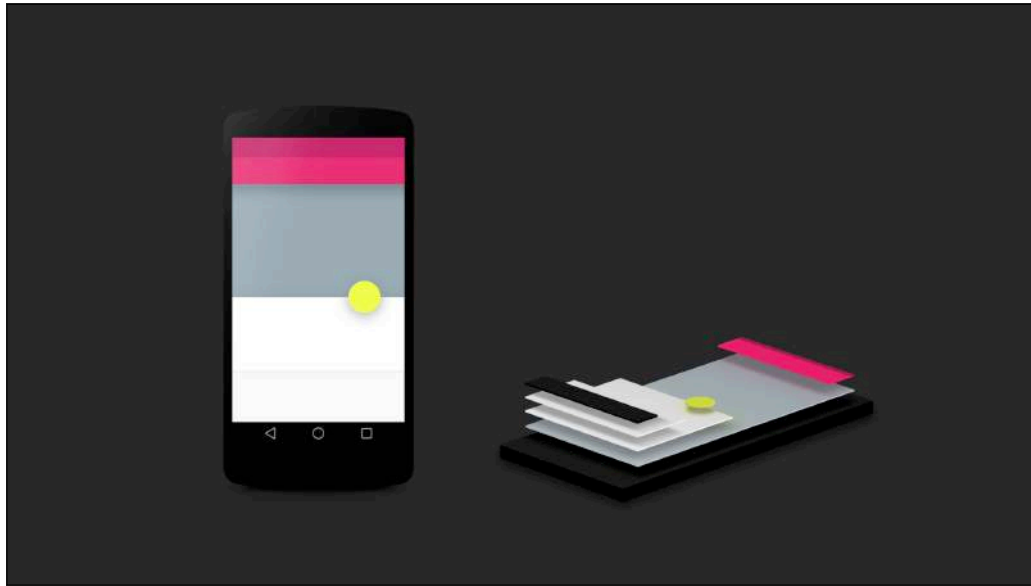
But each surface has an elevation—a position on the Z plane. And like in the real world, surfaces cast shadows on those behind them. These shadows, which are often eschewed in traditional "flat design," are subtle yet critical visual cues that inform us of the hierarchy and structure of a screen.

Depth focuses attention and provides structure
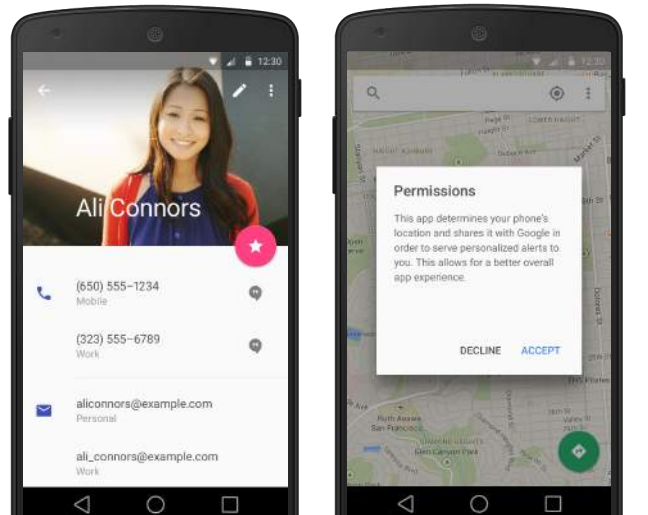
For example, when a surface has a very high elevation, it has a larger shadow. This exaggerated depth helps focus the user's attention in a consistent way.

Interaction cues
(scrolling and pinning)
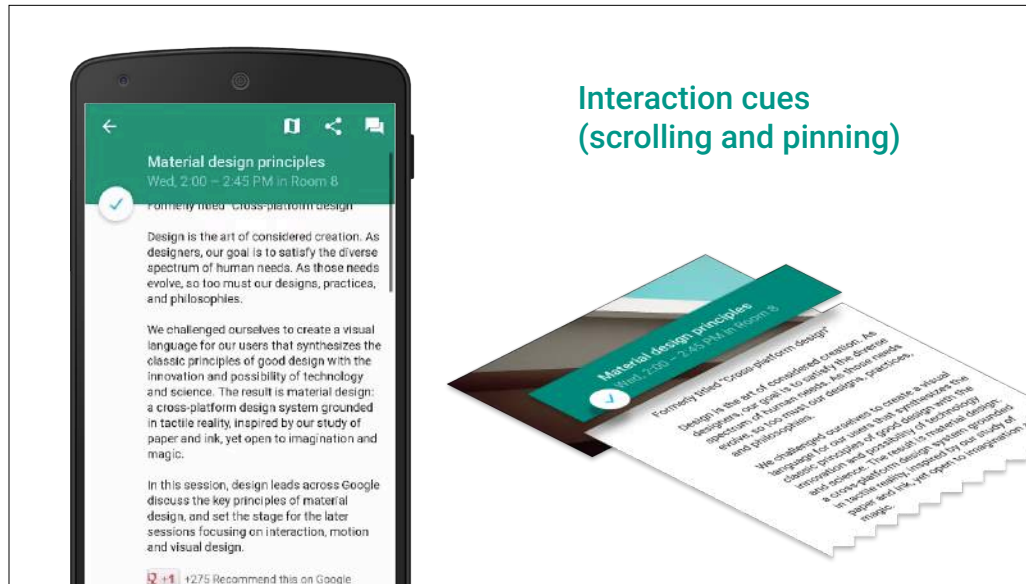
Depth also establishes interaction cues. In this example from the Google I/O app, as the user scrolls, the green surface lifts up, above the white surface beneath it, allowing the white surface to slide under the green surface, which pins to the top.

This gives a subtle cue that it's not the ink that scrolls within the white surface, but the surface itself that's moving.

Whiteframes
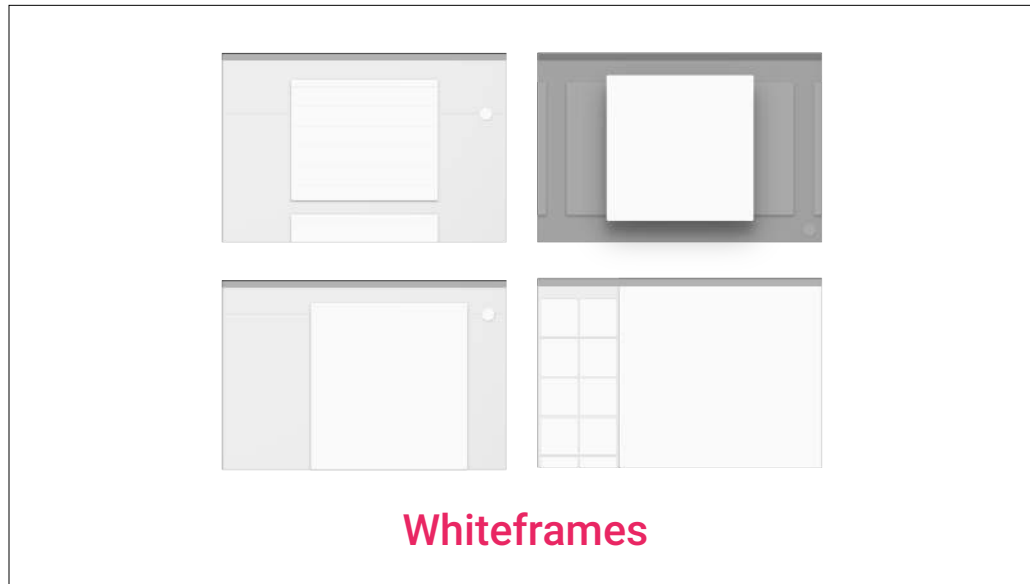
As an exercise, consider thinking about your app in terms of surfaces. Remove all the "ink" (text, media, icons, etc.) and see if you can convey your app's basic structure using only surfaces. In the material design resources at google.com/design/spec, we offer a collection of "whiteframes" that are a good starting point for this kind of exercise.

Constrained depth
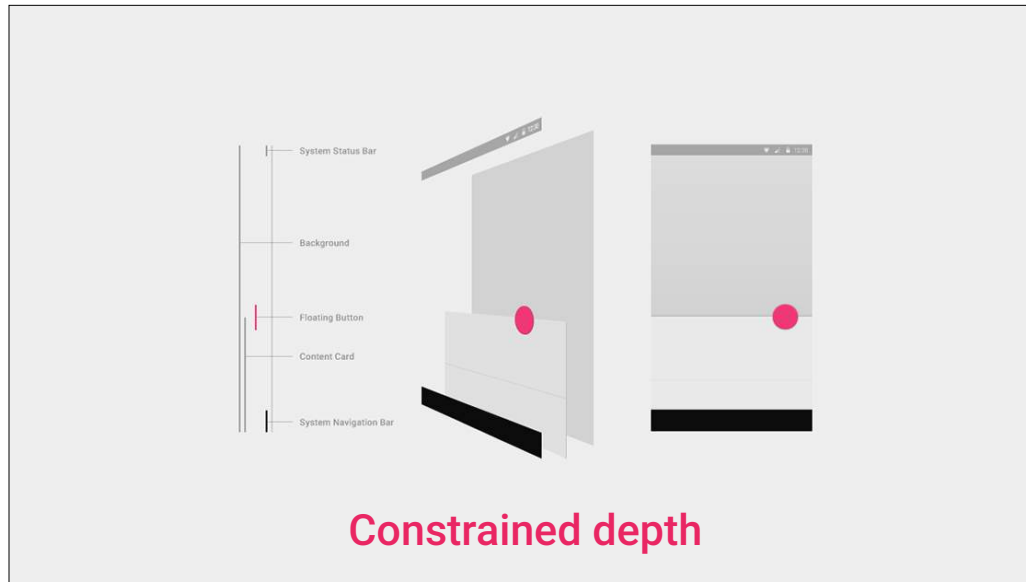
It's worth noting that elevation has limits—we imagine surfaces to live within a finite 3D volume established by the thickness of the device itself. On a handheld device, that's everything between the glass touchscreen and the back of the device. This means that if you have a "card" surface, the card wouldn't be able to flip over to its other side, otherwise at some point during the animation, it would protrude through the front or back of the device, which wouldn't make sense — in material design, paper doesn't intersect.

2 Print-like design
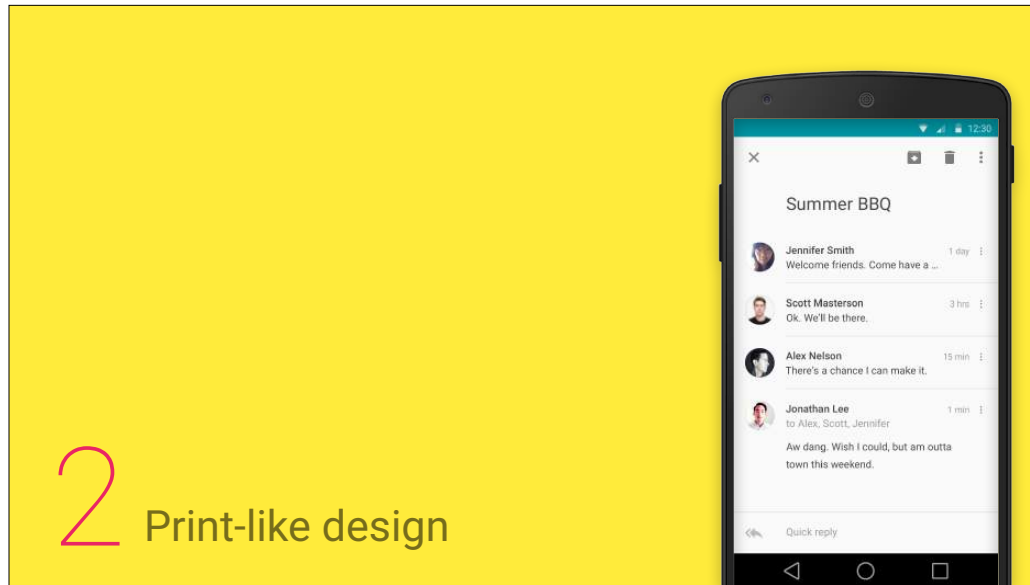
So we talked a little bit about surfaces in material design, or the "pieces of digital paper" as we call them sometimes. Things like text, icons and photos—those constitute the "ink" printed on these pieces of paper.

Material design uses classic principles from print design to arrange and visualize this kind of content.

Refined typography
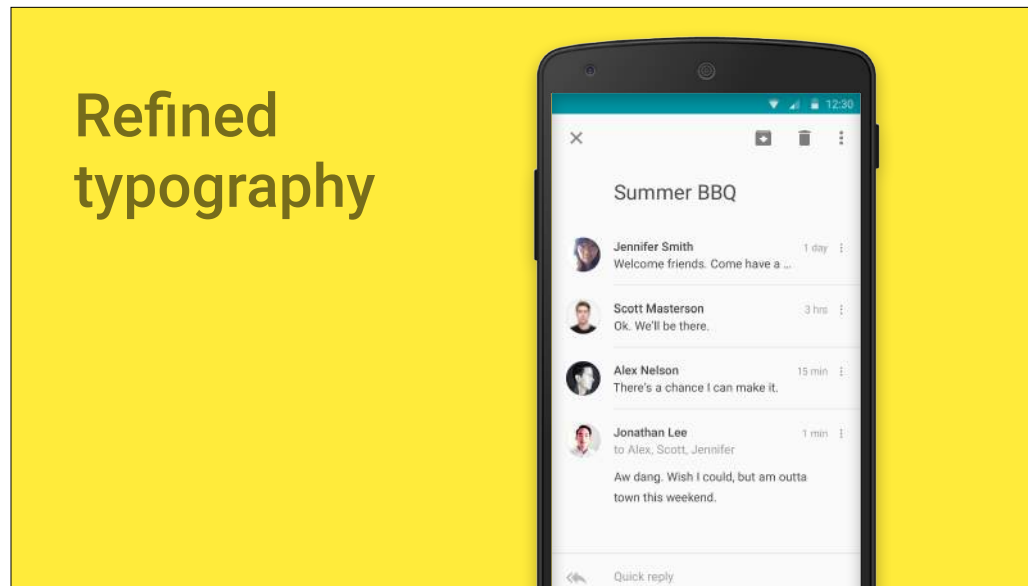
Typography plays an important role in print design. Pick up any magazine off the newsstand and you'll quickly notice that type serves two big functions. First, the choice and juxtaposition of typefaces and styles is a key element of the magazine's branding—each magazine sports meticulously chosen typefaces appropriate to their context and audience.

But type also establishes hierarchy in the content. As an exercise, take a look at this type-heavy screen. Remove the icons and photos and simplify the text blocks using rectangles…
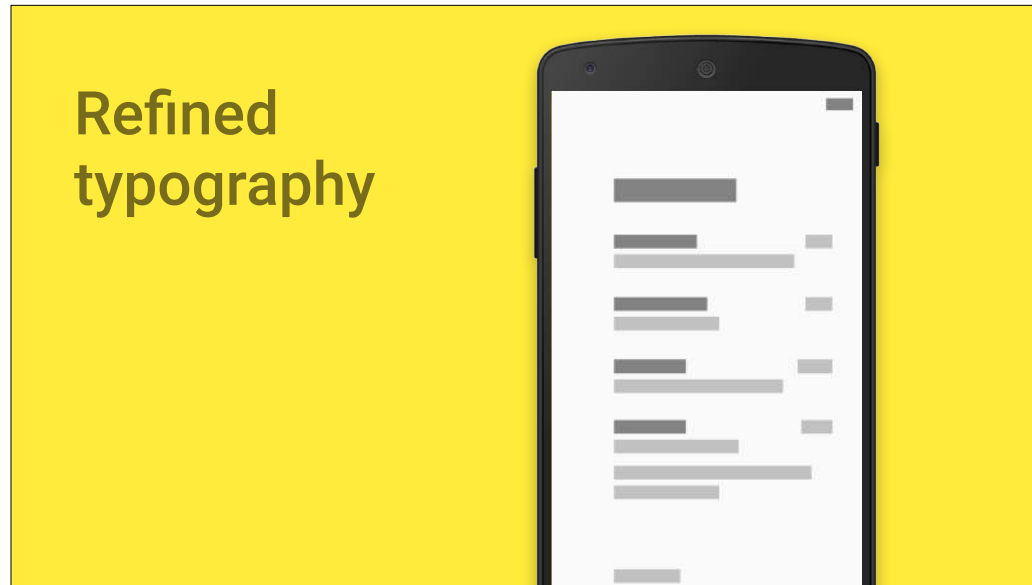
...You'll quickly notice that you can still make out a rough hierarchy of content. You have a single heading represented by a taller, meatier block, and a collection of similar items below it, indicated by the equal-weight line items. Each item also has some supplementary information, as indicated by the lighter, adjacent line items that are visually grouped with the primary text block above them.

Gestalt principles at their finest!

Typographic scale

Display 4	Light 112sp
Display 3	Regular 56sp
Display 2	Regular 45sp
Display 1	Regular 34sp
Headline	Regular 24sp
Title	Medium 20sp
Subhead	Regular 16sp (Device), Regular 15sp (Desktop)
Body 2	Medium 14sp (Device), Medium 13sp (Desktop)
Body 1	Regular 14sp (Device), Regular 13sp (Desktop)
Caption	Regular 12sp
Menu	Medium 14sp (Device), Medium 13sp (Desktop)
Button	MEDIUM (ALL CAPS) 14sp

The material design spec at google.com/design/spec offers a standard typographic palette you can use for establishing these kinds of hierarchies.

While this palette uses Roboto, typography is an area where you should let your brand do the talking, so feel free to use fonts representative of your brand. Just be careful to do an appropriate amount of testing on Android devices, since the font rendering engine is a bit different there. Sometimes an OTF version of a font renders better than its TTF counterpart, so work with your developer team to explore all options.
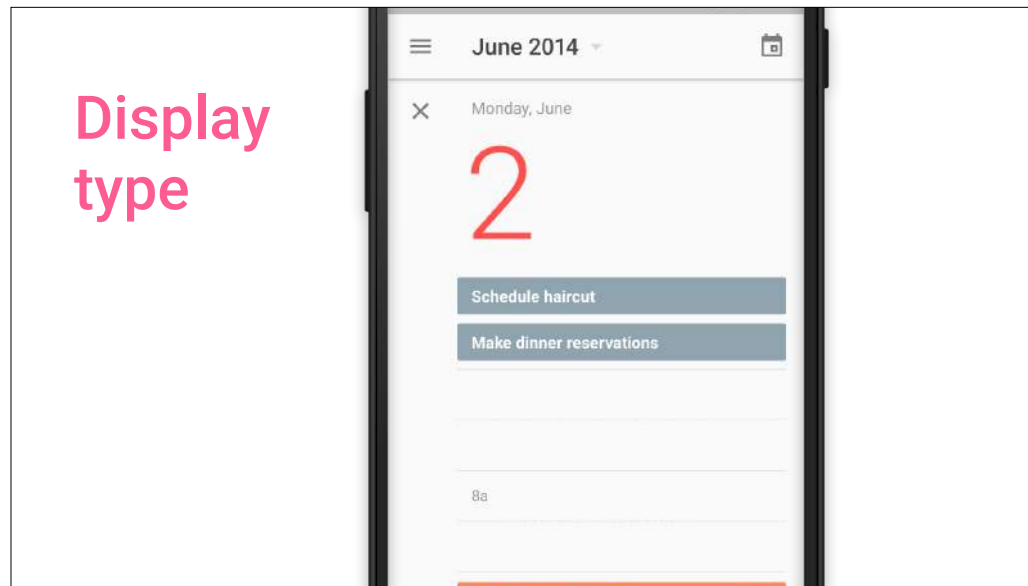
Display type

One element from the print world that's common in material design is the use of large display type to represent hallmark content elements. In many cases, you might be working with text-heavy information, and the lack of rich media might seem like a crutch. Think of it more as an opportunity to render your text content in a bold way. Designers of typefaces spend countless hours perfecting each curve in each glyph. Using large display type shows off each carefully crafted curve the way the type designer originally intended it, with beauty and grace.

BEFORE

AFTER
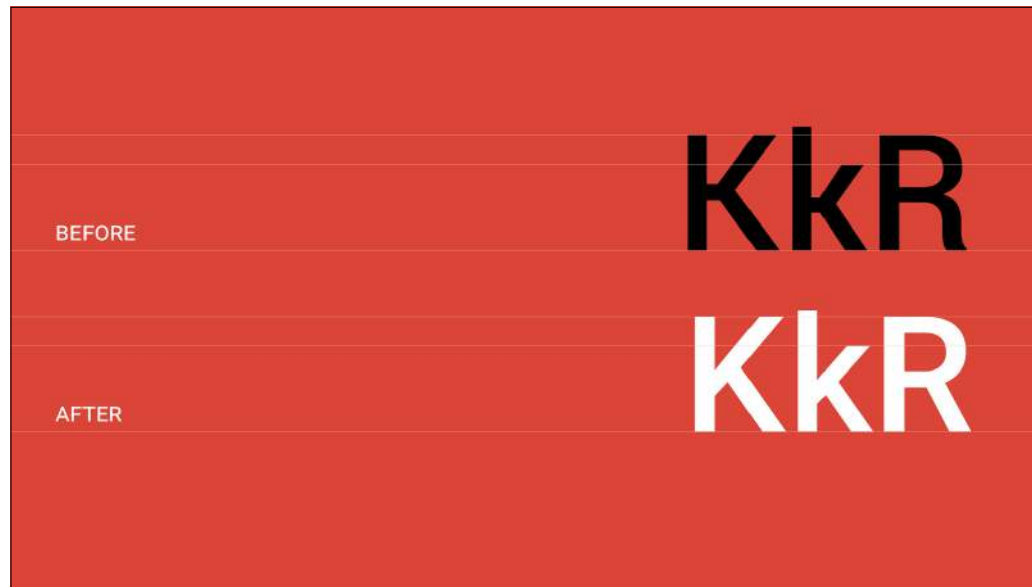
A couple more quick words on type, because it's so important. With material design, type designers at Google have carefully refined the Roboto typeface to work even better on any screen, ranging from phones, to tablets, to wearables, and TVs. Roboto is a phenomenal default choice for these platforms.
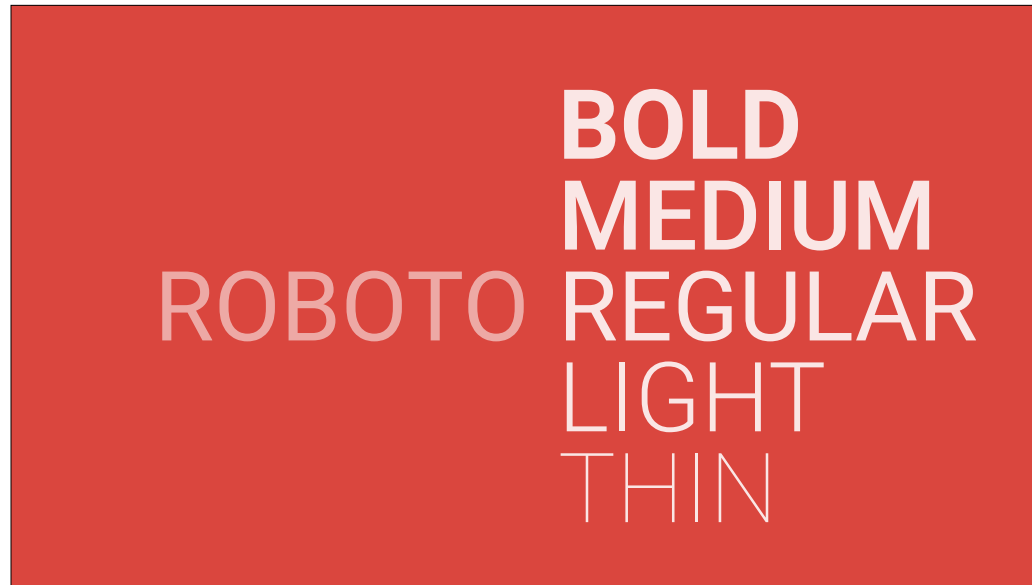
And it comes in a variety of weights, allowing you to create a robust typographic palette that can support and express your content hierarchy.

Baseline grids + keylines
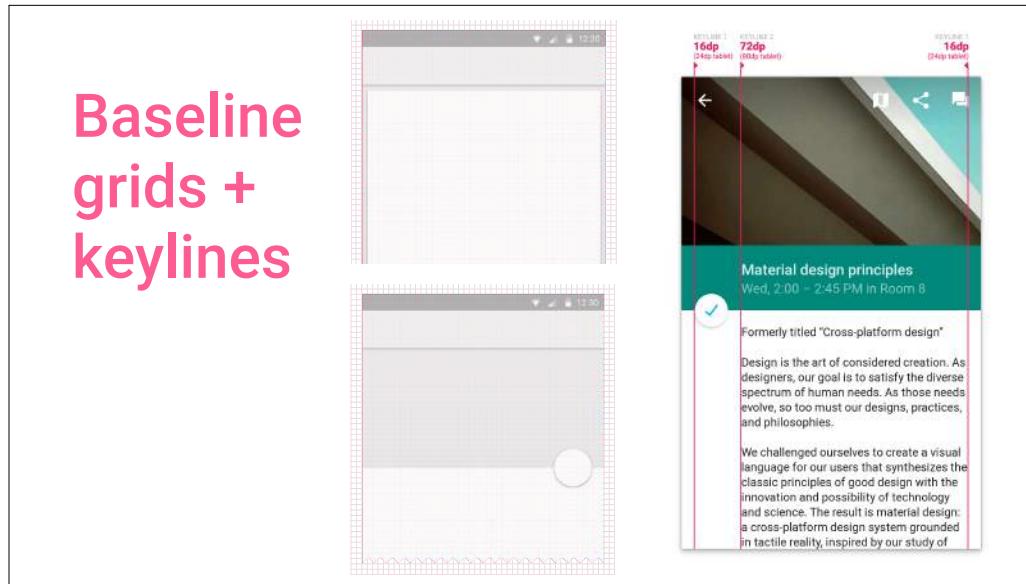
Let's talk a little more about arranging content and space. First, like with print and traditional web design, material uses a baseline grid. The grid is 8dp. DP stands for density-independent pixels, which is similar to 'points' on iOS and CSS pixels on the web.

But one of material design's signature elements is the use of keylines (shown on the right) to help align elements, creating distinct vertical streams of information. This is common in print; think back to textbooks from school. They often had a main column of text in the middle (like you see here between the left-72dp and right-16dp keylines), and supporting information in the margins to the left or right of the primary column. This helps readers/users focus on the primary content. Again, Gestalt principles for the win here.

Geometric iconography
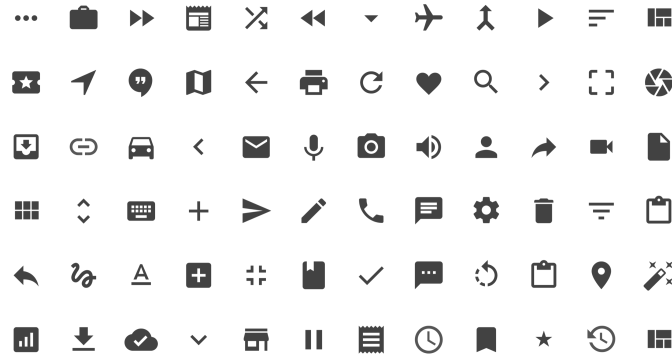
In terms of iconography, Android has for a while used simple colored icons, but with material design, these icons have become simpler and friendlier. They're also a better middle ground, adopting ideas from the web and Android.

The full icon set should be available for download later in 2014.

Let's talk about how to color the surfaces and digital ink. Like with print design, color plays a huge role in material design. Whereas with Holo, color was sometimes an afterthought, material design celebrates and elevates the use of color. Like with type, material design goes big and bold with color.
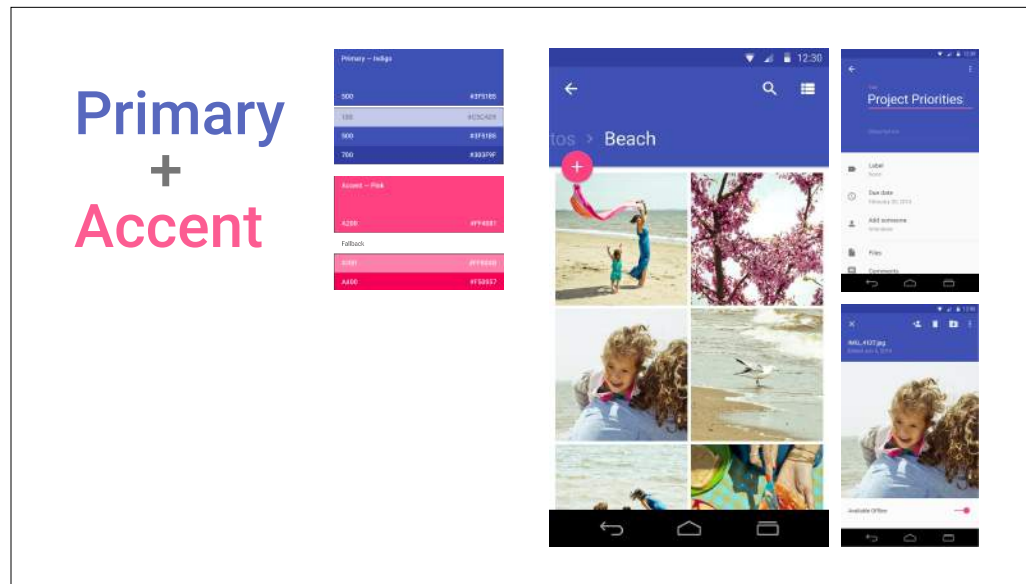
In material design, a common color palette for apps involves a single primary and single accent color. The primary color is generally used in larger areas like the action bar, with a darker variant coloring the system status bar. The accent color, which is normally really bright, is used in smaller areas, such as form controls, buttons, and tab indicator strips. The accent color is intentionally bold and bright to direct the user's attention to key elements (such as the circular floating action button).

Color density depends on content
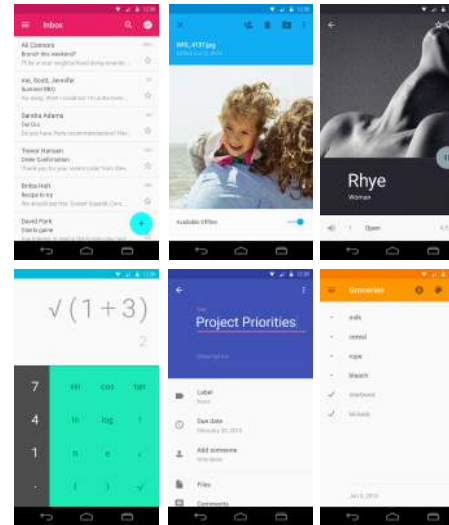
An important thing to think about is how much of each color to use. Per the previous slide, accents should be used in smaller, targeted areas. But for other color blocks, here's a general rule. If you have a large amount of dense content, such as a list of emails, you'll want to use smaller color blocks (e.g. a normal size app bar) to let the user focus their attention on the content. For less-dense content, such as a sparse item detail screen, or a photo, or the calculator example above, these are great moments to use larger color blocks. This often manifests as a double- or triple-height app bar.

Content can provide color
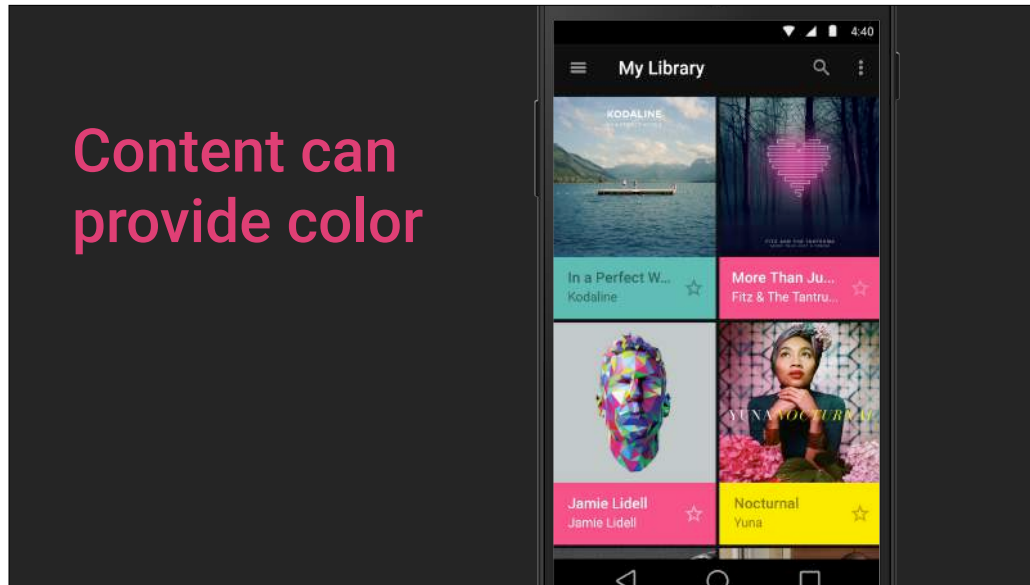
Finally, material design encourages dynamic use of color, especially when you have rich image content. We're providing a library called Palette that'll let you extract a small palette of colors from a bitmap image. The extracted palette will include vibrant and muted tones as well as foreground text colors for optimal legibility. Watch out for Palette for Android later in 2014.

Immersive contextual imagery
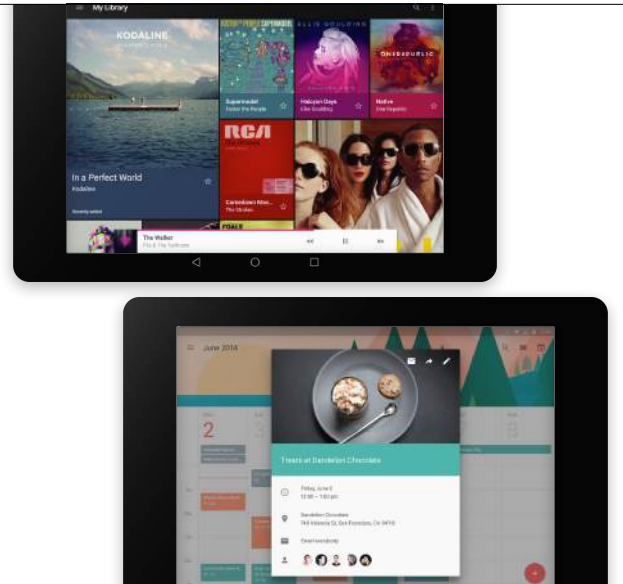
Finally, just like with print design, material design celebrates imagery by giving it full-bleed treatment whenever possible. Photos and illustrations are rarely decorated with borders, often extending to the very edges of the screen. Even the system status bar can appear semitransparent (or fully transparent) in front of the image.

So, taking a step back, if you look at the "ink" on these surfaces, most of the ink here is contributing to content. Very little ink is spent on decoration.

For more on digital paper and ink, check out this DesignBytes episode: https://www.youtube.com/watch?v=YaG_ljfzeUw

3 Meaningful motion
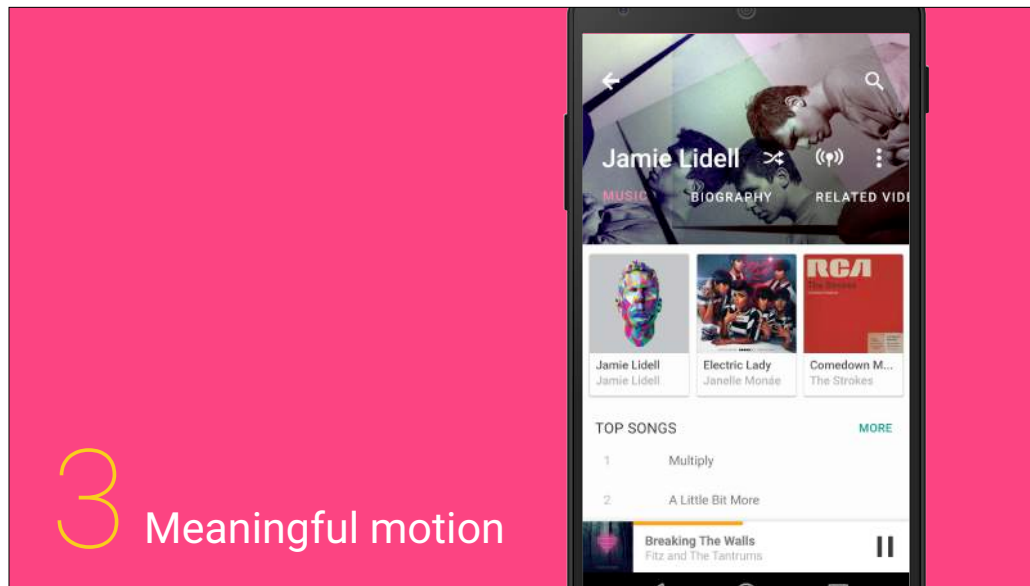
So we've talked about digital paper and ink, now let's talk a little bit about how those digital materials change in your app. In the real world, things don't just appear and disappear. There aren't any "jump cuts" like there are in the movies. So when digital paper and ink appear, disappear, or change, we use meaningful animation that helps convey what exactly is happening. This continuity from one state to another aids user understanding.

In this example, touching a card (which is a piece of paper) in the list of albums, takes you to the details for that album. The transition helps convey this master/detail relationship because the card expands to fill the screen, and its ink rearranges itself to show more information.

Materials transform
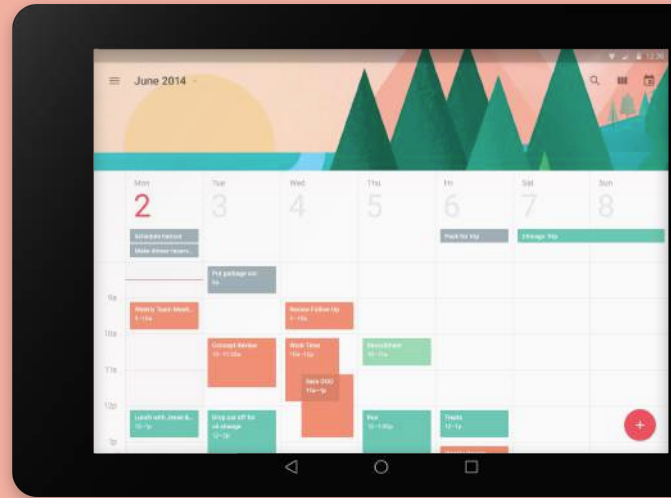
In this example, touching ink representing a schedule item, elevates it into a new piece of paper, which then further lifts and grows to show event details.
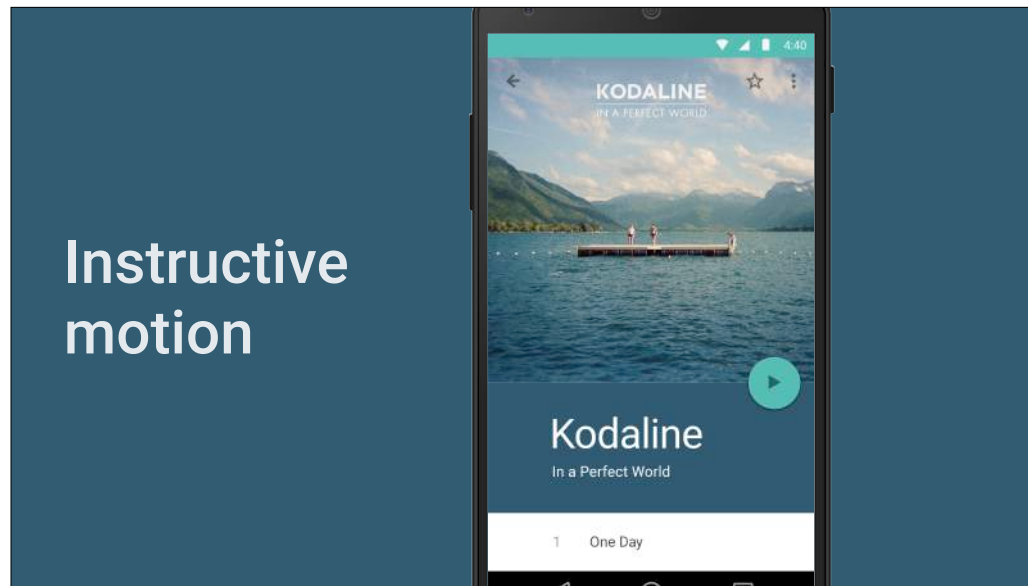
In the example above, the circular floating action button hides more functionality once you play the music... this is indicated by the button surface transforming into the surface containing more actions.

But there's another interesting thing going on here. Our eyes are naturally drawn to movement, so animation can direct user focus. Additionally, the way things move gives cues about how things work — interaction, gestures and motion are deeply interrelated.

In this motion study, when you press play, the volume knob gently animates into place, which simultaneously draws attention to it and hints that it's an interactive element you can slide horizontally.
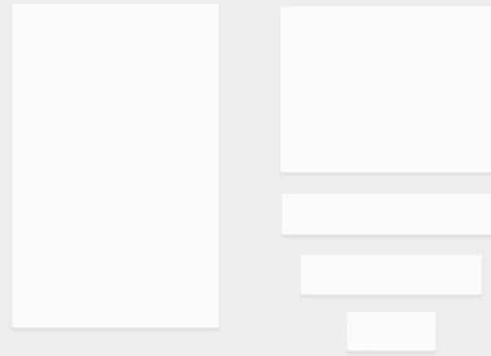
Think back to that discussion of constrained depth — that there's a finite "front" and "back" that limits the Z position of every surface. Now, if you were to animate a small surface to a larger size, scaling each dimension proportionally, it might look like that surface was actually coming forward, rather than simply changing its width and height. A big translation in Z would defy that notion of constrained depth.

A better approach is to separately scale the width and height of the surface, as you see in the slide. It removes that ambiguity of what exactly is happening to the surface.
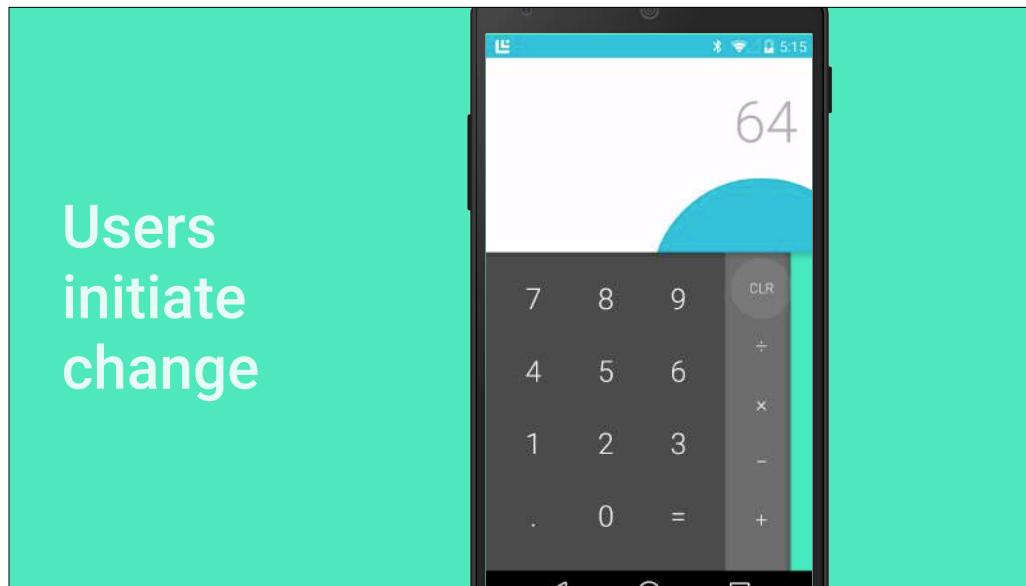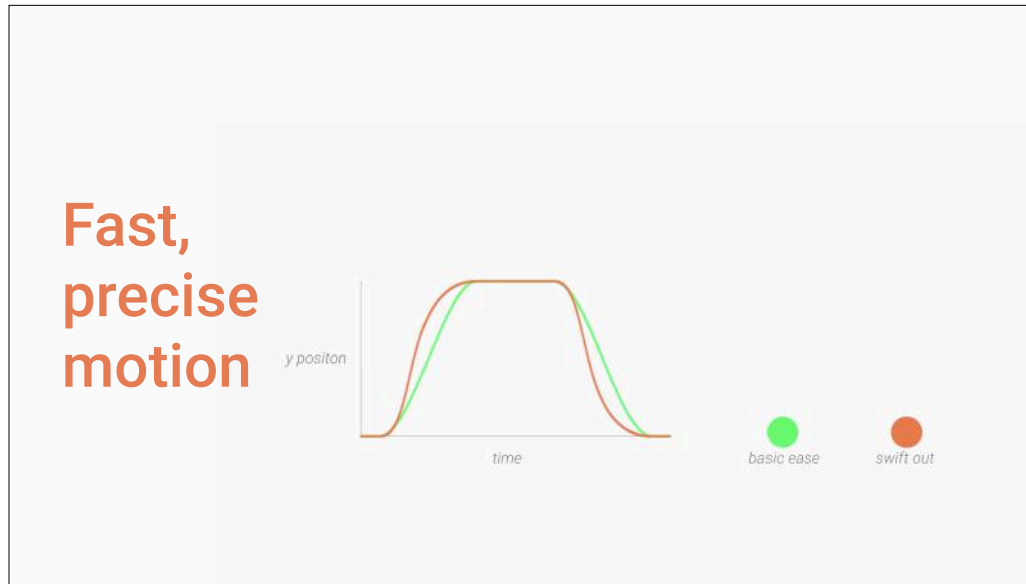
Another key motion principle in material design is user-initiated change. Whenever possible, the epicenter of transitions is driven by the user — on touch devices, the touch of their finger. Here, ink ripples emanating from the touch point provide feedback that an element was touched. This behavior is incredibly easy to add with Android L. And at a larger scale, here when you press CLEAR, the screen wipe again emanates from the user's touch. with Android L, this can be implemented using a circle reveal animator.
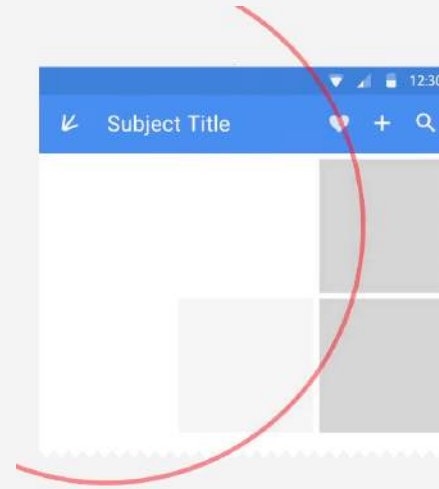
Here's another example of this concept. When you press the navigation button at the top-left, all other state changes are choreographed to occur shortly after the initial change, with a delay driven by their distance to the epicenter. This subtle delay gives you a sense of power—that you're in control of what's happening on screen.

A final key motion principle is that animations and transitions should be fast and precise. Unlike typical ease-in-ease-out transitions, in material design, objects tend to start quickly and ease into their final position. The effect is that over the course of the animation, the object spends more time near its final destination. The result is the user isn't left waiting for the animation to finish, and the negative effects of motion are minimized.
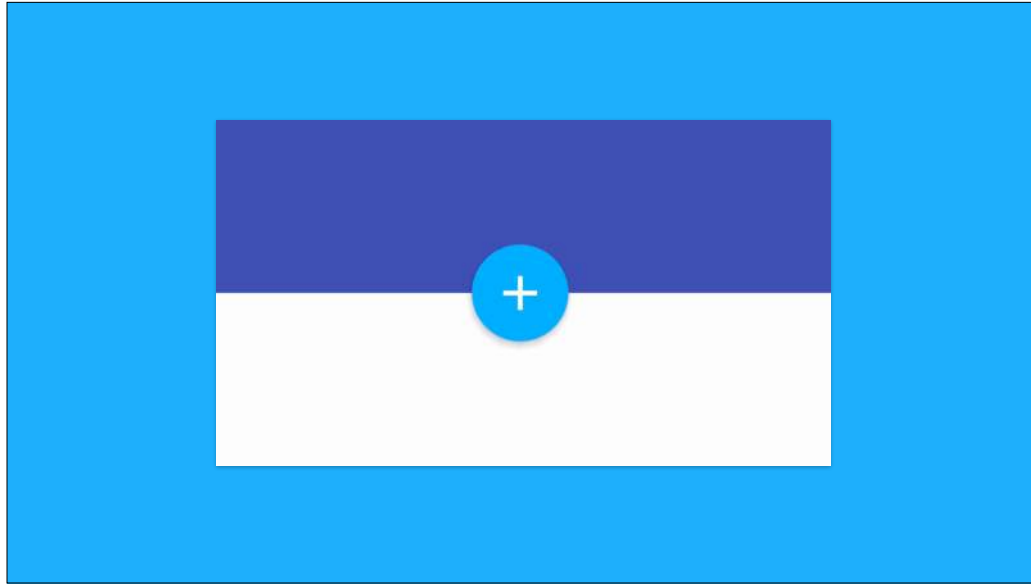
Here's a final example that puts some of these ideas together. It's from the Google I/O 2014 app, which is open source. Here, motion is aiding continuity for the state changes in the "Add to Schedule" button. The change in the button color from blue to white is animated using a subtle ripple effect, that starts from the user's fingertip on touch. And the foreground icon transition into a checkmark subtly conveys that the state has just changed to "in your schedule."

Both of these changes hint that this is ink, rearranging itself on this little circular button surface. The ink doesn't just appear or disappear, it smoothly changes.

4 Adaptive design

So we talked about tangible surfaces, or "digital paper," the digital ink on that paper, and the motion principles that help communicate the changes that paper and ink undergo.

The final major component of material design is the idea of adaptive design, or how we can take these first three concepts and apply them across different form factors.
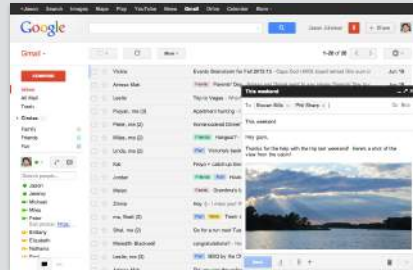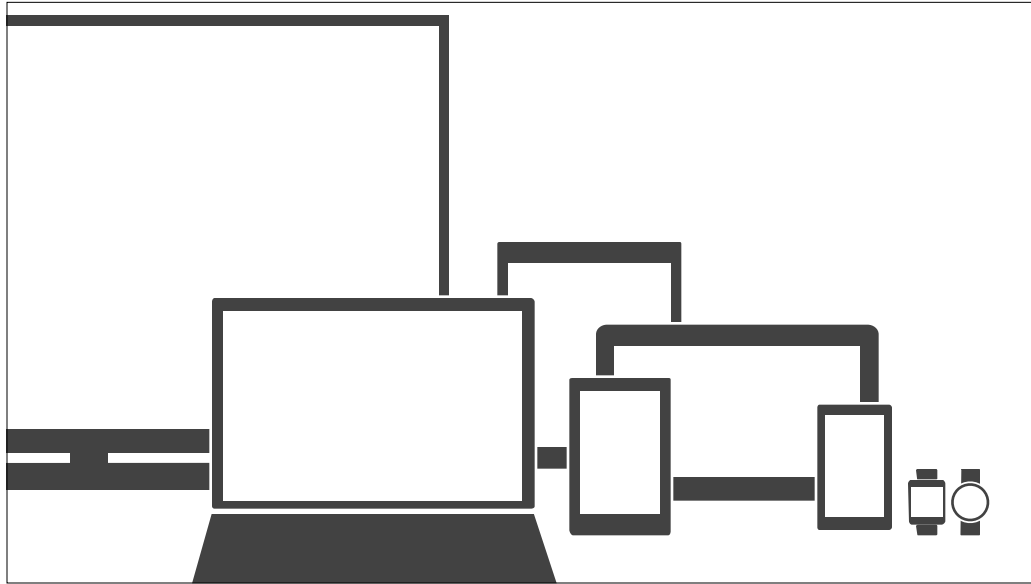
Gmail.com
(Kennedy)
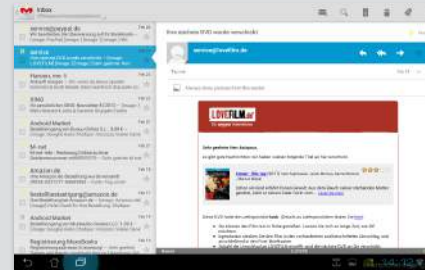
Gmail for Android
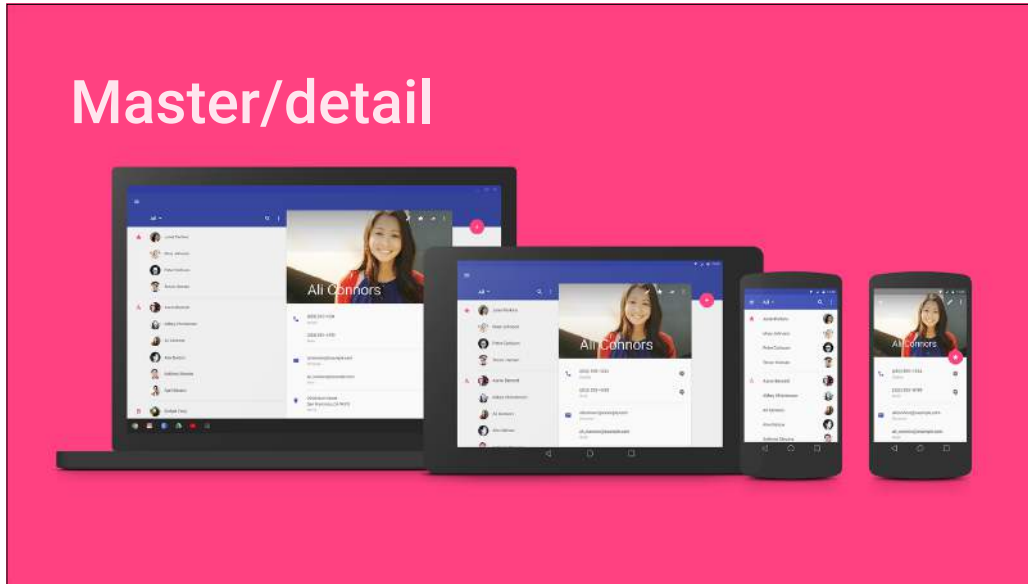(Holo)

smartphoneblogging.com

Adaptive design is the idea that you shouldn't be presented with incredibly different interfaces for the same basic system. It goes back to that problem we talked about with two Gmail apps speaking very different languages.

Adaptive design techniques help us realize the vision that each device reflects a different view of the same underlying system. Each device gives the user a glimpse into the same digital world, with consistent colors, iconography, hierarchy, and spatial relationships as anchors within that world.

Let's look at how material design makes executing adaptive design easier.

Master/detail

First, a very common pattern is the master/detail relationship, where you have a list of items, and you can see specific details on each item. Whereas Holo was a bit opinionated about the size and arrangement of action bars, material design is more flexible.

Larger screens can host a number of toolbar strips, placing them adjacent to their relevant content. Additionally, app bars can be taller where appropriate, helping manage the large amounts of white space available on screens like tablets and desktop web browsers.

Margins
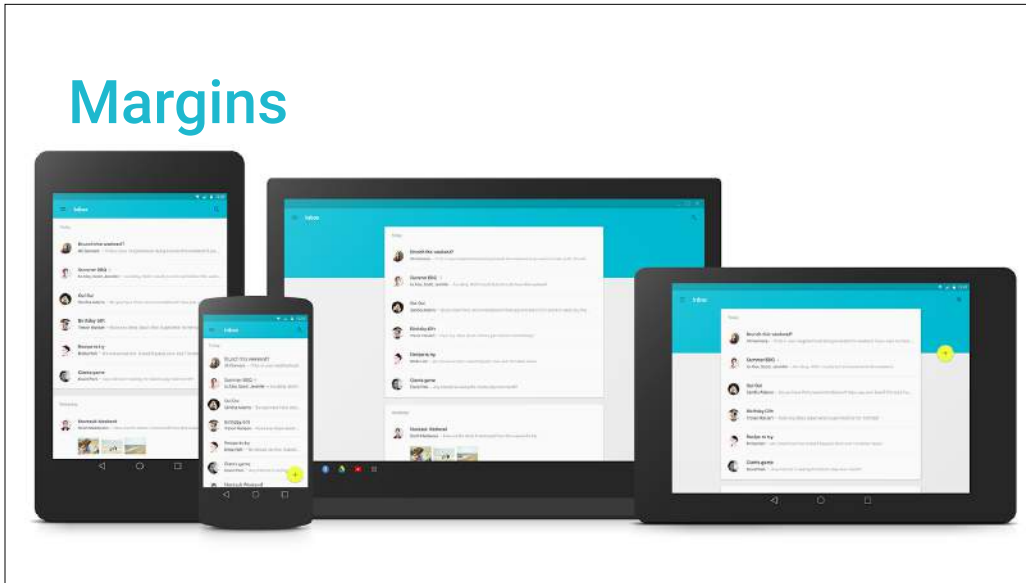
And arranging content using surfaces simplifies decisions around space management for larger screens. Each surface knows its width constraints: how wide it can go before its content feels too sparse, and how narrow it can go before content feels too cramped. On wide screens with surfaces at their maximum width, material design encourages large margins and has recommendations for how best to treat those margins (with floating actions and large color blocks). Material design is incredibly compatible with this kind of "inside-out" or "content-first" thinking.
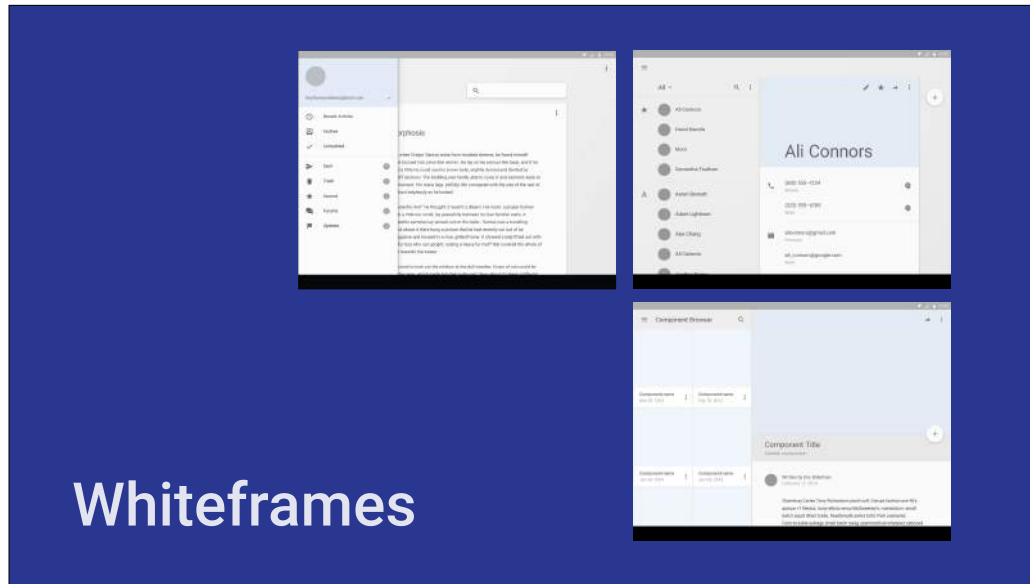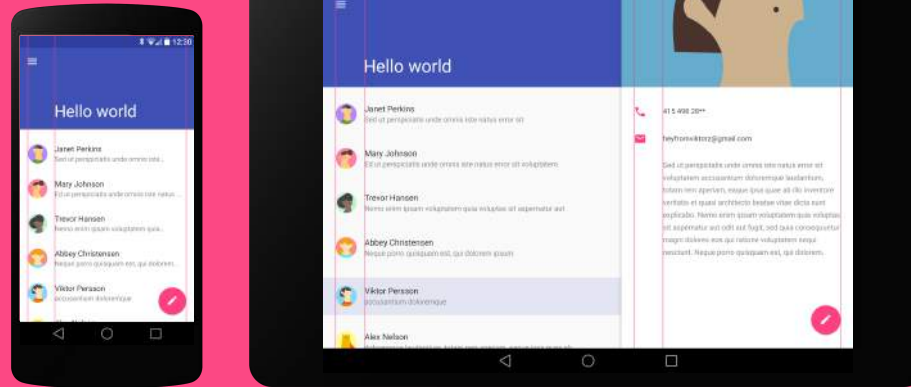
Whiteframes

Some of those recommendations and layout ideas are expressed in the whiteframes available on google.com/design/spec. They're a great starting point for deciding how best to arrange content on phones, tablets, and on the desktop web.
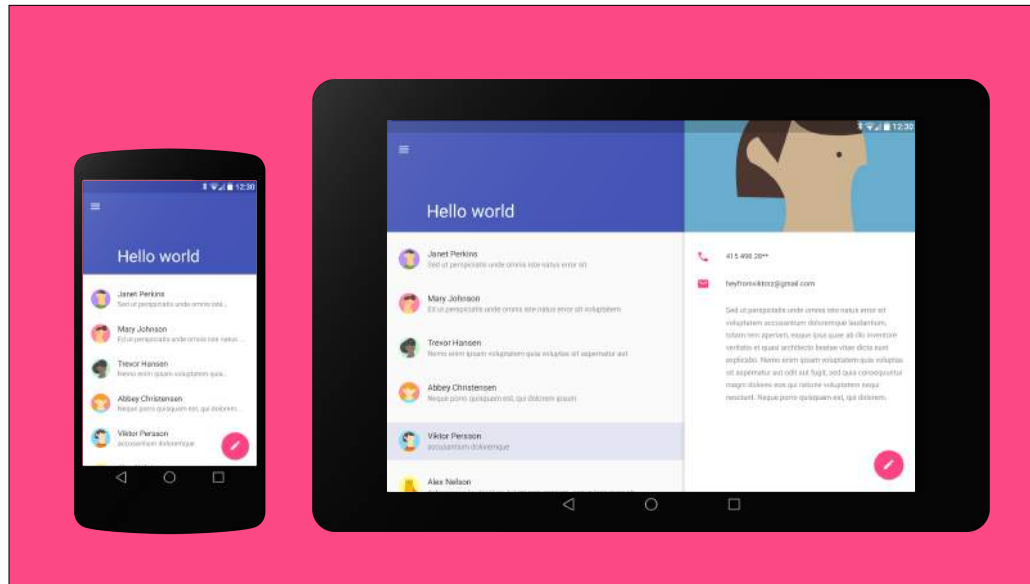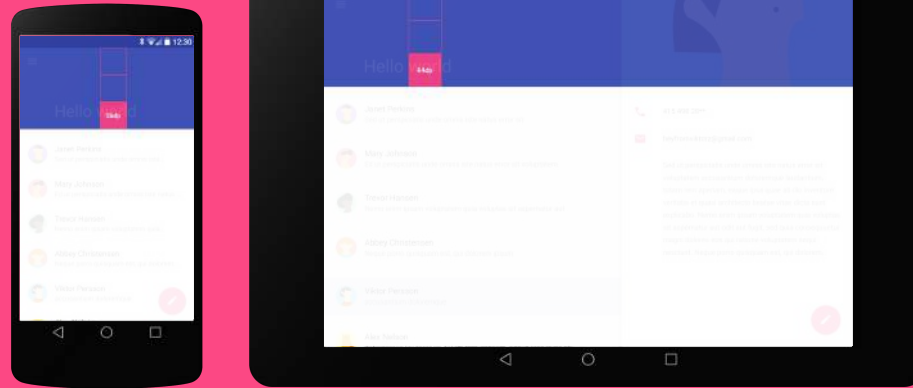
Let's dissect a simple example phone/tablet app to see how the material design approach helps design for tablets.

As we mentioned before, keylines help arrange the ink printed on the various sheets of paper. These can be used across each surface to help control space and aid comprehension. They help bring order to the chaos!

Additionally, using multiples of the app bar size (or increments) brings order to sizing and layout decisions. These aren't rules, or even guidelines — simply suggestions that make your life easier as a designer.

Finally, it helps to think in terms of size blocks. Material design offers some standard block sizes that align to the 8dp baseline grid, that you can use to determine element sizing. The result is an excellent visual rhythm that makes digesting content comfortable and pleasing. All the downloadable material design whiteframes include visual aids representing size blocks in a separate layer.
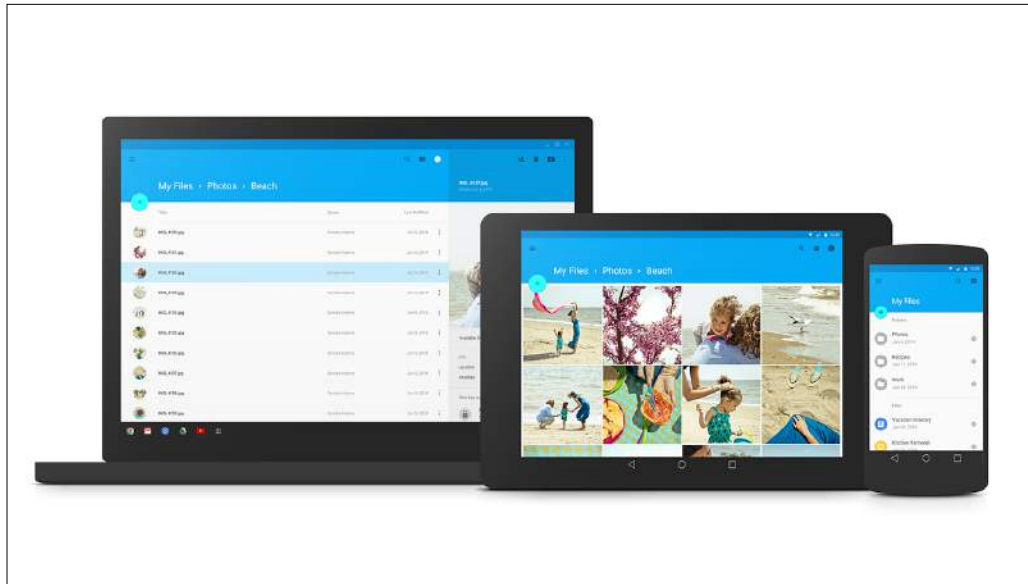
Let's finish off with some inspiring example vignettes of material design across desktop web, phones and tablets.
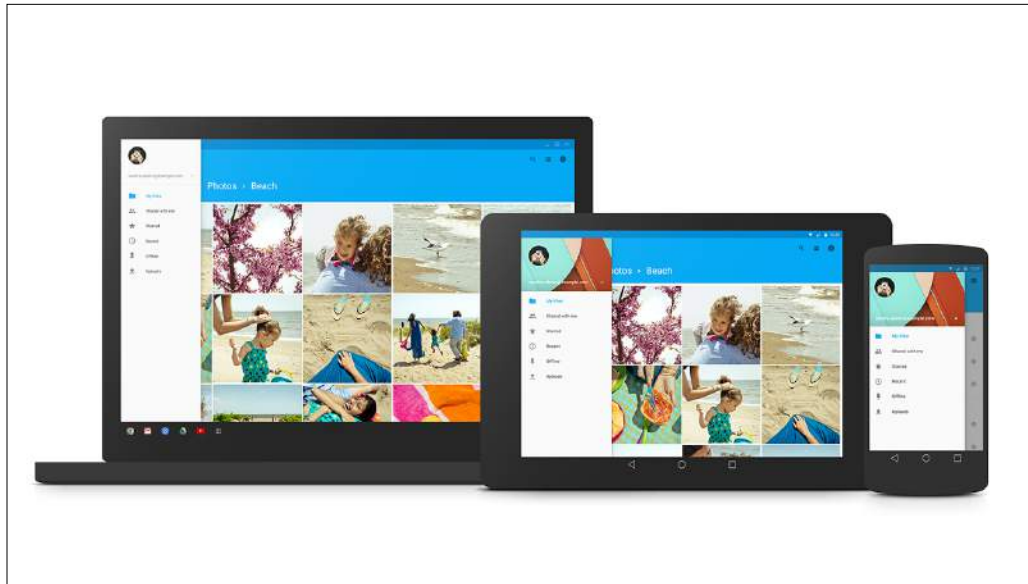
Material design has been built with these different form factors and platforms in mind. Breaking your app down into surfaces helps you make great spatial decisions.
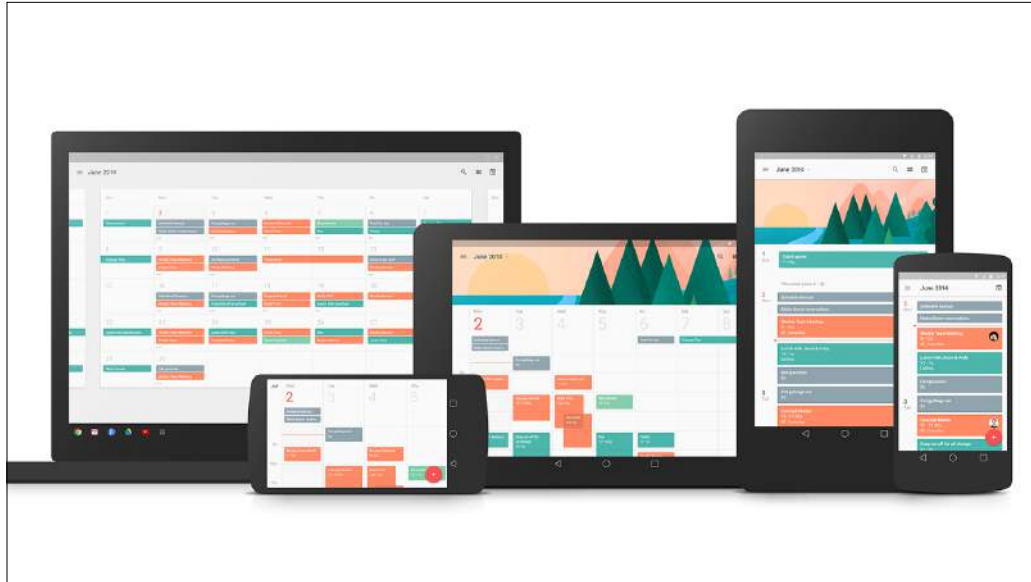
And material design is flexible enough to let your app's visual character take front stage, in a consistent way, across devices.
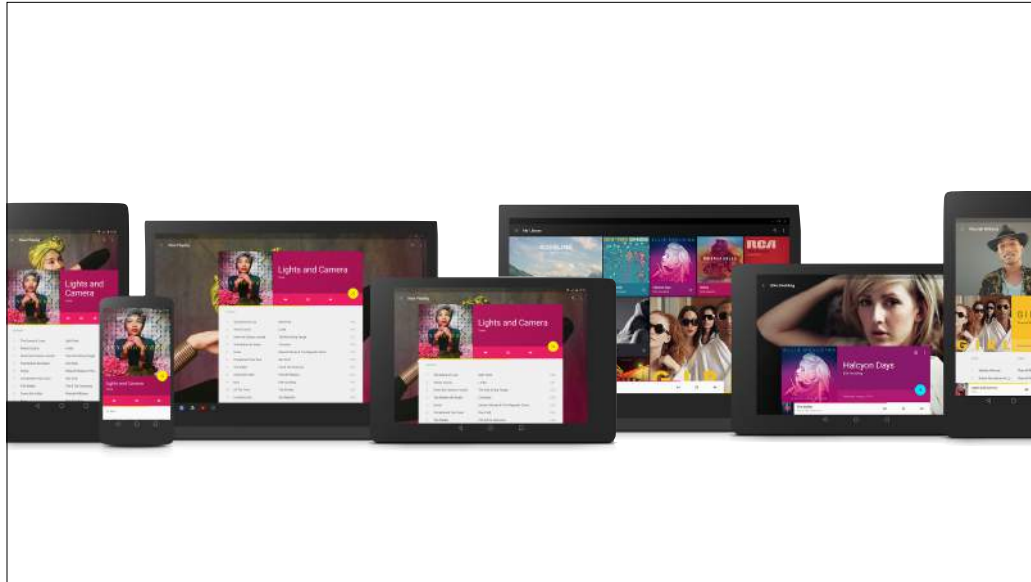
And you realize, that each device is just a view into the same underlying system — the same universe of content. Your app's colors, typography, imagery and surfaces all help tell a single, consistent story for your brand and your content.
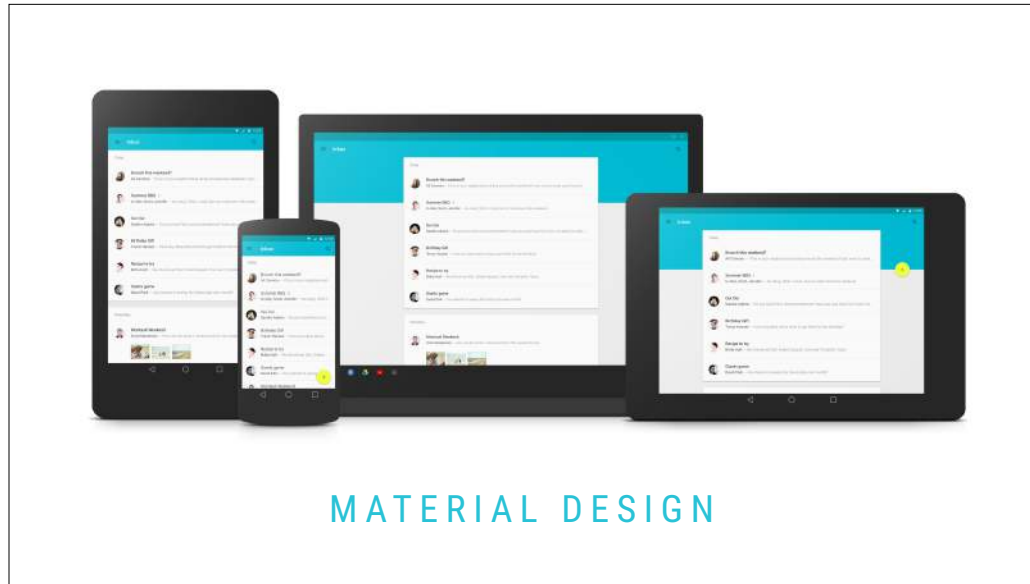
MATERIAL DESIGN

That's the power of material design.
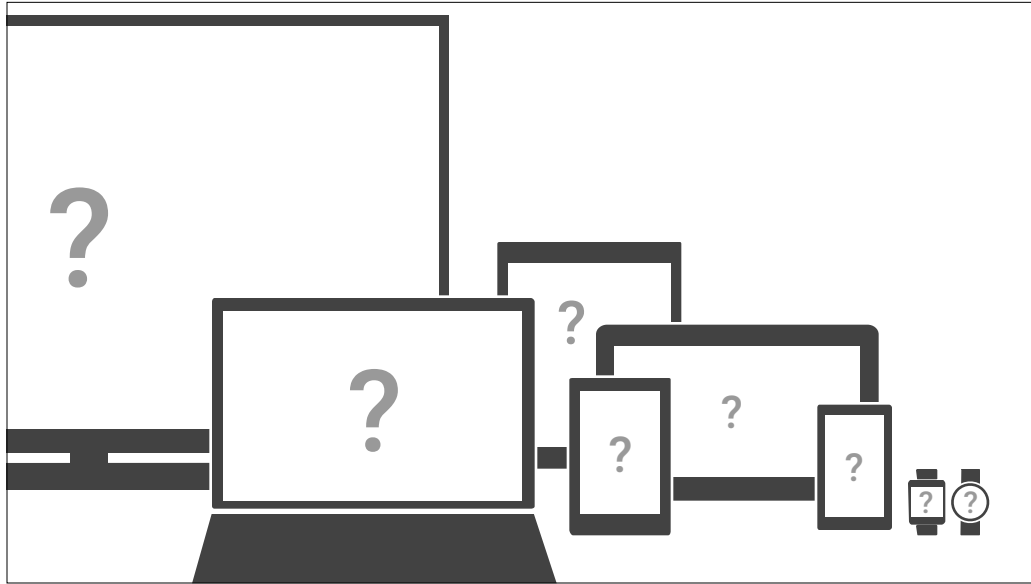
What will you build with it?

Q?

Thanks!